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Plant diversity in old-growth woods: the case of the forest edges of the Favorita Park in Palermo (north-western Sicily, Italy)

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Abstract

This article presents the results of a study on plant diversity at different levels in residual forest stands, located in the historical Favorita Park in Palermo, Italy (established and named in 1799 by King Ferdinand IV of the House of Bourbon). These forest aspects have naturally evolved for over two centuries, under minimal conditions of anthropogenic disturbance (e.g. deforestation, fires, grazing activities, etc.). This is especially true in the area known as "Bosco Niscemi", spread over about 8.5 hectares, in the centre of the park. Bosco Niscemi is characterized by the widespread presence of old trees, abundant necromass and litter. In this study, four different soil profiles were analysed, and classified as follows: (i) Solimovic Regosol (Arenic); ii) Eutric Arenosol (Chromic); (iii) and (iv) Skeletic Regosol (Ochric). From a phytosociological point of view, four forest communities have been identified, two of which are described as new associations (*Viburno tini-Phillyreetum latifoliae* ass. nova and *Teucrio flavi-Phillyreetum latifoliae* ass. nova). The species richness was also found to be noteworthy, with the co-occurrence of several taxa (phanerogams and cryptogams) that are of biogeographic interest or rare in Sicily, including: i) vascular flora (e.g. *Viburnum tinus* and *Arbutus unedo*, both very rare throughout the western sector of Sicily); ii) bryophytes [*Cryphaea heteromalla* (new record of a very rare species in Sicily) as well as *Hypnum cupressiforme* and *Leptodon smithii*, also never previously found at such low altitudes]; iii) lichens (e.g. *Bacidia rosella*, *Gyalecta derivata*, *Ramalina roesleri* and *Waynea stoechadiana*); iv) mushrooms (e.g. *Eichleriella leucophaea*, only known location in Italy). Based on the scientific documentation produced in this study, these woods can be reported as "old-growth forests" to be included in the "National Network" that has been recently established in Italy (Ministerial Decree of 23 June 2023). This area might serve as an ideal control for urban environmental studies, given its pristine ecological setting.

Keywords

Conservation of biological diversity, forest ecosystems, monumental trees, old woods, pristine ecosystems, *Quercetea ilicis*, rare species

Introduction

In recent years, research regarding what are known as "old growth forests" and understanding how their "free evolution" relates to the conservation of threatened diversity has become increasingly important, especially since this diversity is particularly sensitive to anthropogenic disturbances in the environment.

According to the UN Environment Programme's definition "… an old-growth forest is a primary or secondary forest that has reached an age in which the species and structural attributes are comparable to senescent primary forests of the same type, such as to make it distinct as an ecosystem compared to younger woods" (UNEP 2001). Therefore, old growth forests are woody formations where human intervention has ceased for some time, characterized by a marked naturalness (richness in macro- and microfauna, vascular flora, mosses, macromycetes, lichens, etc.) and structural (presence of different layers of vegetation, dead wood, litter, etc.), ecological-functional and dynamic complexity. Identifying and studying these plant formations is important, especially to better enhance and protect this bio-ecological heritage and its structural heterogeneity by implementing appropriate protection and safeguarding actions and by applying adequate forest management measures. In recent years, this need has been reaffirmed by various international conventions, such as the "Pan-European Strategy for Biological and Landscape Diversity" which addresses this specific issue by emphasizing the main objectives of "ensuring the conservation of all forest typologies in Europe, primarily protecting the oldest [...], conserv[ing] the forest habitats of species that need extensive and undisturbed habitats".

In Italy, an initial study aimed at identifying the old-growth wood types of national parks was published by Blasi et al. (2010), which was followed by some initiatives on a regional scale (Marchetti et al. 2012) and a number of other scientific studies (Burrascano et al. 2009; Frascaroli et al. 2016; Romagnoli et al. 2018; Guidotti et al. 2010). In recent years, some scientific surveys have also concerned Sicily (Badalamenti et al. 2018; Maetzke et al. 2017, Sferlazza et al. 2023), which mainly regarding the distribution, floristic-structural characteristics and the ecological functions of old growth woods fragments found on the island.

This paper illustrates the results of an investigation aimed at characterising some centuries-old forest stands located in Palermo's Favorita park (north-western Sicily, Italy) from a phytosociological point of view and at analysing its valuable plant diversity. This historic urban park was established and enclosed in 1799 by King Ferdinand IV of the House of Bourbon to create a game preserve and site for agricultural experimentation. Baptized as the "Real Tenuta della Favorita" after the sovereign's other estate near Naples, it initially covered approximately 400 hectares. It serves as an important "green lung" close to the urban area, extending along a heterogeneous transect from the Palermo Plain to the detrital slopes of Mt. Pellegrino. Since 1995, it has been protected as part of the Mount Pellegrino Nature Reserve. Additionally, this study also aims to quantify the value of the reserve's plant diversity, which has been preserved in the same ecosystems as a result of the aforementioned conservation and protection measures (e.g. significant frequency of ancient or "monumental" arboreal specimens and/or almost exclusive presence of rare taxa of vascular flora, bryophytes, lichens and fungi).

A further objective is to evaluate the possibility of proposing the entire Favorita site to be included among the "old growth woods" of Sicily, in order to implement the "National Network" that has recently been established in Italy by Ministerial Decree of 5 april 2023 – Ministry of Agriculture, of Food sovereignty and Forests (G.U.R.I. S.G. n. 138/2023).

Study area

The study area extends over an area of about 180 hectares within the former "Real Tenuta della Favorita", at an altitude between approximately 50 and 200 m a.s.l. (Fig. 1). A historic topographical map of the park, drafted by Francesco Guttoso in 1856 (Fig. 2), is preserved in the "Giuseppe Pitrè" Ethnographic Museum in Palermo (Buffa et al. 1986). The document shows that the area known as the "Bosco

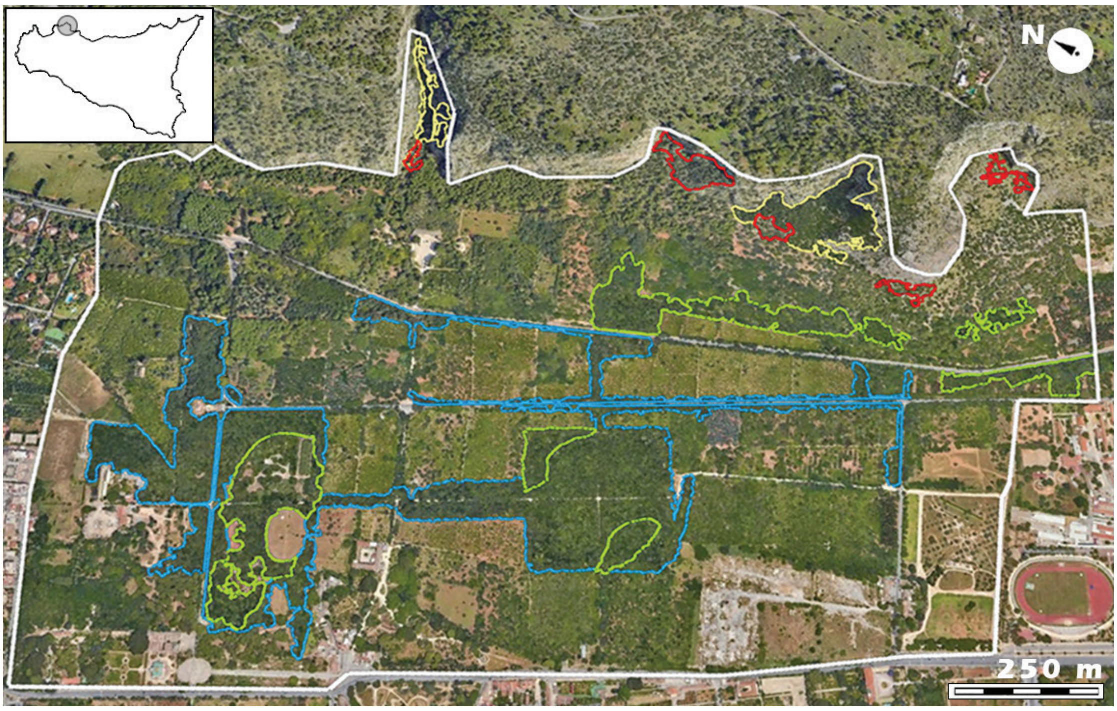

Figure 1. Study area (displayed in white), showing the delimitation of the following forest nuclei under investigation: *Quercus ilex* forest (in blue); maquis forest of *Phillyrea latifolia* with *Arbutus unedo* and *Viburnum tinus* (in green); maquis of *Olea europaea* var. *sylvestris* with *Cercis siliquastrum* (in red); ombrophilous maquis of *Phillyrea latifolia* with *Teucrium flavum* and *Pistacia terebinthus* (in yellow).

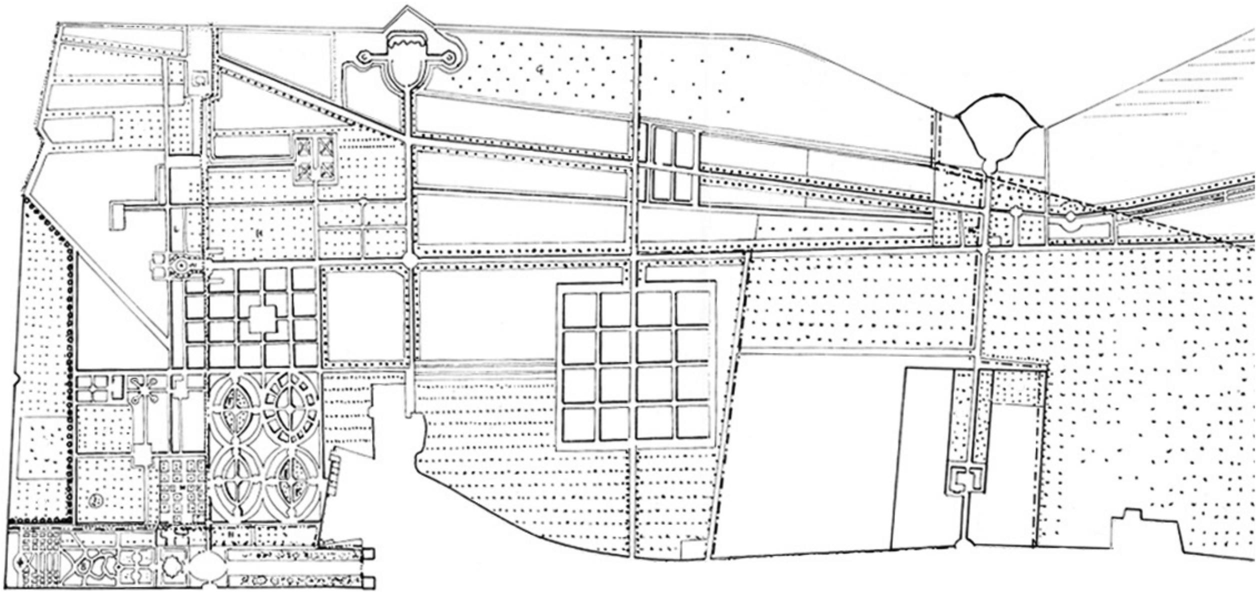

Figure 2. Part of a historic topographic map of the former "Real Tenuta della Favorita", drawn by Francesco Guttoso in 1856 and preserved at the Giuseppe Pitrè Ethnographic Museum in Palermo (from Buffa et al. 1986, modified). In the central part, the area still occupied today by the "Bosco Niscemi" is clearly recognizable, divided into the 16 "squares" that characterize it.

Niscemi" has existed since then. It is located in the central part of the park and continues to be divided into the original 16 squares, each covering 4000 m^2. The total area, including the small roads that delimitate it as well as other "groves (K)" and hedgerows, covers a total of 6.4 hectares.

Historical background of the Favorita Park

Several previous studies (e.g., Buffa et al. 1986; Pirrone et al. 1990; Leone 2003; La Mantia 2004; Pirajno and Flaibani 2015; Sessa 2015) have provided useful insights into the history of the Favorita Park.

During the early 19th century, under Bourbon rule, the area that currently accommodates the Bosco Niscemi became a huge park whose design was inspired by the royal estates of continental Europe. A complex mosaic of hedgerows, ornamental and experimental gardens, tree allées and small wooded areas were created, mostly using native evergreen woody species.

Ferdinand IV of Bourbon, fleeing Napoleon's troops during 1798 revolution in Naples, took refuge in Palermo, designating it as the new capital of the Kingdom. With the aim of creating recreational areas like those he enjoyed in Campania, he expropriated about 400 hectares of land, including part of the Piana dei Colli to the west, the Pantano di Mondello to the north, an area bordering the historic centre of Palermo to the south and the cliffs of Mt. Pellegrino to the east. After a brief return to Naples, Ferdinand returned to Palermo, where between 1806 and 1812 he further enriched the park, which was mostly used as a private hunting estate or devoted to agricultural experimentation. During this time, three main roads were built along with an intricate system of paths. At the same time, several neo-Gothic buildings were built or enlarged, different ornamental and allegorical artefacts (e.g., statues, fountains) were installed, irrigation canals fed by aqueducts were created, and buildings for agricultural purposes (e.g., oil mills, wine cellars) were erected.

Little is known about the period between the sovereign's death (1825) and 1860, when the Favorita passed to the House of Savoy as property of the Crown and was opened to the public. In 1877, the king ceded the park to the State. Part of the park was then converted to house military infrastructure (e.g., bunkers, embankments) and an airport (e.g., airship hangar and runway). In 1920, the king relinquished the usufruct of the park, leading to its division into four areas managed by different administrations. Once assigned to the municipality of Palermo, the park underwent further fragmentation and alteration during the following decades. Despite several public initiatives, such as the establishment of sports facilities between the 1930s and the 1970s, a process of slow but relentless decline began for the Favorita (Leone 2003).

Due to urban sprawl, the entire park and its agroforestry landscape have undergone gradual and continuous degradation and fragmentation over the past 60 years (Barbera et al. 2009). This, along with pedestrian barriers created by cutting arterial roads through the park to connect the city with the seaside village of Mondello has contributed to making the Favorita a no man's land. In fact, for several decades, local ecosystems have developed almost untouched, disturbed only by the hectic and noisy comings and goings of citizens' vehicles. During the 1980s, a wide area adjacent to Bosco Niscemi, originally part of the park, was allocated to host encampments of the nomadic Roma community of Palermo. Paradoxically, the long-lasting state of total abandonment of this sector of the park has preserved Bosco Niscemi to the present day, allowing local processes of undisturbed progressive succession to give this area levels of unpredictable naturalness

(Gianguzzi et al. 2017). Since 1995, the Favorita has been part of the "Monte Pellegrino" Nature Reserve, covering 1,050 hectares, established by the Sicilian administrative Region and managed by the NGO "Rangers d'Italia".

Bioclimatology

The climatic data summarised in (Tables 1, 2) is taken from the thermo-pluviometric surveys of the Palermo Civil Engineering Hydrographic Service (Servizio Idrografico del Servizio Civile di Palermo; Ministero dei Lavori Pubblici 1926–1985, in Duro et al. 1996).

Table 1. Monthly and annual averages of maximum and minimum temperatures (in °C), daily ranges, and absolute maximum and minimum values recorded at the thermometric station of the Palermo Astronomical Observatory from 1926 to1985 (Duro et al. 1996).

Palermo Astronomical Observatory (31 m a.s.l.)						
Month	**Max**	**Min**	**Mean**	**Temp. range**	**Abs. Max.**	**Abs. Min.**
January	15.7	7.8	11.8	7.9	30.4	-1.2
February	16.1	7.9	12.0	8.2	29.6	0.0
March	17.5	9.0	13.3	8.5	33.6	0.0
April	19.8	11.0	15.4	8.8	32.0	3.5
May	23.3	14.2	18.8	9.1	36.8	7.2
June	26.9	17.7	22.3	9.2	40.8	9.0
July	29.7	20.3	25.0	9.4	42.2	13.6
August	29.9	20.8	25.4	9.1	43.0	10.0
September	28.0	18.8	23.4	9.2	41.1	8.0
October	24.6	15.6	20.1	9.0	36.2	5.0
November	20.9	12.3	16.6	8.6	31.9	3.6
December	17.1	9.4	13.3	7.7	29.5	0.3
Year	**22.5**	**13.7**	**18.1**	**8.7**	**43.0**	**-1.2**

Table 2. Monthly and annual average values of rainfall (mm/m²) and number of rainy days (RD) recorded at the three rainfall stations in Palermo for the period 1926–1985 (Duro et al. 1996).

Month	**Castelnuovo Institute (54 m a.s.l.)**		**Hydrographic Service (19 m a.s.l.)**		**Astronomical Observatory (31 m a.s.l.)**	
	mm	**RD**	**mm**	**RD**	**mm**	**RD**
January	99.7	11	93.3	11	82.7	11
February	82.3	10	81.6	10	68.5	9
March	71.2	9	60.9	8	55.7	8
April	60.9	7	42.8	6	43.0	6
May	21.3	3	21.9	3	23.9	3
June	9.5	2	8.7	1	8.3	1
July	2.9	1	3.6	1	3.8	0
August	17.5	2	17.5	2	15.7	1
September	42.5	4	40.2	4	39.0	4
October	91.3	9	85.2	8	79.2	8
November	88.5	9	85.0	9	73.8	9
December	91.8	11	103.0	11	90.5	11
Year	**679.4**	**78**	**643.8**	**73**	**584.1**	**71**

The average daytime temperature of the area under study is 18.1 °C, whereas the average annual maximum and minimum values are 22.5 °C and 13.7 °C, respectively. The coldest month is usually January (average minimum = 7.8 °C, average maximum 15.7 °C) while the hottest is August (average minimum = 20.8 °C, average maximum = 29.9 °C). The rainfall recordings carried out at three localities located in the Palermo Plain show annual averages of 679.4 mm (Castelnuovo Institute, located right on the edge of the Favorita Park), 643.8 mm (Hydrographic Service) and 584.1 mm (Astronomical observatory), with a number of rainy days of 78, 73 and 71, respectively.

