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Fragments of subdesert vegetation in the Mediterranean Region: the *Periploca angustifolia* maquis (*Periplocion angustifoliae*, *Quercetea ilicis*) in Sicily*

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Abstract

The paper presents the results of a phytogeographic, ecological, phytosociological, and management-oriented study on the maquis vegetation dominated by *Periploca angustifolia* (class *Quercetea ilicis*) occurring along of southern coast of mainland Sicily. The species is a South-Mediterranean shrub, previously known in Europe only from some small islands surrounding Sicily (Linosa, Lampedusa, Pantelleria, and the Aegadian, and the Maltese Archipelagos), as well as from southeastern Spain and the Aegean islands of Crete, Khrisi, and Gavdos. Along with providing an updated overview of the species' distribution, the study explores the historical reasons for its presence in Sicily, where it is part of a diverse group of biogeographically related species mainly found along the southern coasts. This further supports the hypothesis of connection routes contracted with North Africa during the drying of the Mediterranean in the Messinian period. Based on a synoptic comparison with similar associations present in the central-Mediterranean, the plant community investigated is proposed as a new syntaxon (association *Asparago albi–Periplocetum angustifoliae* ass. nov.), framed within the alliance *Periplocion angustifoliae* (order *Pistacio–Rhamnetalia alaterni*). Its role as a vicariant association with respect to the association *Periploco angustifoliae–Euphorbietum dendroidis* (occurring on the small islands of the Sicilian Channel) is also discussed, together with floristic, synecological, syndynamic, and conservation data. Finally, issues concerning afforestation with alien species—often carried out on a large scale throughout the Mediterranean area—are discussed, as such interventions may sometimes negatively affect ecosystems typical of endemic or particularly rare species. This is precisely the case of *Periploca angustifolia* in the study area, whose residual population had been brought to the brink of extinction by conifer plantations, leading to the alteration and consequent disappearance of its habitats.

Keywords

Conservation, habitat fragmentation, *Periplocion angustifoliae*, relict Mediterranean maquis, semiarid ecosystems

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Introduction

The flora of Sicily—including the surrounding islands—is recognized as having considerable phytogeographical interest (Giardina et al. 2007; Cañadas et al. 2014), being a major biodiversity hotspot of the Mediterranean region (Médail and Quézel 1997; Testolin et al. 2024). This is not only because it comprises a significant contingent of endemic species, but also due to the presence of several taxa that reach one of the limits of their distribution ranges precisely in this area (Brullo et al. 1995; Brullo and Brullo 2020). The southern coastal and subcoastal areas of mainland Sicily, for instance, host many species that originated from nearby North Africa and are either entirely absent or extremely rare throughout the rest of Europe. This is the case with several interesting shrubs such as *Searsia tripartita* (Brullo et al. 1998), *Tamarix arborea* (Brullo and Sciandrello 2006), *Soda oppositifolia* (Brullo et al. 2012), *Ziziphus lotus* (La Mantia and Scuderi 2021; La Mantia et al. 2025), *Lycium schweinfurthii* (Portal to the Flora of Italy 2025; POWO 2025), to which *Periploca angustifolia* may be added, recorded in a restricted site on Mount San Calogero, near Sciacca, which is the subject of this contribution. According to Quézel (1983, 1985), the migration of these taxa from arid North African areas into the Mediterranean region is linked to the paleogeographic and paleoclimatic history of the Mediterranean Basin during the Early Cretaceous and particularly during the arid phases of the Messinian.

According to Plants of the World Online (POWO 2025), the species is widely distributed in North Africa (Mauritania, Western Sahara, Morocco, Algeria, Tunisia, Libya, and Egypt up to the Sinai area), with localized and fragmented occurrences across the Mediterranean Basin, from the Iberian Peninsula to the Aegean region. In particular, the European populations of this species are located in the southeastern part of Spain [Andalusia (provinces of Almería, Granada, and Málaga), Murcia, and the Valencian Community (Mota et al. 1997; Alcaraz et al. 2000; Mendoza-Fernández et al. 2020)], it was until now known from some small islands of the Sicilian Channel (Fig. 1) and from the Aegean islands of Crete, Gavdos, and Khrisi (Brullo and Guarino 2000).