Based on the bioclimatic classification criteria proposed by Rivas-Martínez (1996, 2008), the study area was found to be affected by a Mediterranean pluviseasonal oceanic bioclimate with a thermomediterranean thermotype and a dry-subhumid ombrotype.

Geolithology

From a geological point of view, the study area falls on the margins of the Sicilian segment of the Apennine-Maghrebian chain (Catalano et al. 1979, 2013). Local rock outcrops belong to what are known as the Panormide carbonate platform succession (Basilone 2018) and the "Cozzo-Lupo" stratigraphic-structural unit of the Lower Trias-Eocene (Abate et al. 1978). They are mainly composed of: a) Quaternary calcarenites (calcareous sands), which cover a large area of the Palermo Plain; b) scree and debris, flows with accumulations of red earth of colluvial origin, mainly concentrated along the slopes of the relief; c) compact limestones rich in fossils of the Pellegrino Formation (western slopes of Mt. Pellegrino. In particular, the Palermo Plain is made up of Pleistocene deposits (calcarenites and sandy clays) superimposed on impervious clay and marl soils of Numidic Flysch (Oligo-Miocene), which in turn rest on meso-cenozoic limestones (Abate et al. 1978; Catalano et al. 1979; Sparacio et al. 2017). Two aquifers are recognized on these substrates, one that is more superficial (on sandy clays and calcarenites) and the other found at a depth of around 100 m (in Mesozoic limestones), which are in turn separated discontinuously by impermeable Flysch (Calvi et al. 1998). These aquifers are fed by the waters that flow in the carbonate rocks of the Palermo Mts., resulting in humid and diversified ecological conditions within the Palermo Plain. The different edaphic characteristics of the study area have led to different potential vegetation, i.e. *Quercus ilex* forest (on the deepest, loamiest and most humified soils), and the maquis forest of *Phillyrea latifolia* (in marginal, more xeric and draining areas).

Materials and methods

Soil

The soils were characterized in accordance with the WRB guidelines (IUSS WG WRB, 2022), leading to their classification based on this system.

Vegetation analysis

The vegetation surveys of the forest nuclei were carried out in the period between April 2018 and June 2023. A total of 38 unpublished phytosociological relevés were carried out, according to the Zurich-Montpellier methodology (Braun-Blanquet 1964). For the syntaxonomic interpretation of the communities, the data were compared with those already available from previous literature (Brullo and Marcenò 1985; Buffa et al. 1986; Gianguzzi et al. 1996; Surano et al. 1996; Brullo et al. 2009; Gianguzzi and Bazan 2020a, b, c). For the elaboration of synoptic tables including similar associations of the *Quercetea ilicis* class already described for Sicily (Appendix 1: Tables A1, A2), reference was made to Brullo et al. (2009) and other more recent papers (cited in the text). The nomenclature of the syntaxa follows the criteria of the International Code of Phytosociological Nomenclature (ICPN: Theurillat et al. 2021), whereas for the syntaxonomic classification of the communities, we referred to Mucina et al. (2016) and to Guarino and Pasta (2017).

Biodiversity analysis

To evaluate the role of "refuge habitat" of these forest ecosystems for the conservation of what's referred to as "valuable" plant diversity (Gigante et al. 2016; Capotorti et al. 2020; Casavecchia et al. 2021), a census of the ancient trees (with localization and dendrometric survey) was performed.

For the classification of vascular plant species, reference was made to Pignatti et al. (2017–2019), while plant naming follows Bartolucci et al. (2018) and the updates available on the Portal to the Flora of Italy (2023). For bryophytes, their nomenclature follows Hodgetts et al. (2020); the specimens are preserved in the Herbarium Mediterraneum Panormitanum (PAL). The identification of lichens was performed using the the online keys published in "ITALIC, the Information System of the Italian Lichens, version 07" (see Nimis and Martellos 2020) and Smith et al. (2009), while their nomenclature follows Nimis (2024). For fungi, the nomenclature used refers to Ferraro et al. (2022), whereas the dried samples are preserved in the SAF Herbarium of the Department of Agricultural, Food and Forestry Sciences of the University of Palermo.

Results and discussion

Soil

We studied four soil profiles, the first two in the colluvium between the dunes (1) and on the back of the coastal sandy dune that covers the calcarenites (2), and the third and fourth on the debris of Mt. Pellegrino (4). The parent materials belong to the Quaternary complex of western Sicily, a calcarenitic-sandy-silty complex with mainly lithoid clasts, composed of calcite and siliceous rocks fragments and monocrystalline quartz (sparitic grains and small amounts of bioclasts) (Zimbardo 2016).

The soils are classified respectively as: (1) Solimovic Regosol (Arenic) (Fig. 3); (2) Eutric Arenosol (Chromic); (3) and (4) Skeletic Regosol (Ochric) (IUSS WG WRB 2022). The average textural classification of these soils is 15% clay, 35% silt and 50% sand expressed as a percentage of the fine earth fraction. Average properties of the fine earth are: organic carbon 3.0±1.1%; pH 7.8±0.6; BD soil bulk density 1.030±0.011 kg dm^{-3}.

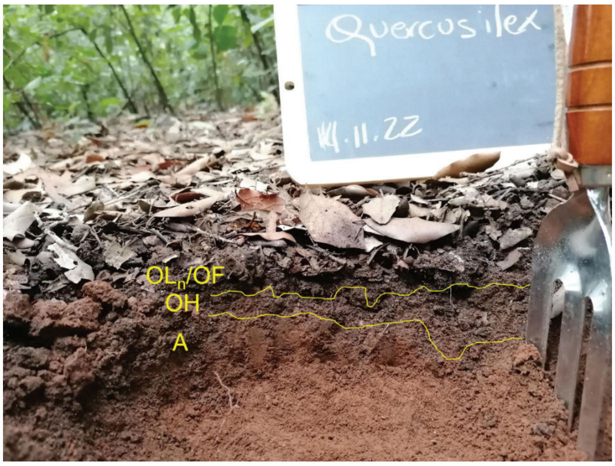

Figure 3. Pachyamphi humus forms in the dune colluvium (site 1).

We used the European classification of humus forms (Zanella et al. 2011), based on the sequence and morphological characteristics, including evidence of biological activity, of organic and/or organomineral horizons observed and described in the field (Table 3). Our correlations between humus forms and soils are consistent with the cross-harmonization proposed by Vacca et al. (2018) for Mediterranean environments. In line with humus theory (Ponge 2003), the formation of humus primarily stems from nutrient availability and reflects the nutrient management approaches adopted by ecosystems. The presence of mull humus indicates systems rich in nutrients, showing

Table 3. Humus forms. Site locations in accordance with Figs 1, 3.

Site	Position	Humus	Horizon	Materials*	HC[2] (%)	Depth (cm)
1	**Dune colluvium**	Pachyamphi	OLn/OF	l, tl, n, t, tt, twm	<10	1
			OH	twm, wdl, ztm, r	>70	2
			maA	r	<5	6+
2	**Dune hump**	Eumacroamphi	OLn	l, n, t, wm	<10	1
			OF/OH	t, tt, aad, r, wdl	>30	2
			saA	r	<5	4+
3	**Talus slope**	Eumull	OLn	l, n, t, wm	<10	1
			OF	tl, wdl, ztm, r	>30	2
			A	r	<5	5+
4	**Talus slope**	Eumull	OLn	l, n, t, wm	<9	1
			OF	tl, wdl, ztm, r	>28	2
			A	r	<4	4+

* l = leaves; n = needles; t = twigs; wm = woody materials; pdl = partly decomposed litter; tl = transformed leaves; tn = needles; tt = transformed twigs; twm = transformed woody materials; wdl = well-decomposed litter; aad = aged animal droppings; ztm = zoogenically transformed material; r = roots; [2] HC = humic component.

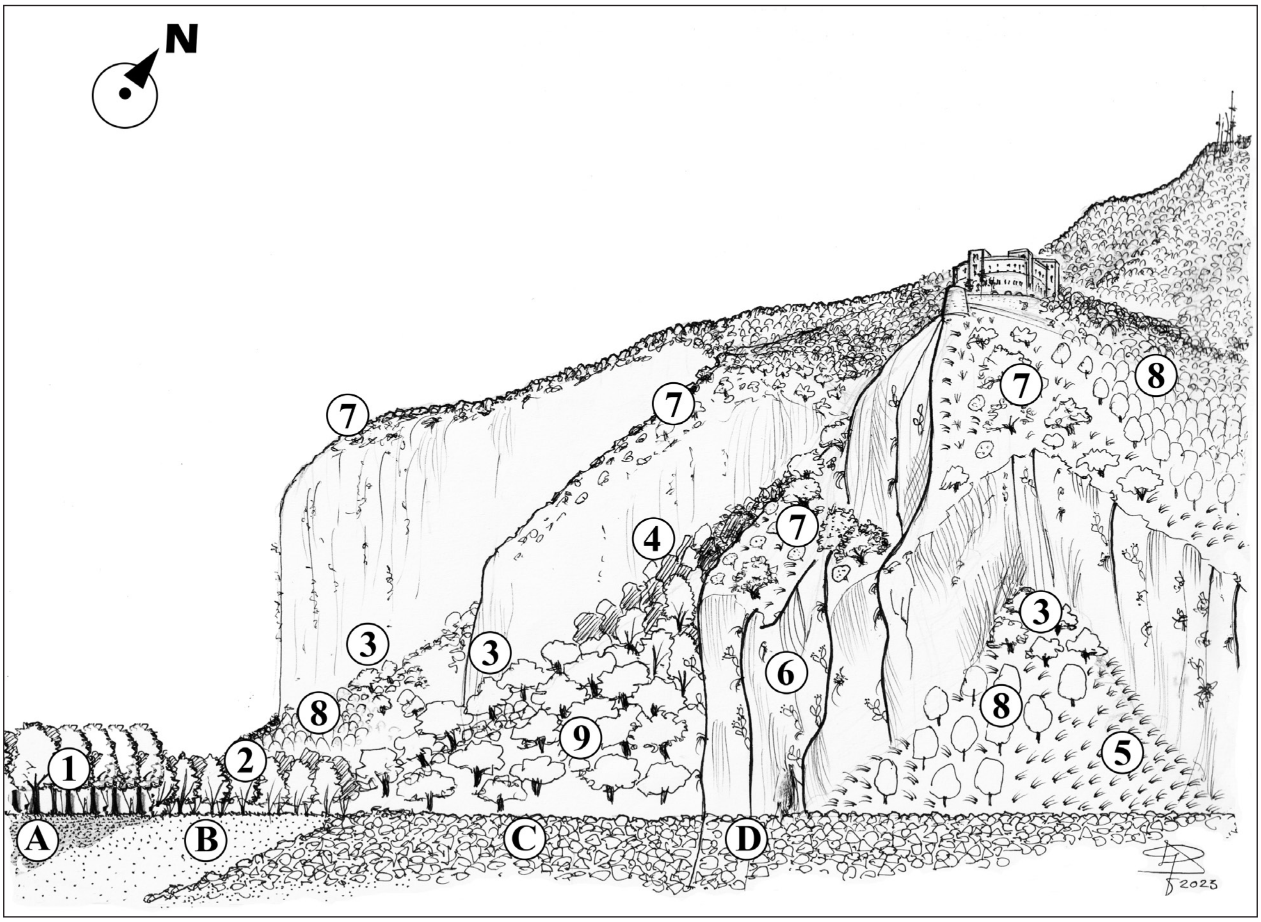

Figure 4. Schematic transect between the Palermo Plain (about 50 m a.s.l.) and Mt. Pellegrino (606 m a.s.l.), in which the geolithological substrates and the main vegetation aspects of the landscape are represented: (**A**) quaternary calcarenites [Solimovic Regosol (Arenic)]; (**B**) quaternary calcarenites [Eutric Arenosol (Chromic)]; (**C**) detrital-clastic materials [Skeletic Regosol (Ochric)]; (**D**) limestones and dolomites; (**1**) *Quercus ilex* forest (*Pistacio lentisci-Quercetum ilicis* subass. *viburnetosum tini*); (**2**) maquis forest of *Phillyrea latifolia* with *Arbutus unedo* and *Viburnum tinus* (*Viburno tini-Phillyreetum latifoliae* ass. nova); (**3**) maquis of *Olea europaea* var. *sylvestris* with *Cercis siliquastrum* (*Ruto chalepensis-Oleastretum sylvestris* subass. *cercidetosum siliquastri*); (**4**) ombrophilous maquis of *Phillyrea latifolia* with *Teucrium flavum* (*Teucrio flavi-Phillyreetum latifoliae* ass. nova); (**5**) grassland vegetation (*Penniseto setacei-Hyparrhenietum hirtae*); (**6**) cliff vegetation (*Scabioso-Centauretum ucriae*); (**7**) maquis of *Olea europaea* var. *sylvestris* with *Euphorbia bivonae* (*Ruto chalepensis-Oleastretum sylvestris* subass. *euphorbietosum bivonae*); (**8**) artificial plantations; (**9**) former cultivations (olive groves, etc.).

a rapid nutrient cycling strategy. It is assumed that because nutrient and organic carbon dynamics are interconnected and organic carbon turnover occurs swiftly, the substantial carbon reserves found are likely a consequence of high net primary ecosystem productivity. Nevertheless, it is worth noting that establishing a straightforward or essential link between these factors is challenging, even in the presence of fast nutrient cycling (Andreetta et al. 2011).

Forest vegetation

Four types of forest vegetation were identified in the study area (Fig. 4):

a) *Pistacio lentisci-Quercetum ilicis* Brullo et Marcenò 1985 subass. *viburnetosum tini* Gianguzzi, Ilardi et Raimondo 1996;
b) *Viburno tini-Phillyreetum latifoliae* Gianguzzi et Caldarella ass. nova hoc loco;
c) *Ruto chalepensis-Oleetum sylvestris* subass. *cercidetosum siliquastri* Gianguzzi et Bazan 2020;
d) *Teucrio flavi-Phillyreetum latifoliae* Gianguzzi et Caldarella ass. nova hoc loco.

Pistacio lentisci-Quercetum ilicis Brullo et Marcenò 1985 subass. *viburnetosum tini* Gianguzzi, Ilardi et Raimondo 1996

Holotypus. Rel. 10, table 5 in Gianguzzi et al. (1996).

Phytosociological data. Table 4, Appendix 1: Table A1 (column 3).

Diagnostic species. *Quercus ilex* (dom.), *Pistacia lentiscus*, *Viburnum tinus*, *Arbutus unedo*, *Clematis cirrhosa* and *Phillyrea latifolia*.

Short description. Dense, closed forest, with a clear dominance of *Quercus ilex*, of variable height between (5)7–14(20) m, in whose tree layer there are *Phillyrea latifolia* and sometimes *Fraxinus ornus* and *Celtis australis*. Other species include *Pistacia lentiscus*, *Viburnum tinus*, *Arbutus unedo*,

Table 4. *Pistacio lentisci-Quercetum ilicis* subass. *viburnetosum tini*: rels. 1–10, Bosco Niscemi (14.11.2022, L. Gianguzzi and O. Caldarella); rels. 11–12, near the Forestry nursery (14.11.2022, L. Gianguzzi and O. Caldarella); rels. 13–14, near the Hercules Fountain (5.2.2013, L. Gianguzzi and O. Caldarella); rel. 15, Villa d’Orleans (17.5.2014, L. Gianguzzi and O. Caldarella).

Life form	Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Presence	Frequency
	Altitude (m a.s.l.)	55	54	54	53	54	47	46	45	44	45	63	64	64	63	50		
	Slope (°)	3	3	3	3	3	3	3	3	3	3	3	3	2	2	5		
	Aspect	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	W	W	W	W	W		
	Area (m^2)	100	100	150	100	100	100	100	100	100	100	100	100	150	150	100		
	Total cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
	Tree cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
	Shrub cover (%)	50	45	50	45	45	50	50	50	45	45	50	50	50	60	25		
	Herb cover (%)	10	10	10	10	10	10	10	10	10	10	10	10	70	30	10		
	Presence of deep litter (yes:+/no:-)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
	Presence of dead wood (yes:+/no:-)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
	Seedlings (%)	15	20	15	15	15	15	15	15	15	15	9	10	15	15	10		
	Average tree height (m)	9,0	7,0	8,0	7,2	7,5	7,2	7,2	15	11	10	7,1	7,0	14	10	18		
	No. of species per relevé	16	13	13	13	15	15	14	18	13	15	15	14	17	16	20		
	Char. and diff. assoc.																	
P scap	*Quercus ilex* L.	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	15	V
P scap	*Quercus ilex* L. (seed.)	1	1	+	1	1	+	1	1	+	1	+	+	+	+	1	15	V
P caesp	*Pistacia lentiscus* L.	2	3	3	2	1	2	1	1	+	1	1	1	1	2	1	15	V
P caesp	*Pistacia lentiscus* L. (seed.)	+	+	1	+	+	+	+	+	+	1	+	+	1	+	+	15	V
P caesp	*Viburnum tinus* L.	3	2	3	4	4	2	3	2	3	4	3	3	1	3	1	15	V
P caesp	*Viburnum tinus* L. (seed.)	2	3	3	3	3	2	2	2	3	2	1	1	+	+	.	14	V
P lian	*Clematis cirrhosa* L.	1	1	2	1	2	1	1	1	1	1	2	3	3	3	.	14	V
P lian	*Clematis cirrhosa* L. (seed.)	.	.	.	.	.	.	+	+	1	.	1	2	+	+	.	7	III
P caesp	*Arbutus unedo* L. (seed.)	+	+	+	+	+	.	+	+	.	.	.	.	.	.	.	7	III
P caesp	*Arbutus unedo* L.	2	1	2	1	1	+	.	.	.	.	.	.	.	.	.	6	II
	Char. all. *Fraxino-Quercion ilicis* (*) and *Quercetalia ilicis*																	
P scap	**Fraxinus ornus* L.	1	2	.	.	.	2	+	.	.	.	.	2	3	.	2	7	III
P scap	**Fraxinus ornus* L. (seed.)	+	+	.	+	.	+	.	+	.	.	+	.	1	.	.	7	III
G rhiz	*Ruscus aculeatus* L.	+	.	.	.	+	.	+	.	+	+	.	.	.	.	.	5	II
G rad	*Dioscorea communis* (L.) Caddick & Wilkin	.	.	.	.	+	.	+	+	+	+	+	.	.	.	.	6	II
NP	*Rosa sempervirens* L.	.	.	.	.	.	+	.	1	.	+	.	+	.	1	.	5	II
P caesp	*Pistacia terebinthus* L.	1	.	.	.	+	.	.	.	.	+	.	.	.	.	.	3	I
NP	**Emerus major* Mill. subsp. *emeroides* (Boiss. & Spruner) Soldano & F. Conti	.	.	.	.	.	.	.	.	.	.	+	.	.	r	.	1	I
G bulb	**Cyclamen hederifolium* Aiton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	I
	Char. Cl. *Quercetea ilicis*																	
P caesp	*Phillyrea latifolia* L.	2	4	3	2	3	2	3	3	3	4	3	3	3	2	1	15	V
P caesp	*Phillyrea latifolia* L. (seed.)	1	1	+	1	1	1	1	1	+	+	1	+	.	+	+	14	V
G rhiz	*Arisarum vulgare* O. Targ.Tozz	2	1	1	1	1	1	1	+	2	1	1	1	2	2	.	14	V
G rhiz	*Asparagus acutifolius* L.	+	+	+	1	.	+	+	.	.	.	+	.	1	+	+	10	IV
P lian	*Rubia peregrina* L.	.	.	.	+	1	+	+	1	.	.	.	.	2	1	.	7	III
P lian	*Hedera helix* L.	.	.	.	.	.	.	.	.	1	.	2	1	1	2	3	6	II
G rhiz	*Smilax aspera* L.	.	.	.	.	+	.	.	1	.	1	.	.	2	1	1	6	II
P scap	*Celtis australis* L.	.	.	+	.	.	.	.	.	.	.	.	1	2	1	2	5	II
P caesp	*Rhamnus alaternus* L.	.	.	1	.	.	.	.	.	1	.	+	.	.	.	1	4	II
Ch frut	*Stachys major* (L.) Bartolucci & Peruzzi	.	.	.	+	+	+	.	.	.	+	.	.	.	.	.	4	II
H scap	*Pulicaria odora* (L.) Rchb.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	3	I
G bulb	*Allium subhirsutum* L.	+	.	.	.	+	.	.	.	.	.	.	.	1	.	.	3	I
H caesp	*Ampelodesmos mauritanicus* (Poir.) T.Durand & Schinz	.	.	.	.	.	1	.	.	.	.	.	.	+	.	.	2	I
G rhiz	*Limodorum abortivum* (L.) Sw.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	2	I
P lian	*Hedera helix* L. (seed.)	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	2	I
P caesp	*Anagyris foetida* L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	I
NP	*Chamaerops humilis* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	I
NP	*Chamaerops humilis* L. (seed.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	I
P caesp	*Laurus nobilis* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	I
	Other species																	
H scap	*Acanthus mollis* L.	1	1	+	.	1	1	+	+	+	+	2	3	4	1	1	14	V
G rhiz	*Arum italicum* Mill.	1	+	+	+	+	+	+	+	+	+	1	+	.	1	1	14	V
H bienn	*Smyrnium olusatrum* L.	+	+	.	.	.	.	.	+	.	.	.	+	+	.	.	5	II
H ros	*Polypodium cambricum* L.	.	.	+	.	.	.	.	+	.	+	.	+	.	.	.	4	II
NP	*Rubus ulmifolius* Schott.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	1	I
G bulb	*Acis autumnalis* (L.) Sweet	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	I
NP	*Cistus salviifolius* L.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	I
H scap	*Parietaria judaica* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	I
G rhiz	*Ruscus hypoglossum* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	I
H caesp	*Oloptum miliaceum* (L.) Röser & H.R.Hamasha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	I
T scap	*Urtica urens* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	I
P scap	*Phitolacca dioica* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	I

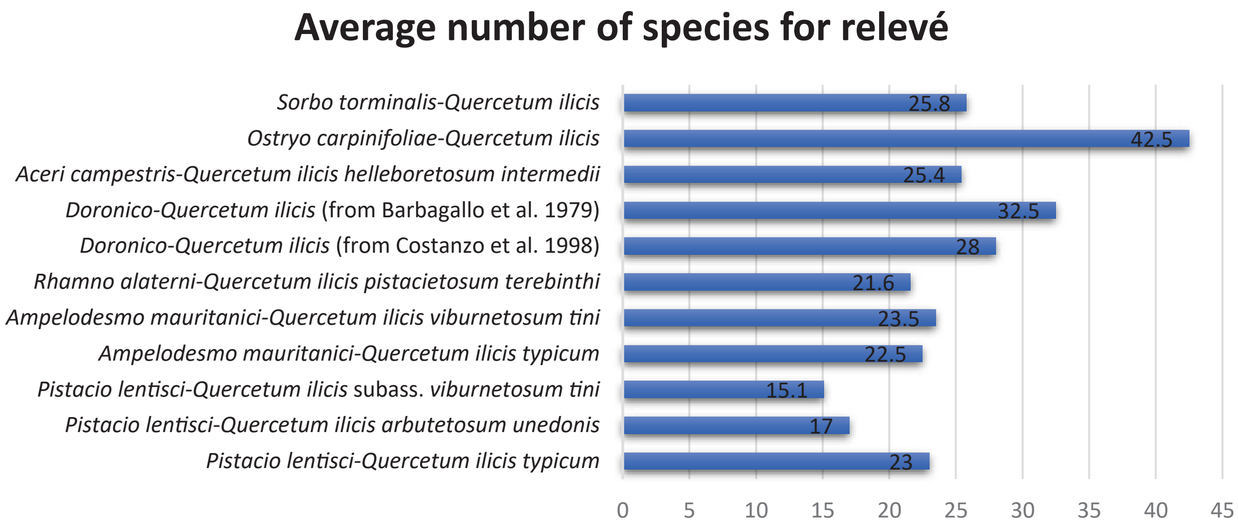

Figure 5. Average number of species per relevé in the main *Quercus ilex* associations described for the Sicilian territory (source data see Appendix 1: Table A1): the *Pistacio-Quercetum ilicis* subass. *viburnetosum tini*, is the community that presents the lowest value.

and some lianas (*Clematis cirrhosa*, *Rubia peregrina*, *Smilax aspera*, *Hedera helix* and *Asparagus acutifolius*), which are represented in the shrub layer. The herbaceous component of the undergrowth is poor (Fig. 5), essentially composed of some native sciaphilous-nitrophilous bulbous plants (*Acanthus mollis*, *Arisarum vulgare*, *Arum italicum*, *Smyrnium olusatrum* etc.), as well as a rich frequency of seedlings of the dominant tree species (Fig. 6a–e).

Substrate/parent material and soil. Coastal Quaternary calcarenites on deep and evolved soils and with edaphic humidity (due to rising groundwater) are widespread in the internal part of the Palermo Plain. These soils are classified as Solimovic Regosol (Arenic) (IUSS WG WRB 2022).

Bioclimate. Mediterranean pluviseasonal oceanic thermomediterranean thermotype and dry-subhumid ombrotype.

Syntaxonomic notes. The *Pistacio lentisci-Quercetum ilicis* association has been described as a thermophilous holm oak forest in Sicily (Brullo and Marcenò 1985), linked to xeric alkaline substrates (marly, limestones, calcarenites, etc.). This forest association is rich in species of the order *Pistacio-Rhamnetalia alaterni* (Brullo and Marcenò 1985; Brullo et al. 2009). The subass. *viburnetosum tini* has been recognized in the calcarenites of the Palermo Plain (Gianguzzi et al. 1996, 2016a). In addition to the high frequency of *Pistacia lentiscus*, the following species are identified as differentials of the subassociation: a) *Viburnum tinus* [Steno-Mediterranean element with relict and fragmentary distribution (Pignatti 1982; Karlson et al. 2005), in Sicily known only in this area and in a few sites in the Sicani Mts. (Gianguzzi et al. 2016a) and Mt. Etna (Siracusa 1998; Brullo et al. 2009), etc.]; b) *Arbutus unedo* (acidophilous and calcifugal species, also quite rare in the basiphilous holm oak forests of the western sector of Sicily; Gianguzzi and La Mantia 2008); c) *Clematis cirrhosa*, a very common vine in this community.

Vegetation series. The community constitutes the best structured aspect of the "Climatophilous series north-western Sicilian, thermomediterranean from dry to subhumid, calcarenitic of *Quercus ilex* (with *Pistacia lentiscus* and *Viburnum tinus*)": *Pistacio lentisci-Querco ilicis viburnetosum tini* sigmetum (Brullo and Marcenò 1985; Gianguzzi et al. 1996; Brullo et al. 2009). On the more xeric and draining sandy-calcarenitic soils, located near the slopes of Mt. Pellegrino, it is replaced by the *Phillyrea latifolia* series of the *Viburno tini-Phillyreo latifoliae* sigmetum (whose more mature forest community is described in the following paragraph). Near watercourses – as in the case of the locality detected in Villa d'Orleans in Palermo, where the Kemonia Stream once flowed – it also finds contact with the hygrophilous series of *Salix pedicellata* of the *Ulmo canescentis-Salico pedicellatae* sigmetum (Gianguzzi et al. 2010, 2013, 2014).

Synchorology. The forest stands represent residual aspects linked to the coastal Quaternary calcarenites of the western sector of Sicily, where they were destroyed by man to make room for crops (citrus groves, orchards, and vegetable gardens) and urban areas. A further small nucleus of approximately 1 hectare was also located within Villa d'Orleans, in the urban area of Palermo (rel. 15 of Table 4). It has developed through free evolution over the last 150 years, although the undergrowth has undergone the removal of topsoil, litter and dead wood. There are also long-standing individuals of *Quercus ilex* here, reaching heights over 20 m.

Eunis code. G2.121(Meso-Mediterranean *Quercus ilex* forests).

Natura 2000 code. 9340 (*Quercus ilex* and *Quercus rotundifolia* forests).

Number of nuclei and total coverage (in ha). 5 units (for 11,86 ha of coverage).

Viburno tini-Phillyreetum latifoliae* Gianguzzi et Caldarella ass. nova *hoc loco

Holotypus. Rel. 3 in Table 5.

Phytosociological data. Table 5, Appendix 1: Table A2 (column 23).

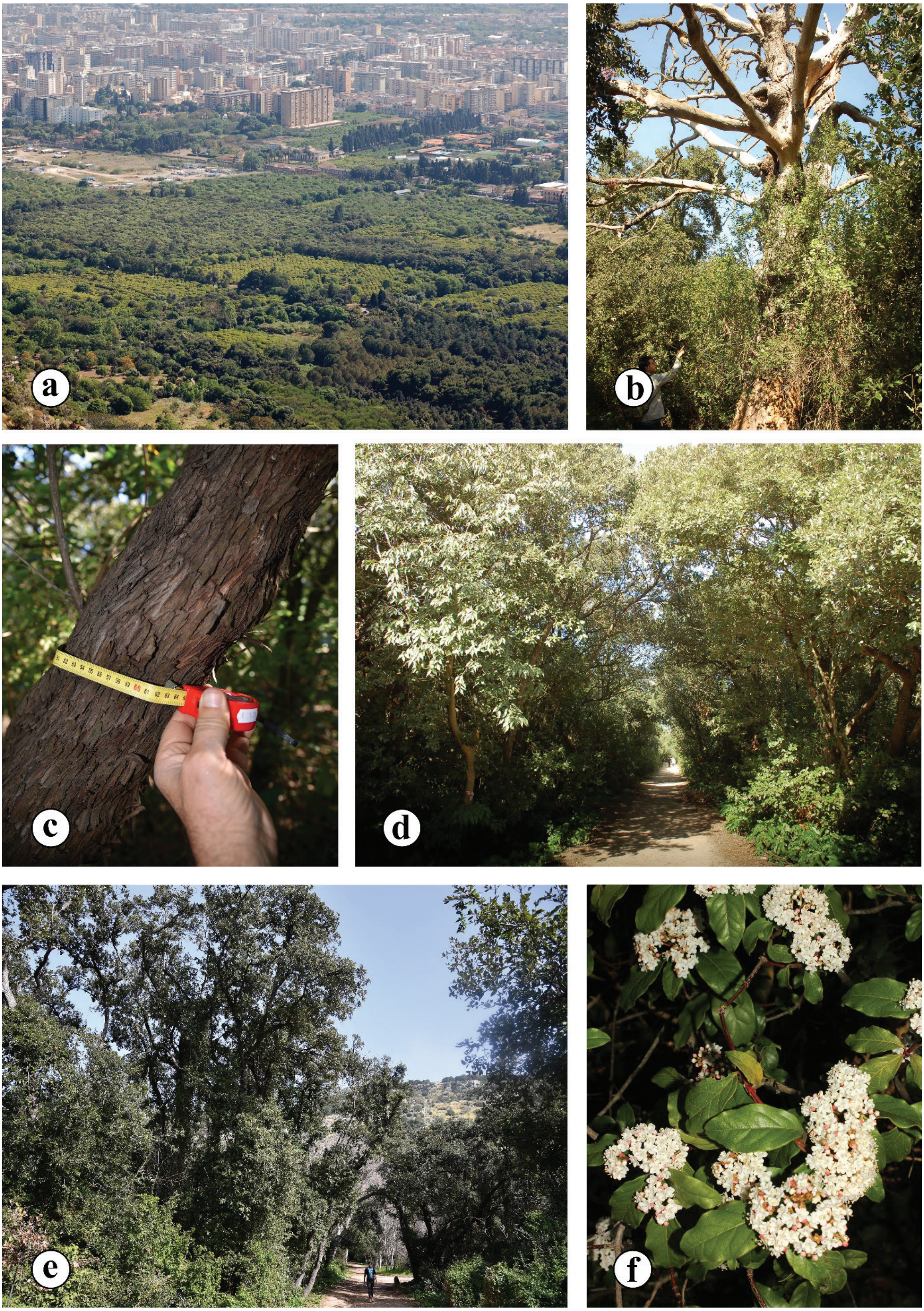

Figure 6. (**a**) Overview of the forest core of the Bosco Niscemi; (**b**) old dead plant of *Quercus ilex* (photo from 2012); (c) detail of old trunk of *Arbutus unedo*; (**d**), (**e**) aspects of the *Pistacio lentisci-Quercetum ilicis* subass *viburnetosum tini*; (**f**) *Viburnum tinus*, a characteristic species of holm oak and *Phillyreetum* communities (respectively, *Pistacio lentisci-Quercetum ilicis* subass *viburnetosum tini* and *Viburno tini-Phillyreetum latifoliae* ass. nova), represented on the calcarenites, in different ecological contexts.

Table 5. *Viburno tini-Phillyreetum latifoliae* ass. nova: rels. 1–4, Bosco Niscemi (22.2.2018, L. Gianguzzi and O. Caldarella); rels. 5–6, along the road beyond Villa Niscemi (06.2.2014, L. Gianguzzi and O. Caldarella); rels. 7–8, near the Hercules fountain (14.12.2017, L. Gianguzzi and O. Caldarella); rel. 9, near the Rocche dello Schiavo (1.6.2023, L. Gianguzzi and O. Caldarella); rels. 10–11, near the Palazzina Cinese (1.6.2023, L. Gianguzzi and O. Caldarella); rels. 10–12, Malvagno (1.6.2023, L. Gianguzzi and O. Caldarella). Asterisk indicates the type relevé.