An additional record of the species has also been reported in Jordan at Wadi Rum (Taifour et al. 2017), whereas it should be considered extinct in Lebanon–Syria (Abd El-Ghani and Ahmed 2025) (Fig. 2). *Periploca angustifolia* is a characteristic species of xeric sub-Saharan environments, exhibiting distinct ecophysiological adaptations and a notable tolerance to soil water deficiency and drought stress (Noumi et al. 2013). It occurs on a range of soil types, though it shows a preference for calcareous substrates,



Figure 1. Distribution of *Periploca angustifolia* in the islands of Sicily Channel (grey dots) with the new stand of Mount S. Calogero (red dot).

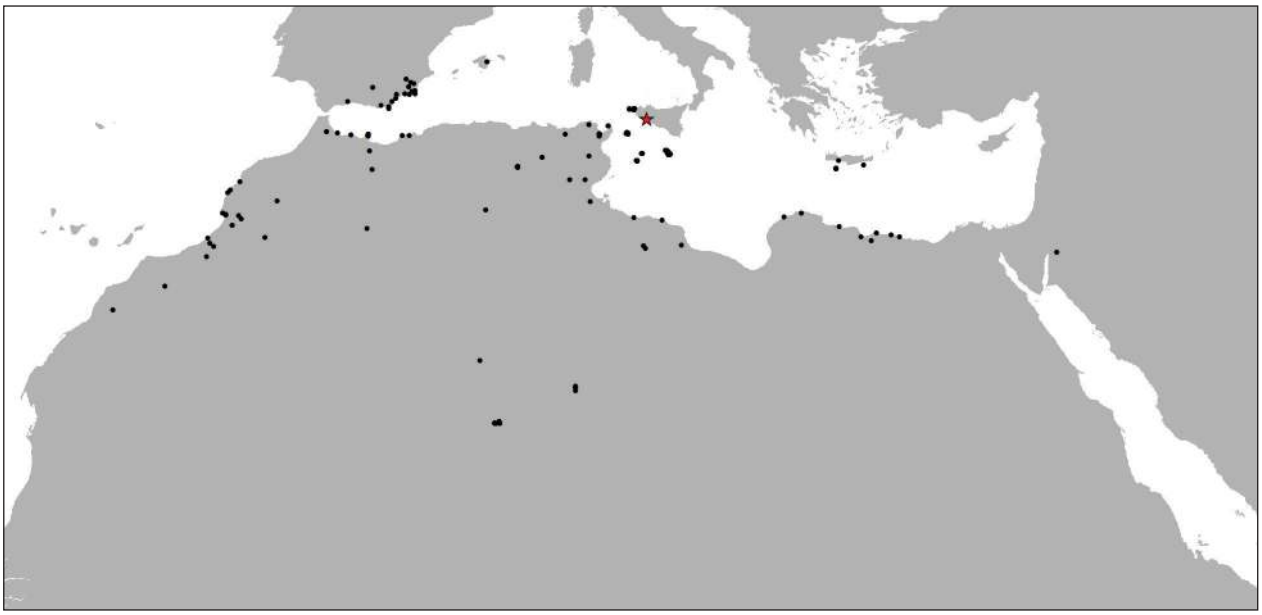


Figure 2. Distribution of *Periploca angustifolia* (from POWO 2025, modif.); in red, the site subject of this survey.

typically in regions with mean annual precipitation below 400 mm, and occasionally as low as 100 mm (Chaieb and Boukhris 1998). Along the North African coasts, it has a broad distribution along the Mediterranean shoreline, from Mauritania to Egypt, extending southwards into desert areas. In Tunisia, it ranges from the northern regions to the Saharan area of Dhiba (Ennaieth et al. 2010), where it is a typical component of open maquis and garrigue, occurring in depressions, gullies, and wadis. It is often associated with *Searsia tripartita*, *Retama raetam* subsp. *raetam*, and *Stipa tenacissima*; in the Algerian Sahara, it is found in communities with *Searsia tripartita* and *Myrtus nivellei* (Benaissa and Djebbar 2018). It is also reported from various habitats of the western Mediterranean desert (sandy plains, ridges and inland plateaus, wadis, and roadsides), where it contributes to maintaining biodiversity and the ecological stability of these environments (Ahmed 2009).

In the eastern portion of its North African range, a gradual decline in populations has been documented, attributed by several authors mainly to anthropogenic pressures (El-Hadidi and Hosni 2000; Gamal et al. 2020). According to Abd El-Ghani and Ahmed (2025), the species shows a significant regression in Egypt and Sinai, with similar reports also concerning certain areas of Tunisia (Noumi et al. 2010). Among the principal factors is intense grazing by goats and camels (Boulos 2000), which adversely affects plant growth and reproductive performance.