Life form														Presence	Frequency
	Relevé number	1	2	3*	4	5	6	7	8	9	10	11	12		
	Altitude (m a.s.l.)	55	55	47	48	61	60	62	63	65	60	62	58		
	Slope (%)	3	3	3	3	2	5	4	5	4	1	2	2		
	Aspect	S	S	S	S	NW	NW	NW	NW	NW	NW	NW	NW		
	Area (m²)	100	100	100	100	100	100	150	100	100	100	100	100		
	Total cover (%)	100	100	100	100	100	100	100	100	100	100	100	100		
	Tree cover (%)	100	100	100	100	100	100	100	100	100	100	100	100		
	Herb cover (%)	10	15	20	15	20	20	30	20	10	20	10	10		
	Presence of deep litter (yes:+/no:-)	+	+	+	+	+	+	+	+	+	+	+	+		
	Presence of dead wood (yes:+/no:-)	+	+	+	+	+	+	+	+	+	+	+	+		
	Average tree height (m)	6,5	7	7	6,5	6,5	6	6	6	7	8	6	10		
	No. of species per relevé	14	11	12	11	14	10	16	13	13	12	14	12		
	Char. and diff. assoc. and var. (°)														
P caesp	*Phillyrea latifolia* L.	5	5	5	5	5	5	5	5	5	5	5	5	12	V
P caesp	*Phillyrea latifolia* L. (seed.)	1	1	1	1	1	1	+	1	1	1	1	1		
P lian	*Clematis cirrhosa* L.	3	2	1	1	4	2	4	3	3	4	4	4	12	V
P lian	*Clematis cirrhosa* L. (seed.)	2	2	+	2	1	1	+	2	2	1	2	1		
P caesp	*Viburnum tinus* L.	2	2	3	3	2	2	+	2	1	1	1	1	12	V
P caesp	*Viburnum tinus* L. (seed.)	+	+	.	2	+	+	+	+	1	+	1	1		
P lian	°*Asparagus asparagoides* (L.) Druce	.	.	.	.	2	1	1	2	1	2	3	1	8	IV
	Char. all. *Oleo-Ceratonion* and ord. *Pistacio-Rhamnetalia alaterni*														
P caesp	*Pistacia lentiscus* L.	1	3	2	1	3	2	2	3	4	3	3	2	12	V
P caesp	*Pistacia lentiscus* L. (seed.)	+	1	1	.	+	+	1	+	1	1	1	1	.	
P caesp	*Pistacia terebinthus* L.	1	.	1	.	.	.	1	.	3	1	2	1	7	III
P caesp	*Rhamnus alaternus* L.	.	.	.	1	.	.	1	.	1	.	1	.	4	II
Ch frut	*Stachys major* (L.) Bartolucci & Peruzzi	.	.	.	.	.	.	.	.	.	.	+	.	1	1
	Char. Cl. *Quercetea ilicis*														
P scap	*Quercus ilex* L.	2	3	2	.	2	1	1	2	1	1	2	3	11	V
P scap	*Quercus ilex* L. (seed.)	+	+	.	.	.	+	1	+	+	1	1	1	.	
G rhiz	*Arisarum vulgare* O. Targ.Tozz	1	1	1	1	2	2	3	1	.	+	.	.	9	IV
G rhiz	*Asparagus acutifolius* L.	+	+	.	.	1	+	+	+	1	.	+	+	9	IV
P scap	*Fraxinus ornus* L.	.	2	1	.	.	.	.	.	1	1	2	2	6	III
G rad	*Dioscorea communis* L. Caddick & Wilkin	.	.	.	.	1	.	.	+	+	+	2	1	6	III
G rhiz	*Smilax aspera* L.	.	.	1	1	2	.	1	.	.	1	.	.	5	III
G bulb	*Allium subhirsutum* L.	+	.	+	.	1	.	1	.	.	.	.	.	4	II
P caesp	*Arbutus unedo* L.	.	.	.	2	.	2	.	+	.	.	.	.	3	II
NP	*Rosa sempervirens* L.	+	.	.	.	.	+	.	.	.	.	.	.	2	I
P lian	*Rubia peregrina* L.	.	.	.	.	3	.	+	.	.	.	.	.	2	I
H caesp	*Ampelodesmos mauritanicus* (Poir.) T.Durand & Schinz	.	.	.	+	.	.	.	.	.	.	.	.	1	1
G rhiz	*Ruscus aculeatus* L.	.	.	.	+	.	.	.	.	.	.	.	.	1	I
	Other species														
H scap	*Acanthus mollis* L.	1	+	.	+	1	.	1	1	2	3	1	1	10	IV
T scap	*Urtica urens* L.	1	+	+	.	.	.	.	1	.	.	+	+	6	III
G rhiz	*Arum italicum* Mill.	1	1	.	.	2	.	.	1	.	.	.	.	4	II
T scap	*Mercurialis annua* L.	.	.	+	.	.	.	+	.	+	.	.	.	3	II
G bulb	*Oxalis pes-caprae* L.	.	.	.	.	.	.	1	.	.	.	.	.	2	I
P scap	*Cupressus sempervirens* L.	2	.	.	.	.	.	.	.	.	.	.	.	1	I

Diagnostic species. *Phillyrea latifolia* (dom.), *Viburnum tinus*, *Arbutus unedo*, *Clematis cirrhosa*; *Asparagus asparagoides* (anthropogenic variant).

Short description. Dense maquis forest of evergreen sclerophyllous scrub, (4)5–6(7) m high, with closed or almost closed canopy structure, clearly dominated by *Phillyrea latifolia*, which is constantly associated with *Arbutus unedo* and *Viburnum tinus*. *Pistacia lentiscus* also frequently appears, as well as various lianas such as *Clematis cirrhosa*, *Asparagus acutifolius*, *Smilax aspera*, *Rubia peregrina* and *Dioscorea communis*. Compared with the *Pistacio lentisci-Quercetum ilicis* subass. *viburnetosum tini*, in this community the presence of *Quercus ilex* is more sporadic and with composed of shrub specimens. The herbaceous component is quite poor and scattered – particularly in the most intact aspects – made up of bulbous and rhizomatous species (*Arisarum vulgare*, *Acanthus mollis*, *Arum italicum*, *Allium subhirsutum*), as well as hosting a significant presence of woody plant seedlings (Fig. 7a–c).

Substrate/parent material and soil. The community is linked to sandy soils on Quaternary calcarenites, in contexts that are more xeric and draining than those colonized

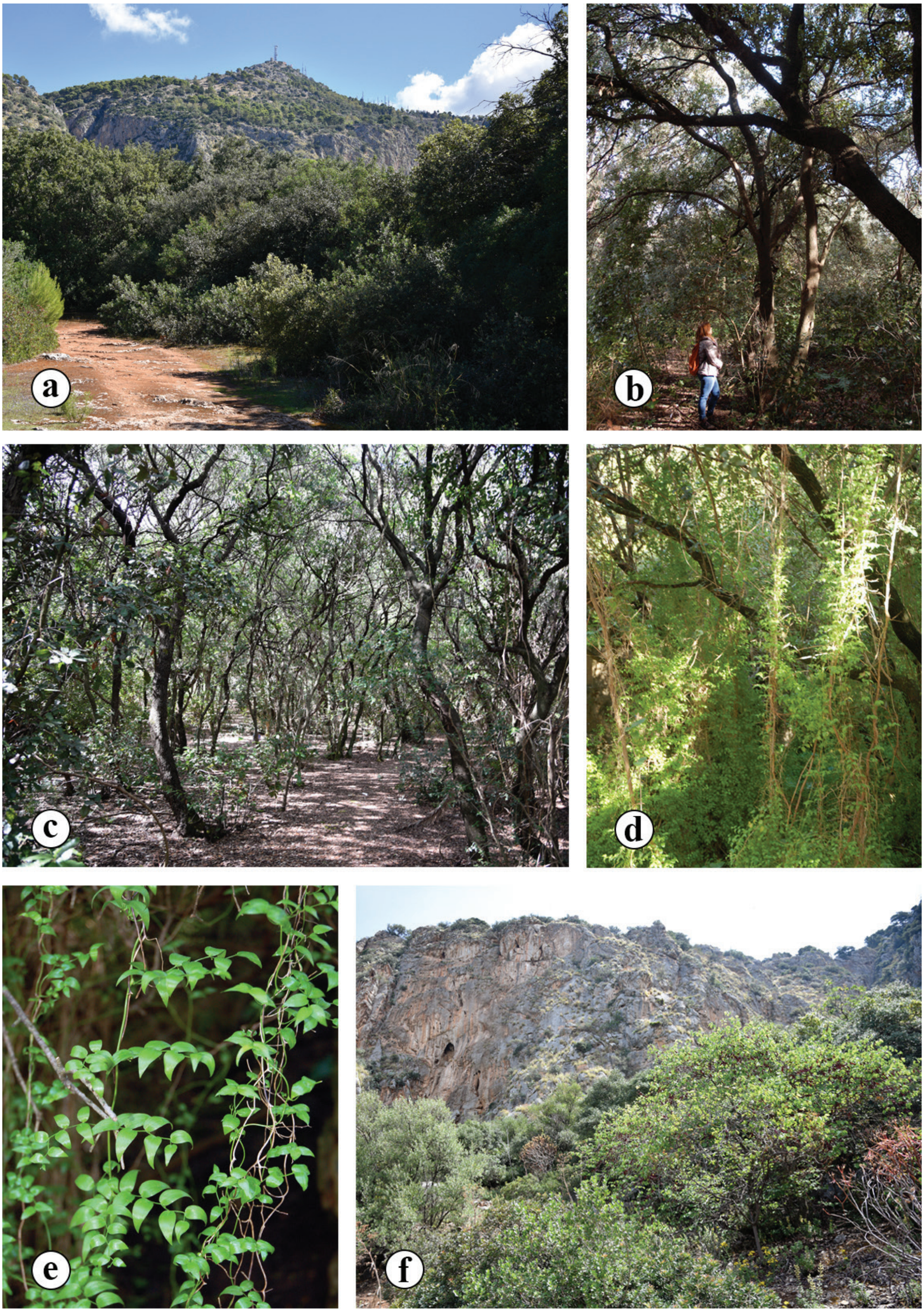

Figure 7. (**a**) Maquis forest of the *Viburno tini-Phillyreetum latifoliae* ass. nova on the calcarenitic substrates of the Favorita Park; (**b**) monumental specimens of *Phillyrea latifolia* in the oldest aspects of the maquis; (**c**) the high naturalness is clearly evident in the undergrowth of *Viburno tini-Phillyreetum latifoliae* ass. nova; (**d**), (**e**) another aspect of the *Phillyrea latifolia* maquis in the *Asparagus asparagoides* variant; (**f**) vegetation of the *Ruto chalepensis-Oleetum sylvestris* subass. *cercidetosum siliquastri*, typical community of the detrital cones of Mt. Pellegrino.

by the holm oak grove of *Pistacio lentisci-Quercetum ilicis* subass. *viburnetosum tini*. These soils are classified as (2) Eutric Arenosol (Chromic) (IUSS WG WRB 2022).

Bioclimate. Mediterranean pluviseasonal oceanic thermomediterranean thermotype and dry-subhumid ombrotype.

Syntaxonomic notes. *Phillyrea latifolia* is distributed in North-Mediterranean and Balkan countries, from southern Portugal to Bulgaria, Greece, and the Aegean islands; it also grows in North Africa (Libya to Morocco) and the Near East, from Anatolia to Syria, Lebanon, Israel, and Jordan (Browicz 1984). In Italy, this species is widespread in almost all regions, but more commonly in the centre-south of the peninsula and islands. It grows more frequently as a sporadic species, rarely playing a dominant role; it participates in aspects of Mediterranean scrub and thermophilous shrublands, but also in the establishment of oak groves and evergreen woods (Brullo et al. 2009). In the central plateau of Morocco (Barbero et al. 1981) for example, is part of thermophilous wild olive forests pertaining to the association *Phillyreo latifoliae-Oleetum sylvestris* Quézel, Barbero, Benabid, Loisel et Rivas-Martínez ex Gianguzzi et Bazan 2020 (Barbero and Quézel 1976; Barbero et al. 1981; Quézel et al. 1988; Gianguzzi and Bazan 2020b), while in Algeria it is found in formations with *Quercus canariensis* (Aimé et al. 1986). In the Iberian Peninsula, it takes part in oak forests of various types (*Quercus ilex*, *Q. coccifera*, *Q. faginea* and *Q. broteroi*) and other mesophilous formations (Costa Tenorio et al. 1997), but also in aspects of Mediterranean scrub.

For example, the *Phillyreo latifoliae-Arbutetum unedonis* (Velasco 1983) Loidi, Herrera, Olano et Silván 1994 association is described along the northern Cantabrian coast, differentiated with the subass. *typicum* and *viburnetosum tini* (Loidi et al. 1994); the first is widespread towards the sea, the second further inland. Another scrub community is also indicated for the Costa Smeralda, in the north-east of France, pertaining to *Hedero helicis-Phillyreetum latifoliae* (Géhu 2007).

On the island of Menorca (Balearic Islands) the species is present with the endemic variety *rodriguezii* (P. Monts.) O. Bolòs et Vigo, which dominates a shrubby community described as *Aro picti-Phillyreetum rodriguezii* (Bolòs et al. 1970). *Phillyrea latifolia* is also widespread in Sardinia, where it is also present in mesophilous woods with *Taxus baccata* (Bacchetta et al. 2009; Farris et al. 2012), as well as in Corsica, where it marks aspects of scrub related to *Erico arboreae-Arbutetum unedonis* subass. *phillyreetosum latifoliae* (Allier and Lacoste 1980). In Italy, it is indicated as an element of the scrub but also of the undergrowth of formations mixed with *Quercus ilex* and *Q. suber*, as in the southern part of Lazio (Blasi et al. 1997); is also present in the *Carpinus orientalis* Mill. community of the *Lonicero etruscae-Carpinetum orientalis phillyreetosum latifoliae* (Blasi et al. 2001). In the Apulian region, it is present in the *Phillyreo latifoliae-Calicotometum infestae* (Di Pietro and Misano 2010), in very intricate shrublands dominated by *Calicotome infesta*, widespread in the Gravina of Laterza area. *Phillyrea latifolia* è also widespread in the eastern part of the Mediterranean region, associated with *Quercus coccifera*, as in the Balkan area (Horvat et al. 1974; Trinajstić 1995) and also in Greece (here described as *Querco cocciferae-Phillyreetum mediae*; Barbero and Quézel 1976). Other communities characterized by the species are also reported in Turkey, such as *Phillyreo latifoliae-Pinetum brutiae* (Ozyigit et al. 2015) and *Pistacio-Phillyreetum latifoliae* (Özen and Kılınç 1995); the latter is probably a geovicariant association.

The *Phillyrea latifolia* maquis located on the calcarenitic substrates of the Palermo Plain is described as *Viburno tini-Phillyreetum latifoliae* Gianguzzi et Caldarella ass. nova hoc loco (Table 5, rel. 1–4; Fig. 7a–c), differentiated also an anthropogenic variant wich *Asparagus asparagoides* (Table 5, rel. 5–12; Fig. 7d, e). It is a climbing species of South African origin, naturalized as far back as historic record in this area (Tropea 1907) and in other locations in Sicily (Giardina et al. 2007). It constitutes a recovery maquis, that is open and more nitrophilous, linked to areas exposed to humid northern winds coming from the Gulf of Mondello.

The synoptic table reported in Appendix 1: Table A2 compares the floristic composition of the two associations dominated by *Phillyrea latifolia* that are presented in this paper [the one (*Viburno tini-Phillyreetum latifoliae* ass. nova) and the *Teucrio flavi-Phillyreetum latifoliae* ass. nova (which will be discussed later)] with the other scrub formations of the *Oleo-Ceratonion* alliance previously observed for Sicily. These are the first associations dominated by *Phillyrea latifolia* that are described in the regional territory. It can be noted that among all the Sicilian associations, the *Viburno tini-Phillyreetum latifoliae* ass. nova records a floristic composition with the lowest average number of species (equal to 12.6 per relevé); this data is also to be related with the old-growth nuclei forest present in this site and the notable environmental integrity of the community.

Vegetation series. The forest formation constitutes the best structured aspect of the "Edapho-xerophilous series north-western Sicilian, dry thermomediterranean, calcarenitic of *Phillyrea latifolia* (with *Viburnum tinus* and *Arbutus unedo*)": *Viburno tini-Phillyreo latifoliae* sigmetum. This environmental landscape unit follows the series of *Pistacio lentisci-Querco ilicis viburnetosum tini* sigmetum, occupying the more xeric and external sandy soils of the Palermo Plain, placed closer to the colluvial substrates. Along the slopes of Mt. Pellegrino, it in turn leaves room for the series of wild olive trees (*Ruto chalepensis-Oleo sylvestri cercidetosum siliquastri* sigmetum).

Synchorology. The *Viburno tini-Phillyreetum latifoliae* ass. nova constitutes a community of relict maquis, potentially linked to the coastal calcarenites of the western sector of Sicily; however, it is only known in these small areas of the Palermo Plain, having been almost destroyed by man for the benefit of cultivation and urban development.

Eunis code. F5.51A (*Phillyrea* thickets). *Natura 2000 code* – 5330 (Thermo-Mediterranean and pre-desert scrub).

Number of nuclei and total coverage (in ha). 9 nuclei (for 9,32 ha of coverage).

***Ruto chalepensis-Oleetum sylvestris* subass. *cercidetosum siliquastri* Gianguzzi et Bazan 2020**

Holotypus. Rel. 15, table S1 in Gianguzzi and Bazan 2020a.

Phytosociological data. Table 6.

Syntaxonomic notes. Scientific contributions to the phytosociological characterization of communities of *Olea europaea* var. *sylvestris* have recently been produced for Sicily (Gianguzzi and Bazan 2020a) and the Mediterranean Region (Gianguzzi and Bazan 2020b), where these forest formations show notable climacic potential in the more xeric bioclimatic belts. In Sicily, they are often represented with small nuclei and a fragmentary distribution (Gianguzzi et al. 2020; Bazan et al. 2021; Guarino et al. 2021; Rivieccio et al. 2020, 2021; Tavilla et al. 2021), as a result of deforestation and anthropic transformations. The *Ruto chalepensis-Oleetum sylvestris* association is described for the regional area of Sicily (Gianguzzi and Bazan 2020a), limited to basiphilous substrates (limestones, marl, calcarenites, etc.) and differentiated into various sub-associations. The subassociation *cercidetosum siliquastri* has been indicated for the xeric detrital slopes of the carbonate reliefs (limestone and dolomite) of north-western Sicily, between Palermo and Trapani (Gianguzzi et al. 2012a).

Table 6. *Ruto chalepensis-Oleetum sylvestris* subass. *cercidetosum siliquastri* [Column 1: synoptic table (from Gianguzzi and Bazan 2020a, table S1, rels. 13–16); Col. 2: rel. 1, near Bosco Vecchio (1.6.2023, L. Gianguzzi and O. Caldarella)].

	Column (n°)	1	2
Life form	Relevé number	-	1
	Altitude (m a.s.l.)	-	150
	Slope (%)	-	30
	Aspect	-	W
	Area (m²)	-	100
	Total cover (%)	-	90
	Tree cover (%)	-	100
	Herb cover (%)	-	40
	Average tree height (m)	-	3,2
	No. of species per relevé	-	21
	Char. and diff. of association and subass. *oleetosum sylvestris*		
P caesp	*Olea europaea* L. var. *sylvestris* (Mill.) Lehr	4	5
P caesp	*Euphorbia dendroides* L	4	3
Ch suffr	*Ruta chalepensis* L.	4	+
P caesp	*Pistacia terebinthus* L.	3	2
	Diff. subass. *cercidetosum siliquastri*		
P scap	*Cercis siliquastrum* L.	4	2
H caesp	*Cenchrus setaceus* (Forssk.) Chiov.	4	1
	Char. of alliance and order		
Ch frut	*Teucrium flavum* L.	4	2
P lian	*Clematis cirrhosa* L.	4	1
Ch frut	*Stachys major* (L.) Bartolucci & Peruzzi	4	+
Ch frut	*Asparagus albus* L.	3	1
G bulb	*Allium subhirsutum* L.	4	+
P caesp	*Pistacia lentiscus* L.	2	3
P caesp	*Anagyris foetida* L.	2	.
P caesp	*Ceratonia siliqua* L.	1	.
	Char. of class		
G rhiz	*Smilax aspera* L.	4	1
P caesp	*Phillyrea latifolia* L.	4	1
G rhiz	*Asparagus acutifolius* L.	3	+
G rhiz	*Arisarum vulgare* O.Targ.Tozz.	4	+
P caesp	*Rhamnus alaternus* L.	3	+
P lian	*Rubia peregrina* L.	3	.
P succ	*Opuntia ficus-indica* (L.) Mill.	.	1
	Other species		
H scap	*Acanthus mollis* L.	4	1
G bulb	*Oxalis pes-caprae* L.	4	1
H scap	*Ferula communis* L.	2	+
H caesp	*Oloptum miliaceum* (L.) Röser & H.R.Hamasha	2	.
G rhiz	*Asphodelus ramosus* L.	2	.
H caesp	*Hyparrhenia hirta* (L.) Stapf subsp. *hirta*	2	.
H scap	*Bituminaria bituminosa* (L.) E.H.Stirt.	2	.
Ch suffr	*Centranthus ruber* (L.) DC. subsp. *ruber*	1	.
H scap	*Thapsia garganica* L. subsp. *garganica*	1	.

Diagnostic species. *Olea europaea* var. *sylvestris* (dom.), *Euphorbia dendroides*, *Ruta chalepensis*, *Pistacia terebinthus*, *Cercis siliquastrum*, *Cenchrus setaceus*.

Short description. Dense scrub-forest, clearly dominated by *Olea europaea* var. *sylvestris*, (3–)5–6 m high (potentially even over 12–15 m), linked to detrital-clastic slopes and with a variable bi- or tri-stratified structure. Various thermophilous species of the order *Pistacio-Rhamnetalia alaterni* are associated with it and of the *Oleo-Ceratonion siliquae* alliance, such as *Euphorbia dendroides*, *Pistacia terebinthus*, *Ruta chalepensis*, *Cercis siliquastrum* [tree native to south-eastern Europe and Asia Minor, common in central Italy but rarer in Sicily (Gianguzzi and Bazan 2020a)] and *Cenchrus setaceus* [invasive and sub-cosmopolitan species of subtropical origin, now widely naturalized on the island, where it shows a highly competitive pioneer character compared to other thermophilous perennial grasses (Gianguzzi et al. 1996; Pasta et al. 2010). The community is found along the western slope of Mt. Pellegrino, at altitudes between approximately 80–100 and 300–350 m a.s.l., in markedly xeric and sunny localities, with exposure to the south and southwest (Fig. 7f).

Substrate/parent material and soil. Forest formation is linked to detrital cones and detrital-clastic materials in sunny and xeric sites, along the slopes of Mt. Pellegrino. These soils are classified as Skeletic Regosol (Ochric) (IUSS WG WRB 2022).

Bioclimate. Mediterranean pluviseasonal oceanic thermomediterranean thermotype, dry-subhumid ombrotype (Gianguzzi et al. 1996, 2015, 2016b; Gianguzzi and La Mantia 2000).

Vegetation series. The forest formation constitutes the best structured aspect of the "Edapho-xerophilous and heliophilous series north-western Sicilian, dry thermomediterranean, colluvial (calcareous-dolomitic) of *Olea europaea* var. *sylvestris* (with *Euphorbia dendroides* and *Cercis siliquastrum*)": *Ruto chalepensis-Oleo sylvestris cercidetosum siliquastri* sigmetum. The secondary aspects mainly consist of shrub vegetation of *Euphorbia dendroides* [*Rhamno alaterni-Euphorbietum dendroidis* Géhu et Biondi 1997 subass. *euphorbietosum bivonae* (Gianguzzi, Ilardi et Raimondo 1996) Gianguzzi, Cuttonaro, Cusimano et Romano 1996], grassland vegetation with *Cenchrus setaceus* (*Penniseto setacei-Hyparrhenietum hirtae* Gianguzzi, Ilardi et Raimondo 1996) and therophytic meadows of the class *Trachynietea distachiae* (e.g. *Thero-Sedetum caerulei* Brullo 1975). In fact, compared with the other forest formations represented in the survey area, the *Ruto chalepensis-Oleetum sylvestris* subass. *cercidetosum siliquastri* are generally more isolated and less extensive. This is because these xeric slopes are mainly reforested with conifers, apart from small plots that have been historically used for dry crops (olive groves, carob groves, almond groves, prickly pear groves, etc.). Crop abandonment and recent fires have partly favoured the *Cenchrus setaceus* prairie (*Penniseto setacei-Hyparrenietum hirtae*), in addition to the evolution of the serial mosaic mentioned previously.

Near the rocky walls, the series comes into catenal contact with the *microgeosigmetum* of the cliffs, dominated by the chasmophytic vegetation of the *Scabioso creticae-Centauretum ucriae* Brullo et Marcenò 1979, partly altered by the invasiveness of *Opuntia ficus-indica*. In the shaded part of the debris slopes, in the north/north-west exposures, the sigmetum is replaced by the ombrophilous series of *Phillyrea latifolia*, belonging to the scrub of *Teucrio flavi-Phillyreetum latifoliae* ass. nova, described in the following paragraph.

Synchorology. North-western Sicily: Mt. Pellegrino (Palermo) and Mt. Sparacio (Trapani) (Gianguzzi and Bazan 2020a).

Eunis code. G2.41 (Wild *Olea europaea* woodland). *Natura 2000 code* – 9320 (*Olea* and *Ceratonia* forests).

Number of nuclei and total coverage (in ha). 6 nuclei (for 1,52 ha of coverage).

Teucrio flavi-Phillyreetum latifoliae Gianguzzi et Caldarella ass. nova *hoc loco*

Holotypus. Rel. 9, Table 7.

Phytosociological data. Table 7, Appendix 1: Table A2 (column 24).

Table 7. *Teucrio flavi-Phillyreetum latfoliae* Gianguzzi et Caldarella ass. nova: rel. 1, Vallone del Porco (28.12.2016, L. Gianguzzi); rels. 2–5, above the racecourse (10.11.2012, L. Gianguzzi); rel. 6, near Roccia dello Schiavo (8.5.2015, L. Gianguzzi; rels. 7–10, near Roccia dello Schiavo (1.6.2023, L. Gianguzzi). Asterisk indicates the type relevé.

Life form												Presence	Frequency
	Relevé number	1	2	3	4	5	6	7	8	9*	10		
	Altitude (m a.s.l.)	150	100	110	120	200	90	100	120	150	150		
	Slope (%)	40	55	50	50	50	15	35	35	35	30		
	Aspect	NW	NW	NW	NW	NW	NW	W	NW	NW	W		
	Area (m²)	150	200	150	150	150	100	100	100	100	100		
	Total cover (%)	100	95	100	100	100	100	95	100	100	100		
	Tree cover (%)	100	80	80	100	100	100	100	100	100	100		
	Herb cover (%)	20	80	80	20	20	20	10	10	10	10		
	Average tree height (m)	3.5	3.8	4.0	4.0	4.0	3.2	3.2	4.0	4.0	5.5		
	No. of species per relevé	15	15	14	17	18	13	16	14	13	14		
	Char. and diff. of assoc.												
P caesp	*Phillyrea latifolia* L.	4	5	5	5	5	5	5	5	5	5	10	V
P caesp	*Pistacia terebinthus* L.	2	2	2	2	2	2	2	2	1	2	10	V
Ch frut	*Teucrium flavum* L.	3	1	2	2	+	+	1	2	3	+	10	V
P caesp	*Euphorbia dendroides* L.	2	1	2	1	1	.	+	1	+	1	9	V
P caesp	*Olea europaea* L. var. *sylvestris* (Mill.) Lehr	1	2	1	1	.	2	1	.	1	2	8	IV
	Char. all. *Oleo-Ceratonion* and ord. *Pistacio-Rhamnetalia alaterni*												
P caesp	*Pistacia lentiscus* L.	+	1	2	2	3	3	2	3	3	4	10	V
P lian	*Clematis cirrhosa* L.	.	2	+	+	+	2	1	1	1	2	9	V
Ch suffr	*Stachys major* (L.) Bartolucci & Peruzzi	.	.	.	+	+	.	+	+	+	+	6	III
P caesp	*Ceratonia siliqua* L.	.	2	1	1	.	.	1	.	.	1	5	III
Ch frut	*Asparagus albus* L.	1	.	.	.	+	.	.	.	.	.	2	I
P caesp	*Rhamnus alaternus* L.	3	.	.	.	.	.	.	.	.	.	1	I
	Char. cl. *Quercetea ilicis*												
G rhiz	*Smilax aspera* L.	2	1	1	.	1	1	2	2	1	2	9	V
G rhiz	*Arisarum vulgare* O.Targ.Tozz.	1	2	2	2	2	+	+	+	.	.	8	IV
P lian	*Rubia peregrina* L.	1	+	.	+	+	2	+	.	+	.	7	IV
G rhiz	*Asparagus acutifolius* L.	+	.	.	+	+	1	.	1	.	2	6	III
P scap	*Quercus ilex* L.	.	2	.	1	1	.	2	.	.	.	4	II
G bulb	*Allium subhirsutm* L.	.	.	.	.	1	+	+	.	.	.	3	II
Ch suffr	*Ruta chalepensis* L.	1	.	.	.	+	.	.	.	.	.	2	I
G rad	*Dioscorea communis* (L.) Caddick & Wilkin	+	.	.	.	.	.	.	.	.	.	1	I
NP	*Rosa sempervirens* L.	.	.	.	.	.	.	.	.	.	+	1	I
	Other species												
H scap	*Acanthus mollis* L.	5	3	3	3	2	3	2	2	1	1	10	V
G bulb	*Biarum tenuifolium* (L.) Schott	.	.	+	+	+	.	+	1	.	.	5	III
G bulb	*Oxalis pes-caprae* L.	2	1	2	+	.	.	.	.	.	.	4	II
T scap	*Mercurialis annua* L.	.	1	+	+	.	+	.	.	.	.	4	II
G bulb	*Umbilicus horizontalis* (Guss.) DC.	.	.	.	.	.	.	.	+	+	+	3	II
H caesp	*Oloptum miliaceum* (L.) Röser & H.R.Hamasha	.	.	.	.	+	.	.	.	.	.	1	I
H ros	*Asplenium ceterach* L.	.	.	.	.	.	.	.	+	.	.	1	I
G bulb	*Squilla maritima* (L.) Steinh.	.	.	.	.	.	.	.	.	+	.	1	I

Diagnostic species. *Phillyrea latifolia* (dom.), *Pistacia terebinthus*, *Teucrium flavum*, *Euphorbia dendroides* and *Olea europaea* var. *sylvestris*.

Short description. Dense, intricate, and impenetrable scrub, clearly dominated by *Phillyrea latifolia*, 3–5 (6) m high, frequently associated with *Pistacia terebinthus*, *Euphorbia dendroides*, and *Olea europaea* var. *sylvestris*, precisely indicated as diagnostic of the characteristic combination of the community, together with *Teucrium flavum*, a lithophilous-glareicola fruticose species, also common in the undergrowth (Fig. 8a–c). Compared with the other association with *Phillyrea latifolia* previously described for calcarenites of the Palermo Plain (*Viburno tini-Phillyreetum latifoliae* ass. nova), *Viburnum tinus* and *Arbutus unedo* are also absent. The herbaceous layer is mainly composed of rhizomatous and bulbous plants, such as *Acanthus mollis*, *Arisarum vulgare* and *Allium subhirsutum*.

Substrate/parent material and soil. The community is linked to detrital-clastic materials along the slopes of Mt. Pellegrino; however, it prefers shady, ventilated, and fresh sites exposed to the north/north-west, subjected to humid currents coming from the Gulf of Mondello. The parent materials belong to the Quaternary complex of Western Sicily, a calcarenitic-sandy-silty complex (Palermo Calcarenites) with mainly lithoid clasts, composed of calcite and siliceous rocks fragments and monocrystalline quartz (sparitic grains and small amounts of bioclasts). These soils are classified as Skeletic Regosol (Ochric) (IUSS WG WRB 2022).

Bioclimate. Mediterranean pluviseasonal oceanic (thermomediterranean thermotype and dry-subhumid ombrotype).

Vegetation series. The forest formation constitutes the best structured aspect of the "Edapho-xerophilous and ombrophilous series north-western Sicilian, thermomediterranean from dry to subhumid, colluvial (calcareous-dolomitic) of *Phillyrea latifolia* (with *Pistacia terebinthus* and *Teucrium flavum*)": *Teucrio flavi-Phillyreo latifoliae* sigmetum). In the sunniest xeric parts of the slopes of Mt. Pellegrino landscape unit, it is replaced by the wild olive series (*Ruto chalepensis-Oleo sylvestris* subass. *cercidetosum siliquastri* sigmetum), while upwards it connects the microgeotype of the cliffs, mainly characterized by the chasmophytic vegetation of the *Scabioso creticae-Centauretum ucriae* association.

Synchorology. Known for Mt. Pellegrino, but probably also present in other locations in the Palermo Mts.

Eunis code. F5.51A (*Phillyrea* thickets).

Natura 2000 code. 5330 (Thermo-Mediterranean and pre-desert scrub).

Number of nuclei and total coverage (in ha). 2 nuclei (for 3,20 ha of coverage).

Old or "monumental" trees and shrubs

Old trees are declining in forests around the world (Lindenmayer et al. 2012) because of the consumption of natural resources which, also threatens their survival (Rigoni Stern 1990). They significantly impact the biodiversity of an area and are gaining increasing attention as indicators of sustainable forest management (e.g. Forest Europe 2015). In fact, once silvicultural maturity has been reached, centenarian trees contribute to increasing the ecological value of ecosystems, because of an increase in biomass (variable depending on the age, size, and environmental conditions of the sites), and the development of a diversified range of microhabitats. This is reflected in the species of flora and fauna (at various levels), with an important contribution also made to the conservation of saproxylic species (Siitonen and Ranius 2015).

Our first census of these old or "monumental" trees growing in the study area was carried out on 48 specimen concentrated on a relatively small surface (Fig. 2), whose data are summarized in Appendix 1: Table A3.

Among these surveyed old specimens, the following deserve particular mention: a) the "monumental" *Olea europaea* var. *europaea* specimen, with a maximum trunk circumference of 11.10 m (at the stump) and 8.18 m (at breast height) (Fig. 8e); whose estimated age is about 1,000 years-old (Schicchi and Raimondo 2007); b) some *Quercus ilex* specimens that are 12–15 m tall, with a maximum circumference varying between 4.5 and 5.3 m (at the stump) and of 2–3 m (at the breast height); c) some *Phillyrea latifolia* specimen, that are over 15 m tall, with maximum circumference of about 3 m (at the stump) and 1 m (at breast height) with these measurements being quite unusual for this species); d) the *Pistacia terebinthus* specimen that is about 13 m tall, with a maximum circumference over 3 m (at the stump) and about 1 m (main branch at the breast height); e) some *Arbutus unedo* specimen that are between 6.5 and 8 m tall, with a maximum circumference between 1.95 and 2.95 m (at the stump) and up to 0.72 m (main branch at breast height); f) an over 200 year-old specimen of *Pistacia lentiscus*, with a maximum circumference of 2.25 m (at the stump).

Rare vascular plants

In addition to some rare species of vascular flora, there are also other species of bryophytes, lichens, and mushrooms, in Sicily that have also exclusively been recognized in this area and/or in just a few other locations, further demonstrating the important conservation role of the site and the forest formations investigated.

Viburnum tinus

Small thermophilic shrub, forming part – together with other species, such as *Coriaria myrtifolia* L., *Arbutus unedo*, and *Phillyrea latifolia* – of what is known as the "paleo-Mediterranean" element, typical of past eras with a subtropical climate (Ladero Álvarez 1976; Domínguez and Martínez 1993). It has a fragmentary and relict distribution throughout the indigenous area (Pignatti

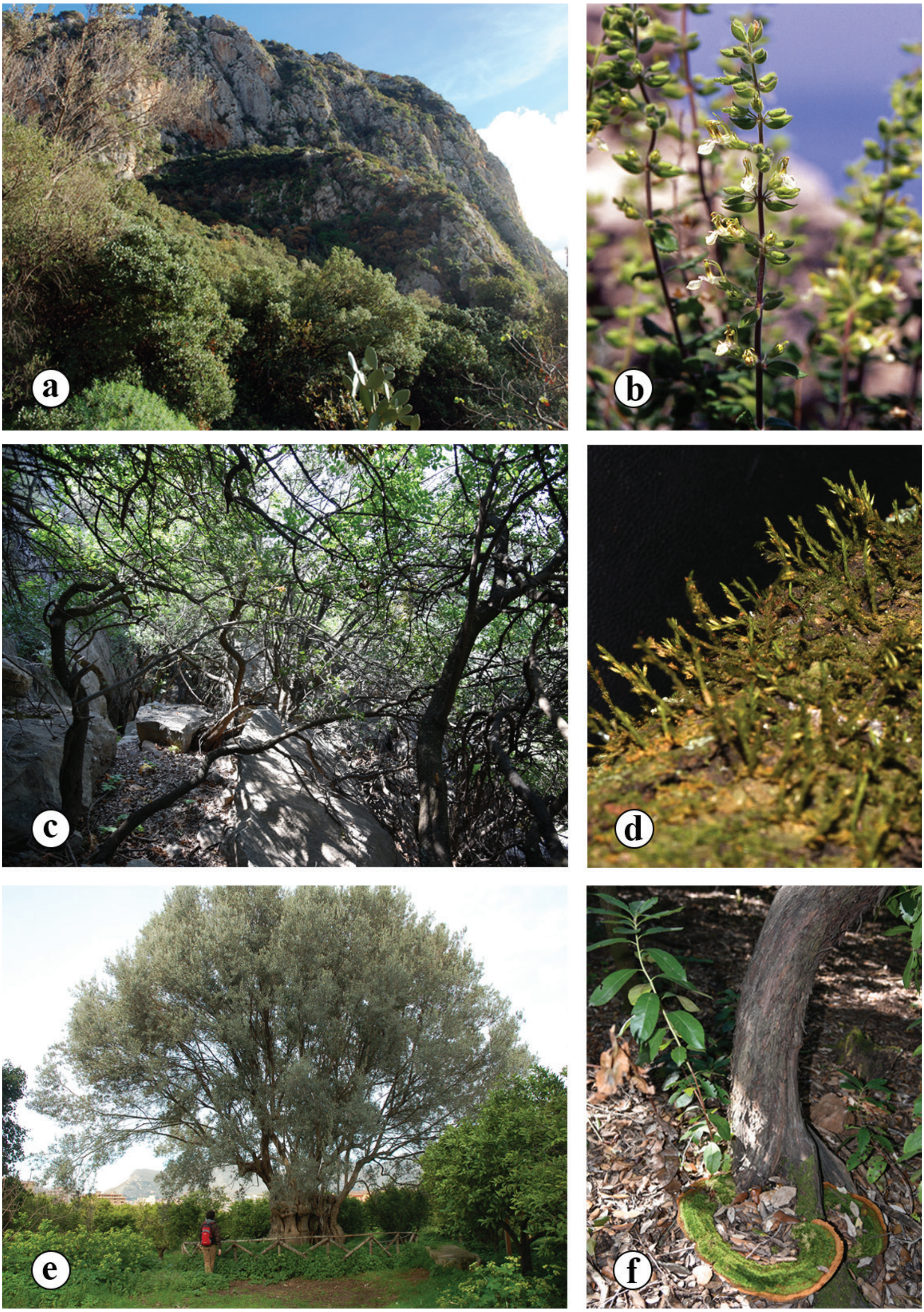

Figure 8. (**a**) *Teucrium flavum*, typical element of cliffs and stony slopes, characteristic of the *Teucrio flavi-Phillyreetum latifoliae* ass. nova; (**b**), (**c**) aspects of the *Teucrio flavi-Phillyreetum latifoliae* ass. nova, ombrophilous community along the detrital slopes of Mt. Pellegrino; (**d**) *Cryphaea heteromalla* very rare species in Sicily, found in the Bosco Niscemi, on the trunks of *Quercus ilex*; (**e**) multi-centennial specimen of *Olea europaea* var. *europaea* in the Favorita Park; (**f**) *Fuscoporia torulosa* (Pers.) T.Wagner & M.Fisch. wood rot species on *Arbutus unedo* stump.

1982; Karlson et al. 2005) and is also quite rare in Sicily. In addition to this area (Brullo and Marcenò 1985; Gianguzzi et al. 1996), it is also reported in the following other locations: a) above the Rotoli Cemetery, near Palermo (Gianguzzi et al. 1996); b) Sicani Mts. [Sibilla coast (Bazan et al. 2007), Santa Maria del Bosco, Cozzo Danesi, Bosco di Santo Adriano, northern slope of Mt. Gristia (Gianguzzi et al. 2016a)]; c) Madonie Mts. (Gianguzzi and Bazan 2017) in Gibilmanna; d) Mt. San Giuliano (Pasta and La Mantia 2021); e) Mt. Conca (Pasta and La Mantia 2021); f) Mt. Etna (Brullo et al. 2009).

Arbutus unedo

Species with a circum-Mediterranean distribution that extends as far as the Atlantic, where it reaches Ireland; it is also present in the Canary Islands. In Sicily, it grows between 50 and 1,050 m a.s.l., with optimum levels between 300–400 and 700–900 m a.s.l. (Sparacio et al. 2022), preferring siliceous or decarbonated substrates. It is sometimes also found as an element of the garrigue (Gianguzzi et al. 2016b), although it is more frequent in maquis scrubland (Costanzo et al. 1998; Gianguzzi 1999; Brullo et al. 2003), evergreen oak forests (*Quercus suber* and *Q. ilex*; Brullo et al. 2009), or even pine forests of *Pinus pinea* (Brullo et al. 2003), *P. halepensis* (Brullo et al. 2009), and *P. pinaster* subsp. *escarena* (Gianguzzi 1999). *Arbutus unedo* is quite widespread along the Tyrrhenian slopes of the Peloritani (on metamorphites), the Nebrodi (on sandstones, between Caronia and Tusa) and the Madonie Mts. (between Castelbuono, Pollina, Cefalù and Gratteri, also on sandstones), including the volcanic islands of the Aeolian Archipelago (apart from Vulcano and Stromboli). However, in the western sector of Sicily, it becomes very rare, and is generally associated with relict localities: a) Bosco Niscemi, in the Palermo Plain (on calcarenites; Figs 6c, 8f); b) coastal limestone-dolomite reliefs battered by humid marine winds (in sites exposed to the north and sheltered from fires), such as Mt. Gallo (M. S. Margherita; unpublished data), Mt. Cofano (Gianguzzi and La Mantia 2008), and Marettimo Island (Mt. Campana; Brullo et al. 2009; Gianguzzi et al. 2006, 2023); c) arenaceous outcrops, such as near Cozzo Secco (Borgetto, province of Palermo; Gianguzzi et al. 2008), Bosco Gaggera (Calatafimi, province of Trapani; Gianguzzi and Bazan, in Rivieccio et al. 2022), and Bosco Scorace (Buseto Palizzolo, province of Trapani; Scuderi et al. 1994). It reappears, always sporadically, in the plains of south-western Sicily between Marsala and Sciacca, on the internal hills of Agrigento, Caltanissetta, and Enna, and is more common in isolated areas of the Sicani Mts. and the Iblean sector (Sparacio et al. 2022).

Other rare vascular plants

Among the other rarities that stand out in the floristic entourage of the communities, the following should also be mentioned: a) *Cistus salviifolius*, a typical species of acidophilic/calcifugal submontane hilly garrigues (Gianguzzi et al. 2015), which is currently very rare in the Palermo Plain (only a few sporadic individuals have been detected); b) *Limodorum abortivum*, an uncommon and localized entity, that had already been identified in the territory, but could no longer be confirmed in recent times (Künkele and Lorenz 1995; Raimondo et al. 1996); c) *Acis autumnalis*, also typical of garrigues, uncommon (La Rosa et al. 2021).

Bryophytes

Bryophytes also play an important role within old-growth forests (Campisi et al. 2020). Investigations carried out in the Bosco Niscemi have led to the discovery of species that are typical of Mediterranean woods, some of which are quite rare. This is the case of *Cryphaea heteromalla* (Hedw.) D.Mohr – which has been identified in Sicily so far in very few other residual localities – in addition to *Hypnum cupressiforme* Hedw. and *Leptodon smithii* (Hedw.) Weber & D.Mohr, which have also never previously been found at such low altitudes and in contexts so close to the urban environment.

***Cryphaea heteromalla* (Hedw.) D.Mohr**

This is a suboceanic-Mediterranean epiphytic species of the *Cryphaeaceae* Schimp., sensitive to air pollution (Dierßen 2001), and indicated in regression for some European areas (Sérgio et al. 1994). In Sicily, it is quite rare; so far it has only been recognized in only three other localities, all of which are at high altitudes. Two of them are located on isolated reliefs in the north-western sector, specifically Mt. Bonifato (Alcamo) and Mt. San Giuliano (Erice), both on artificially planted conifer populations; the third concerns the island of Pantelleria (Raimondo and Dia 1980; Raimondo et al. 1981), on natural woodland formations (Lo Giudice 1991; Gianguzzi 1999). A small population had also been reported for the Palermo Mts. (Dia et al. 2000), however this can no longer be confirmed, following recent devastating fires. Therefore, its discovery in the Bosco Niscemi, on the trunks of *Phillyrea latifolia*, constitutes an interesting confirmation of this species for northern Sicily (Fig. 8d).

Lichens

References on the lichenological component relating to the investigation area are lacking, apart from a study by Giovenco et al. (1996) on epiphytic lichens as biomonitors of air pollution in the urban area of Palermo. Our recent sampling within the forest nuclei of the Bosco Niscemi also confirmed the important role of the cryptogamic component. Some of the lichens present with greater frequency and coverage values include *Parmotrema perlatum* (Huds.) M. Choisy, *Punctelia subrudecta* (Nyl.) Krog., and *Ramalina canariensis* J. Steiner., which are generally quite common in the Mediterranean area. The presence of species of conservation interest was also detected (according to Nimis 2024), including *Bacidia rosella* (Pers.) De Not., as well as the epiphytic *Gyalecta derivata* (Nyl.) H.Olivier, *Ramalina roesleri* (Schaer.) Nil. and *Waynea stoechadiana* (Abbassi Maaf & Cl.Roux) Cl.Roux & P.Clerc.

***Bacidia rosella* (Pers.) De Not.**

It is a nemoral species, rare globally, with wide distribution in Europe and northern Africa, in areas with a mild temperate to Mediterranean-Atlantic climate. It is indicated as rapidly declining in most of its distribution area, and indeed reported in "Red Lists" for many countries, such as Austria, Denmark, Germany, Norway, Sweden, and Switzerland. In Italy, it has been found in open and humid woods, even in riparian ecosystems, localized on deciduous trees (especially of the *Acer* and *Fraxinus* genera), but also evergreens, such as *Quercus ilex*. It is listed as "possibly extinct" in much of northern Italy as well as "locally abundant" in suitable habitats in southern Italy. It is included in the "Red List of Italian epiphytic lichens" as "Near threatened" (Nascimbene et al. 2013).

***Gyalecta derivata* (Nyl.) H. Olivier**

This species is widespread in Europe and northern Africa. In Italy, it is mainly widespread along the Tyrrhenian side of the Peninsula, where it is considered "very rare" (in the humid Mediterranean belt) to "extremely rare" (Nimis 2024). In Sicily, has only been identified on Marettimo Island (Nimis et al. 1994); therefore, the analysed locality represents the first report for the regional area. Similar to the previous species, it is also included in the "Red List of Italian epiphytic lichens" as "Near threatened" (Nascimbene et al. 2013).

Fungi

Mycocenological studies have demonstrated the significance of the relationships between old forest formations and fungi, with the latter providing the forest with the "pabulum" of organic substance (Barluzzi et al. 1991); in fact, important correlations, trophic and otherwise, can be hypothesized between the woody component of the same communities (trees, shrubs and lianas) and the saprotrophic, in particular lignicolous and leaf litter components. Macrofungal diversity in forest ecosystems is strongly influenced by different management practices (Tomao et al. 2020). Unmanaged forests are distinguished by the richness of wood-inhabiting fungi and indicator species. In contrast, ectomycorrhizal species are more diverse in managed stands, whereas terrestrial saprotrophs are highly diversified in both managed and unmanaged mixed forests (Dvořák et al. 2017). Specific investigations carried out on the mycological flora in the Bosco Niscemi (Venturella et al. 2001; Ferraro et al. 2022) led to the discovery of 295 taxa in the site (30 Ascomycetes and 265 Basidiomycetes), in addition to *Eichleriella leucophaea*, a very rare lignicolous entity has recently been found (Saitta 2015), which will be discussed below. The most representative families are Tricholomataceae (61 taxa), Agaricaceae (24 taxa), Russulaceae (18 taxa), and Cortinariaceae (16 taxa). The numerically richest genera are *Amanita* Pers. and *Agaricus* L. (13 taxa), *Russula* Pers. (11 taxa), and *Tricholoma* (Fr.) Staude (11 taxa). The occurrence of infrequent species such as *Trichoglossum hirsutum* (Pers.) Boud. (Geoglossaceae) and *Hydnocystis piligera* Tul. & C. Tul. (Pyronemataceae) and the rare *Typhula fistulosa* (Holmsk.) Olariaga (Typhulaceae) is noteworthy. Significant ecological adaptability of species usually found in Sicily at altitudes above 800 m, such as *Rubroboletus satanas* (Lenz) Kuan Zhao & Zhu L. Yang (Boletaceae), *Hygrophorus russula* (Schaeff. ex Fr.) Kauffman (Hygrophoraceae), *Lactarius mairei* Malençon (Russulaceae), *Phellodon niger* (Fr.) P.Karst. (Thelephoraceae), *Aureoboletus gentles* (Quél.) Pouzar (Boletaceae), and *Tricholoma acerbum* (Bull. ex Pers.) Quél. (Tricholamataceae) has been detected. Another infrequent species is *Mollisia cinerea* (Batsch) P.Karst. (Mollisiaceae), confirming its lowest presence in the most disturbed clear-cut forests. Among other taxa, *Xylaria polymorpha* (Pers.) Grev. (Xylariaceae) and *Hymenoscyphus serotinus* (Pers.) W.Phillips (Helotiaceae) are old-growth forest indicators (Schmid and Helfer 1999; Parmasto 2001).

***Eichleriella leucophaea* Bres.**

This is a species with a wide distribution, albeit very rare and fragmentary, with its only known locality so far for Sicily and Italy in the study area (Saitta 2015). In Europe, it is also reported in Spain (Dueñas 1997, 2002; Hernández-Crespo 2006; Prieto-García et al. 2010), France (Bourdot and Galzin 1928), Bulgaria (Pilát 1937), Poland (Bresadola 1903), Germany (Aron et al. 2005) and Norway (Saitta 2015), collected on dead wood of various forest species such as *Q. ilex* (Dueñas 2002).

Discussion and conclusions

Overall, within the study area (that extends for approximately 180 ha) 22 natural forest nuclei have been identified, covering a total wooded area of 32.92 hectares. The study led to the identification of four different communities, two of which are described as new associations. Along the transect that runs throughout the calcarenites of the Favorita Park in Palermo and the detrital slopes of Mt. Pellegrino, these communities are well distinguishable, both in floristic and ecological terms (Fig. 4). They are as follows: i) *Quercus ilex* forest (*Pistacio lentisci-Quercetum ilicis* Brullo et Marcenò 1985 subass. *viburnetosum tini* Gianguzzi et al. 1996), developed on humified soils of quaternary calcarenites [Solimovic Regosol (Arenic)]; ii) *Phillyrea latifolia* maquis forest with *Arbutus unedo* and *Viburnum tinus* (*Viburno tini-Phillyreetum latifoliae* ass. nova) tied to sandy and xeric soils on quaternary calcarenites [Eutric Arenosol (Chromic)]; iii) maquis of *Olea europaea* var. *sylvestris* with *Cercis siliquastrum* (*Ruto chalepensis-Oleastretum silvestri* subass. *cercidetosum siliquastri* Gianguzzi et Bazan 2020), present on detrital-clastic materials surrounding Mt. Pellegrino [Skeletic

Regosol (Ochric)]; iv) ombrophilous maquis of *Phillyrea latifolia* with *Teucrium flavum* and *Pistacia terebinthus* (*Teucrio flavi-Phillyreetum latifoliae* ass. nova), also developed on detrital-clastic materials [Skeletic Regosol (Ochric)] but located in the upper part of the shady slopes, in contact with the cliffs of Mt. Pellegrino.

The two newly described associations of *Phillyrea latifolia* maquis (positioned in the *Oleo sylvestris-Ceratonion siliquae*, cl. *Quercetea ilicis* alliance), are of syntaxonomic interest because they represent the first plant communities dominated by this species to be described for Sicily. Both these paraclimactic forest communities are linked to the thermo-Mediterranean belt; they have a rather limited distribution, constituting interesting examples of residual stands that have been destroyed elsewhere by the anthropogenic degradation of the territory.

All these ancient forest communities display an extraordinary richness in necromass, in particular in Bosco Niscemi, where the presence of dead wood and litter forms other useful habitats where bryophytic, lichen and saprophagous species can establish themselves.

The synoptic table (Appendix 1: Table A1) comparing the *Pistacio-Quercetum ilicis* subass. *viburnetosum tini* identified in the study area (column 3) with similar communities already described for Sicily, shows that the average number of species per relevé is significantly lower here (Fig. 5); the data is evidently correlated to the integrity and maturity of plant formation. This is especially the case of the Bosco Niscemi forest (Fig. 6a–f), where the low floristic richness datum is probably related to the old age of the forest stands and to the low degree of disturbance, which effectively limited the occurrence of synanthropic or alien invasive species (these latter are quite common along the outer edge of the forest, e.g., *Oxalis pes-caprae*, *Cenchrus setaceus*, etc.). Centenarian or "monumental" plants are also frequent, including small trees (e.g. *Phillyrea latifolia*, *Arbutus unedo*, *Pistacia lentiscus*, *P. terebinthus*, etc.), whose dimensions and dendrometric parameters were also found to be unusual for Sicily in some cases (see Appendix 1: Table A3).

The results of this paper demonstrate that a large part of the forest stands occurring in the Favorita Park fall almost perfectly within the definition of "old-growth forests" as defined by the Ministry of Agricultural, Food and Forestry Policies (MASAF) Guidelines, aimed at the establishment of a national network of Italian old-growth forests (Ministerial Decree of 5 april 2023 in G.U.R.I. S.G. n. 138/2023). The forest stands identified in this study area satisfy all three of the criteria established in the aforementioned guidelines, namely: 1) the presence of coherent spontaneous native species..."; 2) a characteristic biodiversity, deriving from the absence of disturbances for at least 60 years"; 3) the presence of "serial stages linked to spontaneous regeneration and senescence" identifiable both in the outer fringe of the wooded stands and in the clearings inside the woods. In particular, the "absence of disorders for at least 60 years" revealed in some sectors of the study area is surprising, especially if one considers that these sectors are next to urbanized areas. In fact, the only significant disturbance suffered by the park was caused by the construction of two important vehicle access roads connecting the city and the seaside resort of Mondello.

Indeed, some Mediterranean elements of the vascular flora present in the study area stand out because they are infrequent in western Sicily. This is, for example, the case of some woody plants, especially *Viburnum tinus* and *Arbutus unedo*, but also *Phillyrea media* (which is even present as dominant species of the forest bush, and with plants over 12–15 m tall). Other shrubs worth mentioning include *Cistus salvifolius* and *Emerus major* subsp. *emeroides*. Among herbaceous species, *Limodorum abortivum* and *Acis autumnalis* are also unusual throughout the Palermo Plain. Phytogeographically important bryophytes are also present, such as the very rare *Cryphaea heteromalla*, whose locality detected on the site is new for Sicily, *Hypnum cupressiforme* and *Leptodon smithii*, which also have never been found at such low altitudes. Lichens worth noting include *Bacidia rosella* (first record for Sicily), *Gyalecta derivata*, *Ramalina roesleri* and *Waynea stoechadiana*. The area's fungi include various saprotrophs species such as *Eichleriella leucophaea*, among others, which is the only location observed in Italy so far.

In summary, we have found a rich and varied diversity, "typical of mature forest systems", this latter being closely related to the high degree of ecosystem renewal and senescence, the degradation of dead wood, and the integrity of food chains.

For the "minimum size of the nuclei", the "Guidelines" of the aforementioned Ministerial Decree speak of "*... an area of no less than 10 hectares. For particular cases, expressly motivated by specific characteristics... down to 2 hectares, provided that the area constitutes a single ecological-stationary, functional and structural system... The Regions may also approve provisions for the identification and protection of plant formations consistent with the characteristics of old age... but which do not reach the surfaces indicated above, designating them as islands of senescence destined to increase the structural complexity and biodiversity of forest systems...*".

The main cause of global biodiversity loss is known to be habitat destruction. This survey demonstrates that a low disturbance degree, even within an area such as Palermo affected by widespread anthropization allows a high level of precious biodiversity to be maintained.

The forest stands investigated here represent the final stage of successional dynamics, what's known as the head of different "vegetation series" inside a dynamically homogeneous area ("teselas" *sensu* Rivas-Martínez 1996). This progressive evolution of the vegetation up to the "climax" was possible because: i) after the acquisition of the area by the House of Bourbon, restrictive measures were adopted for anthropic activities; ii) after the Second World War, this area developed with total disinterest on the part of the human population, and managed to avoid urbanization and building speculation (which devastated other parts of the city) as well as being transformed by agriculture or coppicing for timber.

Consequently, the forest communities identified in this study are an example of the potential forest landscape of the coastal areas of Sicily, which has almost completely disappeared throughout the whole regional territory. The most intact and interesting forest is in the "Bosco Niscemi" biotope along with the closely adjacent wooded areas, where a rather rich and peculiar biodiversity is preserved, which deserves careful protection and constant monitoring. In this regard, it would be desirable for micro-fauna diversity to also be investigated (e.g., phytophagous insects, soil microbiota, etc.).

Based on the scientific documentation produced in this paper regarding flora and vegetation, the proposal to include the investigated area among the sites of the "National Old Forest Network" recently established in Italy (Ministerial Decree of 5 april 2023) seems justified, relevant, and appropriate.

Furthermore, the Favorita site investigated here also affects the objectives referred to in the "EU Forestry Strategy for 2030 [COM (2021) 572 final]" – which has already been implemented by the Italian State – aimed at "protecting, restoring and expanding forests … to combat climate change, reverse biodiversity loss and ensure resilient and multifunctional forest ecosystems." Indeed, the planned actions include "... the scrupulous protection of the last primary and old-growth forests in the EU...", primarily acting on Natura 2000 sites, with the possibility of integrating them. The site is right next to the Special Conservation Area (SAC) ITA020014 (Mt. Pellegrino), which is well suited to be expanded to also protect these important old and residual forest nuclei, which were monitored and characterized with this present study.

Syntaxonomic scheme

QUERCETEA ILICIS Br.-Bl. in Br.-Bl., Roussine et Nègre 1952

QUERCETALIA ILICIS Br.-Bl. *ex* Molinier 1934 *em*. Rivas-Martínez 1975

Fraxino orni-Quercion ilicis Biondi, Casavecchia et Gigante in Biondi et al. 2013

Pistacio lentisci-Quercetum ilicis Brullo et Marcenò 1985 subass. *viburnetosum tini* Gianguzzi, Ilardi et Raimondo1996

PISTACIO LENTISCI-RHAMNETALIA ALATERNI Rivas-Martínez 1975

Oleo sylvestris-Ceratonion siliquae Br.-Bl. ex Guinochet et Drouineau 1944

Viburno tini-Phillyreetum latifoliae Gianguzzi et Caldarella ass. nova hoc loco

Ruto chalepensis-Oleetum sylvestris subass. *cercidetosum siliquastri* Gianguzzi et Bazan 2020

Teucrio flavi-Phillyreetum latifoliae Gianguzzi et Caldarella ass. nova hoc loco

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Appendix 1

Table A1. Simplified synoptic table of basiphilous holm oaks described for Sicily (all. *Fraxino orni-Quercion ilicis*): **1** – *Pistacio lentisci-Quercetum ilicis* subass. *typicum*, Sicilia, from Brullo and Marcenò (1985), table 2, rels. 1–5 and 8; **2** – *Pistacio lentisci-Quercetum ilicis* subass. *arbutetosum unedonis*, Sicilia, from Brullo et al. (2009), table 5a, rels. 7–11; **3** – *Pistacio lentisci-Quercetum ilicis* subass. *viburnetosum tini*, Palermo Plain, table 4; **4** – *Ampelodesmo mauritanici-Quercetum ilicis* subass. *typicum*, Sicani Mts., from Gianguzzi et al. (2016), table 9, rels. 1–8; **5** – *Ampelodesmo mauritanici-Quercetum ilicis* subass. *viburnetosum tini*, Sicani Mts., from Gianguzzi et al. (2016), table 9, rels. 9–20; **6** – *Rhamno alaterni-Quercetum ilicis* subass. *pistacietosum terebinthi*, Palermo, from Gianguzzi et al. (1996), table 6, rels. 1–12; **7** – *Doronico-Quercetum ilicis*, Iblei Mts., from Costanzo et al. (1998), table 1; **8** – *Doronico-Quercetum ilicis*, Iblei Mts., from Barbagallo et al. (1979), table 1; **9** – *Aceri campestris-Quercetum ilicis* subass. *helleboretosum intermedii*, Palermo, from Marcenò and Ottonello (1991), table 1; **10** – *Ostryo carpinifoliae-Quercetum ilicis*, Sicani Mts., from Venturella et al. (1991), table 3; **11** – *Sorbo torminalis-Quercetum ilicis*, Sicani Mts., from Gianguzzi et al. (2016), table 10, rels. 1–10.

Association number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Number of relevés	**6**	**5**	**15**	**8**	**8**	**12**	**6**	**12**	**7**	**7**	**10**
Average number of species per relevé	**23,0**	**17,0**	**15,1**	**22,5**	**23,5**	**21,6**	**28,0**	**32,5**	**25,4**	**42,5**	**25,8**
Guide species											
Quercus ilex L.	V	V	V	V	V	V	V	V	V	V	V
Char. association and subassassociation											
Pistacia lentiscus L.	V	V	V	II	II	.	.	III	.	.	.
Arbutus unedo L.	.	V	II	V	III	.	.	.	.	.	.
Viburnum tinus L.	.	.	V	.	V	.	.	.	.	.	.
Clematis cirrhosa L.	.	1	V	.	.	II	IV	.	II	.	.
Phillyrea latifolia L.	III	.	V	.	.	II	.	III	.	.	.
Ampelodesmos mauritanicus (Poir.) T.Durand & Schinz	I	II	I	V	V	IV	.	.	.	V	III
Erica multiflora L.	.	.	.	II	II	.	.	.	.	.	.
Pulicaria odora (L.) Rchb.	.	.	I	III	.	.	.	.	.	.	.
Pistacia terebinthus L.	.	.	I	II	III	V	II	III	.	.	.

Association number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Number of relevés	**6**	**5**	**15**	**8**	**8**	**12**	**6**	**12**	**7**	**7**	**10**
Average number of species per relevé	**23,0**	**17,0**	**15,1**	**22,5**	**23,5**	**21,6**	**28,0**	**32,5**	**25,4**	**42,5**	**25,8**
Rhamnus alaternus L.	.	.	II	.	.	V	III	III	.	I	.
Celtis australis L.	.	.	II	.	.	III	.	.	.	.	.
Rhus coriaria L.	.	.	.	.	.	II	.	.	.	.	.
Doronicum orientale Hoffm.	.	.	.	.	.	.	V	4	.	.	.
Scutellaria rubicunda Hornem.	.	.	.	.	.	.	III	IV	.	.	.
Aristolochia clusii Lojac.	.	.	.	.	.	.	III	III	.	.	.
Acer campestre L.	.	.	.	.	.	.	.	.	III	I	V
Ilex aquifolium L.	.	.	.	.	.	.	.	.	IV	.	.
Helleborus viridis L. subsp. *bocconei* (Ten.) Peruzzi	.	.	.	.	.	.	.	.	IV	.	.
**Ostrya carpinifolia* Scop.	.	.	.	.	.	.	.	.	II	V	.
Euphorbia meuselii Geltman	.	.	.	.	.	.	.	.	.	.	V
Sorbus torminalis (L.) Crantz	.	.	.	.	.	.	.	.	.	.	IV
Char. all. *Fraxino-Quercion ilicis* (*) and ord. *Quercetalia ilicis*											
**Dioscorea communis* (L.) Caddick &Wilkin	II	IV	II	IV	V	IV	V	V	V	IV	V
Rosa sempervirens L.	I	II	II	II	III	II	IV	III	III	III	II
Ruscus aculeatus L.	V	.	II	V	IV	II	V	V	V	V	V
**Cyclamen repandum* Sm.	I	II	.	II	III	II	IV	V	IV	III	V
**Fraxinus ornus* L.	II	.	III	V	IV	V	III	.	I	.	V
**Cyclamen hederifolium* Aiton	.	.	I	V	V	.	II	II	IV	.	II
**Cistus creticus* L. subsp. *eriocephalus* (Viv.) Greuter & Burdet	III	IV	.	II	.	.	I	II	.	.	III
Carex distachya Desf.	II	.	.	.	II	.	III	IV	.	II	II.
Viola alba Besser subsp. *dehnhardtii* (Ten.) W.Becker	.	.	.	.	I	.	V	II	IV	.	.
Paeonia mascula (L.) Mill.	.	.	.	I	III	.	.	.	III	IV	III
**Emerus major* Mill. subsp. *emeroides* (Boiss. & Spruner) Soldano & F. Conti	.	.	I	V	V	.	.	.	.	IV	.
Thalictrum calabricum Sprengel	.	.	.	.	I	.	.	.	I	III	II
**Drymochloa drymeja* (Mert. & W.D.J.Koch) Holub subsp. *exaltata* (C.Presl) Foggi & Signorini	.	.	.	I	V	.	.	.	.	.	III
Laurus nobilis L.	.	.	I	.	.	.	.	.	.	.	.
Char. Cl. *Quercetea ilicis*				.	.						.
Rubia peregrina L.	III	IV	III	III	III	V	V	V	V	V	V
Asparagus acutifolius L.	V	II	IV	V	V	V	V	V	III	V	V
Hedera helix L.	II	.	II	V	IV	II	V	IV	V	V	V
Smilax aspera L.	I	.	II	V	V	V	V	IV	II	II	III
Arisarum vulgare O. Targ.Tozz	V	V	V	III	II	V	III	II	.	.	I
Euphorbia characias L.	I	I	.	III	.	II	III	IV	II	IV	II
Allium subhirsutum L.	I	.	I	V	V	V	V	III	II	.	IV
Teucrium flavum L.	.	II	.	II	II	IV	I	II	.	IV	II
Osyris alba L.	III	.	.	II	III	I	II	III	.	.	II
Lonicera etrusca Santi	.	.	.	.	III	I	.	I	II	III	V
Stachys majus (L.) Bartolucci & Peruzzi	V	I	II	II	.	V	.	.	.	.	I
Lonicera implexa Aiton	V	III	.	V	II	.	.	.	.	II	.
Daphne gnidium L.	II	IV	.	I	.	I	.	II	.	.	.
Dryopteris pallida	.	.	.	.	.	I	II	III	III	V	.
Asplenium onopteris L.	.	.		.	.	.	II	III	IV	III	I
Euphorbia dendroides L.	I	II	.	.	.	I	.	.	.	.	.
Olea europaea L. var. *sylvestris* (Mill.) Lehr	.	.	.	.	.	III	.	.	.	.	.
Anagyris foetida L.	.	.	I	.	.	.	.	.	.	.	.
Chamaerops humilis L.	.	.	I	.	.	.	.	.	.	.	.
Other species											
Rubus ulmifolius Schott.	II	II	I	I	III	III	IV	II	II	IV	III
Acanthus mollis L.	II	II	V	I	III	III	III	II	.	V	I
Crataegus monogyna Jacq.	III	.	.	IV	IV	II	V	IV	I	.	IV
Quercus pubescens Willd. s.l. [sub Q. *virgiliana* (Ten.) Ten.] [see Di Pietro et al. 2020, 2021]	.	.	.	V	V	I	V	V	.	V	IV
Clematis vitalba L.	.	.	.	IV	III	.	II	II	III	IV	III
Brachypodium sylvaticum (Huds.) P.Beauv.	.	.	.	V	IV	.	V	II	IV	III	V
Prunus spinosa L.	.	.	.	I	III	I	.	.	III	III	III
Rosa canina L.	.	.	.	I	.	.	.	.	I	IV	II
Daphne laureola L.	.	.		.	.	.	.	.	II	V	III

Table A2. Simplified synoptic table of the Sicilian associations pertaining to the alliance *Oleo sylvestris-Ceratonion siliquae* (the values in cells refer to characteristic or differential species, while the symbol (*) points out the dominant species of the association). Associations corresponding to the numeric codes: 1 – *Rhamno alaterni-Euphorbietum dendroidis* subass. *typicum*, from Brullo and Marcenò (1985), table 19 (sub *Oleo-Euphorbietum dendroidis*); 2 – *Rhamno alaterni-Euphorbietum dendroidis* subass. *phlomidetosum fruticosae*, Brullo and Marcenò (1985), table 20, rels. 1–6; 3 – *Rhamno alaterni-Euphorbietum dendroidis* subass. *euphorbietosum bivonae*, from Gianguzzi and La Mantia (2008), table 11; 4 – *Rhamno alaterni-Euphorbietum dendroidis* subass. *rhamnetosum oleoidis*, from Brullo et al. (2009) table 3b, col. 17–19; 5 – *Pistacio lentisci-Chamaeropetum humilis*, from Brullo and Marcenò (1985), table 22; 6 – *Pistacio terebinthi-Celtidetum aetnensis* subass. *typicum*, from Gianguzzi et al. (2014a, 2014b), table 2, rels. 1–14; 7 – *Sarcopoterio spinosi-Chamaeropetum humilis*, from Bartolo et al. (1982), table 29 (sub *Chamaeropo humilis-Sarcopoterietum spinosi*); 8 – *Teucrio fruticantis-Rhamnetum alaterni*, from Turrisi et al. (2002), table 8; 9 – *Myrto communis-Pistacietum lentisci*, from Bartolo et al. (1982), table 28; 10 – *Ephedro fragilis-Lycietum europaei*, from Brullo and Marcenò (1985), table 24; 11 – *Asparago acutifolii-Ziziphetum loti*, from Gianguzzi et al. (1996), table 4; 12 – *Chamaeropo humilis-Quercetum calliprini*, from Brullo et al. (2009), table 3c, rels. 16–20; 13 – *Pyro amygdaliformis-Calicotometum infestae*, from Gianguzzi and La Mantia (2008), table 12; 14 – *Salvio fruticosae-Phlomidetum fruticosae*, from Barbagallo et al. (1979), table 2, rels. 1–12; 15 – *Ampelodesmo-Juniperetum turbinatae* subass. *cistetosum creticae*, from Gianguzzi et al. (2012) table 7; 16 – *Ruto chalepensis-Oleetum sylvestris*, from Gianguzzi and Bazan (2020a), table S1; 17 – *Chamaeropo humilis-Oleetum sylvestris* subass. *acanthetosum mollidis*, from Gianguzzi and Bazan (2020a), table S4; 18 – *Asparago albi-Artemisietum arborescentis*, from Gianguzzi et al. (2016), table 6; 19 – *Euphorbio characiae-Anagyridetum foetidae*, from Gianguzzi et al. (2016), table 7; 20 – *Hippocrepido emeri-Bupleuretum fruticosi*, from Brullo et al. (1993), table 3; 21 – *Spartio juncei-Bupleuretum fruticosi*, from Raimondo and Ilardi (2009); 22 – *Malvo olbiae-Ptilostemonetum greuteri*, from Gianguzzi et al. (2022), table 1; 23 – *Viburno tini-Phillyreetum latifoliae* ass. nova, table 5; 24 – *Teucrio flavi-Phillyreetum latifoliae* ass. nova, table 7.

Association number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Number of releves	**20**	**6**	**8**	**3**	**20**	**14**	**9**	**8**	**13**	**6**	**6**	**5**	**8**	**12**	**9**	**12**	**28**	**8**	**10**	**6**	**24**	**12**	**12**	**10**
Average number of species per relevé	**17,5**	**15,8**	**24,1**	**18,6**	**15,3**	**23,5**	**30,0**	**15,5**	**30,8**	**18,0**	**21,0**	**13,6**	**15,4**	**29,3**	**14,8**	**21,7**	**18,5**	**13,5**	**15,3**	**22,2**	**14,9**	**30,0**	**12,6**	**14,9**
Char. of association and subassociation																								
Euphorbia dendroides L.	V*	V*	V*	V*	I	II	.	.	.	.	.	.	III	V	II	V	I	IV	.	.	.	.	.	V
Phlomis fruticosa L.	.	V	.	.	.	.	.	.	.	.	.	.	.	V*	.	.	.	.	II	.	.	.	.	.
Euphorbia bivonae Steud.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.
Ephedra major Host	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhamnus lycioides L. subsp. *oleoides* (L.) Jahand. & Maire	.	.	.	V	I	.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.
Celtis tournefortii Lam. subsp. *aetnensis* (Tornab.) Raimondo & Schicchi	.	.	.	.	.	V*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poterium spinosum L.	.	.	.	.	.	.	V*	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.
Myrtus communis L.	II	.	.	.	.	.	.	.	V	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ephedra fragilis Desf.	.	II	.	.	.	.	.	III	V	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lycium europaeum L.	.	.	.	.	.	.	.	.	.	V*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ziziphus lotus (L.) Lam.	.	.	.	.	.	.	.	.	.	.	V*	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus coccifera L.	.	.	.	.	.	.	.	.	.	.	.	V*	.	.	.	.	.	.	.	.	.	.	.	.
Pyrus spinosa Forssk.	.	I	.	.	.	II	.	.	.	.	.	.	V	I	.	.	.	.	I	.	.	.	.	.
Salvia fruticosa Mill. subsp. *thomasii* (Lac.) Brullo, Gugl., Pav. & Terr.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.
Juniperus turbinata Guss.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V*	.	.	.	.	.	.	.	.	.
Erica multiflora L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.
Cistus creticus L. subsp. *creticus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.
Acanthus mollis L.	.	.	.	.	.	III	.	.	.	.	.	.	.	III	.	.	V	I	.	V	I	IV	IV	V
Artemisia arborescens (Vaill.) L.	II	.	I	I	I	.	.	.	.	.	II	.	.	.	.	III	II	V*	.	.	I	.	.	.
Anagyris foetida L.	I	.	I	I	.	.	.	.	.	.	.	.	.	.	.	II	III	.	V*	.	.	.	.	.
Emerus major Mill. subsp. *emeroides* (Boiss. & Spruner) Soldano & F. Conti	I	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	I	.	.	V	IV	III	.	.
Bupleurum fruticosum L.	.	.	.	.	..	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V*	V*	.	.	.
Spartium junceum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV	.	.	.
Ptilostemon greuteri Raimondo & Domina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V*	.	.
Malva olbia (L.) Alef.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.
Centranthus ruber (L.) DC.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.
Viburnum tinus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.
Asparagus asparagoides (L.) Druce	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV	.
Phillyrea latifolia L.	.	.	I	III	I	I	II	.	IV	.	.	V	.	I	V	II	I	.	.	.	.	II	V	V

Association number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Number of releves	**20**	**6**	**8**	**3**	**20**	**14**	**9**	**8**	**13**	**6**	**6**	**5**	**8**	**12**	**9**	**12**	**28**	**8**	**10**	**6**	**24**	**12**	**12**	**10**
Average number of species per relevé	**17,5**	**15,8**	**24,1**	**18,6**	**15,3**	**23,5**	**30,0**	**15,5**	**30,8**	**18,0**	**21,0**	**13,6**	**15,4**	**29,3**	**14,8**	**21,7**	**18,5**	**13,5**	**15,3**	**22,2**	**14,9**	**30,0**	**12,6**	**14,9**
Char. alliance *Oleo-Ceratonion siliquae*																								
Olea europaea L. var. *sylvestris* (Mill.) Lehr.	IV	II	V	V	III	I	II	II	IV	III	II	I	I	IV	IV	V*	V*	.	I	.	II	.	.	V
Chamaerops humilis L.	III	II	V	I	V*	.	V*	II	V	IV	.	IV	I	II	.	I	V	I	I	.	.	IV	.	.
Teucrium flavum L.	II	I	.	.	.	I	.	.	.	.	.	.	.	III	III	II	I	.	.	IV	I	V	.	V
Asparagus horridus L.	.	.	.	.	.	III	I	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Char. ord. *Pistacio-Rhamnetalia alaterni*																								
Stachys major (L.) Bartolucci & Peruzzi	IV	V	V	V	III	II	IV	V	IV	IV	.	III	III	V	IV	V	IV	III	III	I	I	III	IV	III
Teucrium fruticans L.	IV	II	II	III	IV	.	IV	V	V	V	.	II	I	V	.	III	III	.	.	I	II	II	.	.
Pistacia lentiscus L.	III	.	II	V	V*	.	III	V	V*	IV	.	II	I	IV	V	IV	V	.	.	.	III	I	V	V
Rhamnus alaternus L.	II	IV	IV	.	II	.	.	V	.	.	I	.	.	IV	IV	IV	III	.	IV	.	III	II	II	.
Asparagus albus L.	I	I	V	.	III	.	III	.	.	IV	I	.	IV	III	.	III	IV	V	IV	.	.	.	.	.
Osyris alba L.	I	III	I	.	.	II	.	.	.	III	I	.	.	IV	.	II	III	II	III	I	II	.	.	.
Pistacia terebinthus L.	.	II	I	.	.	V	.	.	.	.	I	.	.	IV	I	III	I	.	I	.	.	V	III	V
Clematis cirrhosa L.	.	.	II	.	.	III	.	.	.	.	.	.	.	I	.	III	II	I	.	.	I	III	V	V
Ceratonia siliqua L.	III	.	.	.	II	.	.	I	I	.	.	.	.	III	.	II	I	.	.	.	.	.		III
Char. Cl. *Quercetea ilicis*																								
Asparagus acutifolius L.	IV	IV	V	V	IV	V	V	V	V	V	IV	V	IV	V	IV	V	V	II	V	V	IV	IV	III	III
Rubia peregrina L.	II	.	V	II	III	IV	.	III	IV	V	IV	III	IV	III	I	IV	IV	I	III	V	V	V	I	IV
Smilax aspera L.	II	.	II	.	III	III	.	II	IV	V	II	IV	II	II	.	IV	IV	.	II	III	III	V	III	.
Arisarum vulgare Targ. Tozz.	II	IV	I	II	II	.	IV	IV	II	V	V	II	IV	.	.	V	V	.	IV	III	I	III	IV	IV
Cytisus infestus (C. Presl) Guss.	IV	II	IV	.	V	.	IV	.	III	IV	.	III	V*	V	.	II	II	.	.	III	IV	.	.	.
Ampelodesmos mauritanicus (Poir.) T.Durand & Schinz	IV	I	V	III	III	I	.	.	.	.	I	.	III	II	V	III	III	II	.	I	V	V	I	.
Daphne gnidium L.	II	.	I	I	I	IV	.	.	II	II	.	I	II	IV	.	I	II	.	.	.	.	.	.	.
Allium subhirsutum L.	I	I	I	II	I	IV	.	.	.	.	.	.	.	II	.	V	V	.	IV	.	.	II	II	
Dioscorea communis (L.) Caddick & Wilkin	I	II	I	.	.	III	.	.	.	.	.	.	.	.	.	II	I	.	.	II	I	III	III	I
Ruta chalepensis L.	I	.	IV	IV	.	V	.	.	.	.	I	.	V	V	.	III	I	III	IV	.	.	.	.	I
Rosa sempervirens L.	.	.	.	.	.	II	.	.	.	.	.	.	I	.	.	II	I	I	III	III	III	II	I	I
Euphorbia characias L.	.	.	.	.	.	V	.	.	.	.	.	.	.	I	.	I	I	.	V	II	I	I	.	.
Lonicera implexa Aiton	I	II	.	I	.	.	.	.	III	.	.	II	.	.	I	.	.	.	II	.	.	III	.	.
Fraxinus ornus L.	I	I	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	II	III	III	.
Cyclamen hederifolium Aiton	.	.	IV	.	.	IV	.	.	.	.	.	.	.	I	II	I	.	.	II	II	.	III	.	.
Quercus ilex L.	.	.	.	.	.	I	.	.	.	.	.	II	.	.	I	.	.	.	.	IV	I	III	V	V
Cyclamen repandum Sm.	I	.	.	I	.	IV	.	.	.	.	.	I	.	.	.	III	.	.	.	.	I	.	.	.

Table A3. List of old-growth trees and shrubs recorded in Bosco Niscemi and in closely adjacent areas.

N°	Species	Height (m)	Coordinates	Maximum circumference at the stump (m)	Circumference 1.3 m above the ground	Canopy width (m)	Estimated age (years)	Conditions of the plant
1	*Ulmus minor*	14.00	38°09'31"N, 13°20'20"E	1.95	1.16	14.0 N-S 9.5 E-W	80/100	Discreet; some dry branches
2	*Ulmus minor*	12.00	38°09'32"N, 13°20'24"E	1.80	1.52	12.0 N-S 9.0 E-W	80/100	Senescent; several dry branches
3	*Cercis siliquastrum*	10.50	38°09'38"N, 13°20'21"E	1.91	1.10 (1+3)	9.5 N-S 6.5 E-W	80/100	Good
4	*Albizia julibrissin*	6.50	38°09'42"N, 13°20'21"E	1.26	1.13	8.0 N-S 4.0 E-W	220	Senescent; several dry branches
5	*Cupressus sempervirens*	25.00	38°09'48"N, 13°20'20"E	3.75	2.81	14.0 N-S 12.0 E-W	220	Good
6	*Arbutus unedo*	6.50	38°09'43"N, 13°20'20"E	2.26	0.63	7.0 N-S 12.0 E-W	150	Good; coppiced trunk
7	*Quercus ilex*	22.00	38°09'45'N, 13°20'20"E	4.58 (many stems)	2.21 (one)	24.0 N-S 22.0 E-W	220	Senescent; several dry branches
8	*Pistacia lentiscus*	3.00	38°09'44'N, 13°20'20"E	2.25	0.70	8.0 N-S 6.0 E-W	200	Discreet; curved trunk
9	*Fraxinus ornus*	9.50	38°09'45"N, 13°20'20"E	1.30	0.70	8.0 N-S 6.5 E-W	160	Good
10	*Arbutus unedo*	7.50	38°09'46"N, 13°20'19"E	1.95	0.49	7.5 N-S 6.0 E-W	180	Good; coppiced trunk
11	*Arbutus unedo*	8.00	38°09'46"N, 13°20'18"E	2.95	0.67	8.0 N-S 9.0 E-W	180	Good
12	*Fraxinus ornus*	9.50	38°09'42"N, 13°20'12"E	1.38	0.88	7.0 N-S 6.5 E-W	180	Good
13	*Ulmus minor*	22.00	38°09'31"N, 13°20'25"E	3.55	2.02	25.0 N-S 21.0 E-W	180	Good
14	*Arbutus unedo*	7.00	38°09'37"N, 13°20'10"E	1.96	0.72	5.0 N-S 6.0 E-W	180	Senescent; several dry branches
15	*Phillyrea latifolia*	8.50	38°09'44"N, 13°20'13"E	2.55	1.00	8.5 N-S 8.0 E-W	180	Good
16	*Phillyrea latifolia*	8.50	38°09'43"N, 13°20'14"E	2.22	0.88	9.0 N-S 9 .0E-W	180	Good
17	*Quercus ilex*	12.00	38°09'38"N, 13°20'10"E	4.17	1.13	11.0 N-S 12.0 E-W	200	Senescent
18	*Viburnum tinus*	5.00	38°09'51"N, 13°20'09"E	0.95	0.17	4.0 N-S 6.0 E-W	100	Good
19	*Phillyrea latifolia*	13.00	38°09'52"N, 13°20'08"E	2.16	0.93	10.0 N-S 15.0 E-W	200	Good
20	*Phillyrea latifolia*	8.00	38°09'52"N, 13°20'08"E	3.08	0.93	6.5 N-S 6.0 E-W	200	Good
21	*Quercus ilex*	20.00	38°09'54'N, 13°20'07"E	3.58	1.14	15.0 N-S 18.0 E-W	220	Senescent
22	*Quercus ilex*	20.00	38°09'52'N, 13°20'12"E	4.07	2.41	25.0 N-S 21.0 E-W	220	Senescent
23	*Celtis australis*	12.00	30°09'58"N, 13°19'58"E	3.30	3.22	12.0 N-S 16.0 E-W	220	Senescent
24	*Olea europaea*	21.00	30°09'57"N, 13°19'58"E	4.22	1.77	25.0 N-S 23.0 E-W	300	Good
25	*Phillyrea latifolia*	16.00	38°09'57"N, 13°19'55"E	3.11	0.73	15.0 N-S 15.0 E-W	200	Good
26	*Pyrus spinosa*	8.00	38°09'36"N, 13°20'22"E	1.35	1.21	10.0 N-S 10.0 E-W	80/100	Good
27	*Quercus ilex*	17.00	38°09'38'N, 13°20'15"E	4.51	3.01	18.0 N-S 16.0 E-W	220	Good
28	*Gleditsia triacanthos* L.	10.00	38°09'38"N, 13°20'10"E	2.25	1.30	8.0 N-S 8.5 E-W	220	Senescent
29	*Viburnum tinus*	4.00	38°09'40"N, 13°20'12"E	1.09	0.17	4.0 N-S 3.0 E-W	80	Good
30	*Pistacia terebinthus*	13.00	38°09'42"N, 13°20'13"E	1.10	1.22	10.0 N-S 7.5 E-W	200	Good
31	*Quercus ilex*	10.00	38°09'45'N, 13°20'12"E	4.88	0.63	9.0 N-S 13.0 E-W	220	Good
32	*Quercus ilex*	15.00	38°09'57'N, 13°20'06"E	5.34	3.15	15.0 N-S 15.0 E-W	220	Good
33	*Phillyrea latifolia*	18.00	38°09'52"N, 13°20'07"E	1.80	1.12	8.0 N-S 10.0 E-W	220	Excellent
34	*Phillyrea latifolia*	14.00	38°09'52"N, 13°20'08"E	1.87	0.87	13.0 N-S 13.0 E-W	220	Excellent
35	*Clematis cirrhosa* (on *Phillyrea latifolia*)	7.00	38°09'58"N, 13°20'03"E	0.90	0.85	6.0 N-S 5.0 E-W	200	Excellent
36	*Pistacia lentiscus*	7.00	38°10'08'N, 13°20'02"E	2.40	0.95	6.0 N-S 6.0 E-W	220	Senescent
37	*Cupressus sempervirens*	25.00	38°10'06"N, 13°20'06"E	2.87	3.27	10.0 N-S 8.0 E-W	220	Senescent
38	*Pinus halepensis*	32.00	38°10'05"N, 13°20'07"E	3.45	2.77	25.0 N-S 22.0 E-W	220	Good
39	*Celtis australis*	28.00	38°10'11"N, 13°20'08"E	4.05	3.01	25.0 N-S 25.0 E-W	200	Good
40	*Celtis australis*	25.00	38°10'10"N, 13°20'08"E	3.69	2.90	28.0 N-S 25.0 E-W	200	Good
41	*Phillyrea latifolia*	13.00	38°10'09"N, 13°20'10"E	2.24	0.97	9.0 N-S 7.0 E-W	200	Excellent
42	*Celtis australis*	22.00	38°10'12"N, 13°20'15"E	3.34	2.56	22.0 N-S 22.0 E-W	200	Good
43	*Cercis siliquastrum*	14.00	38°10'13"N, 13°20'13"E	4.67	0.73	13.0 N-S 13.0 E-W	200	Good
44	*Olea sylvestris*	14.00	38°10'12"N, 13°20'16"E	4.30	1.65	15.0 N-S 14.0 E-W	200	Excellent
45	*Viburnum tinus*	4.00	38°10'14"N, 13°20'16"E	2.44	0.12	3.0 N-S 5.0 E-W	200	Excellent
46	*Pistacia terebinthus*	5.50	38°09'32"N, 13°20'38"E	2.26	5.00	4.0 N-S 6.0 E-W	200	Good
47	*Pistacia terebinthus*	6.50	38°09'33"N, 13°20'37"E	3.42	7.50	8.0 N-S 6.0 E-W	200	Good