Other important pressures are also represented by the degradation and decline of its preferred habitats, due to agricultural expansion and infrastructure development by humans (Salama et al. 2005; Abd El-Ghani and Ahmed 2025).

In this contribution, we first report the important discovery of a new population of the species in mainland Sicily, located on the southern slopes of Mount San Calogero (also known as Mount Kronio), in the municipality of Sciacca (Agrigento province). This discovery is indeed rather surprising, not only because the new site significantly expands the species' range, but also due to its phytogeographical significance and the notable phytosociological and ecological value, including its potential future importance. Based on these premises, the results of a study are presented here, addressing the following objectives:

a) to provide an updated distributional framework for the species in the Mediterranean territories;
b) to discuss the historical factors underlying its occurrence along the southern coasts of the insular area, in comparison with other biogeographically analogous entities;
c) to develop a phytosociological, synecological, and syndynamic characterization of the vegetation in which it occurs, in relation to other communities of the alliance *Periplocion angustifoliae* so far documented across the islands of the Sicilian Channel;
d) to assess the pressures and threats affecting its habitat, with the aim of supporting the implementation of targeted conservation measures.

Study area

The new stand of *Periploca angustifolia* was found along the southern slopes of Mount San Calogero (397 m a.s.l.), a small hill that is part of a highly active volcanic region along the southwestern coast of Sicily (37°31'N – 13°6'E). About 60 km further southeast lies the submarine volcano Empedocles, which in 1831 gave rise to the island of Ferdinandea (or Graham Bank), later submerged following collapses caused by waves (Badino 2013). This hill, known since antiquity also as Mount Kronio—legendary home of the Greek deity Cronus (father of Zeus)—is catalogued among the most important geosites of the Sicilian Region, primarily

due to its rich labyrinth of caves affected by intense hydrothermal phenomena related to secondary volcanism.

For this reason, an oriented nature reserve was established by the Sicilian Region (D.A. Territory and Environment No. 366/44 of 26/07/2000), covering 52.25 hectares, managed by the Department of Rural and Territorial Development (ORBD 2025a). The same area was subsequently included within a Natura 2000 site [SAC ITA040009 – Mount San Calogero (Sciacca); DM 07/04/2021 – Official Gazette 90 of 15/04/2021], together with adjacent territories of the elevation (Fig. 3), for a total area of approximately 127 hectares (ORBD 2025b).

Geomorphological and hydrothermal features

The relief of Mount San Calogero consists of a rock outcrop of the Upper Triassic–Lower Lias (stromatolitic limestones with *Megalodon* of Late Triassic–Early Lias) (Basilone 2018), characterized by Meso-Cenozoic limestones assigned to the "Saccense Unit" (Lentini and Carbone 2014). Its importance, however, is mainly due to a complex system of hypogene karst cavities, which also includes around twenty hydrothermal caves (Guidi and Verde 2001; Badino et al. 2009; Badino 2013; Commissione Grotte Boegan e Associazione Geografica La Venta 2013; Guidi et al. 2014). This geosite is considered a world unique site (ORBD 2025c) due to its speleo-thermal peculiarities (Floriani 1979; Forti 1991) and its significant historical importance since prehistoric Sicily. Human presence is documented here as early as the 6th century BC in the upper caves, and up to 4000 years ago in the intermediate ones (Verde 2021). The entrances located at the top of the relief, namely the "Stufe di San Calogero," consisting of two natural steam-filled caves, called the Antro di Dedalo (or Grotta di San Calogero and Grotta degli Animali) are incorporated within an ancient thermal complex built near the Sanctuary of San Calogero, patron saint of Sciacca.

This complex network of cavities and tunnels remains only partly explored due to its extreme conditions, including fluctuating temperatures (15–37 °C) and nearly 100% humidity (Di Piazza et al. 2017). These closed or semi-closed habitats resemble caves, where darkness and nutrient scarcity allow only specialized organisms—such as arthropods and microorganisms—to survive, while others, like bats, use them temporarily (Souza Maysa and Ferreira 2011; Smith et al. 2012). Recent micromycological studies have also identified various fungal taxa, including species from the genera *Penicillium*, *Cladosporium*, and *Trametes* (Di Piazza et al. 2017).

From an ecological perspective, it remains unclear how these internal environmental conditions influence the external characteristics of the site (e.g., the temperature of lithological substrates and soils). Nevertheless, the presence of *Periploca angustifolia* and *Searsia tripartita* (La Mantia et al. 2025)—rare shrub species in Sicily and typical of pre-desert formations—clearly highlights their potential climacic role within the area.

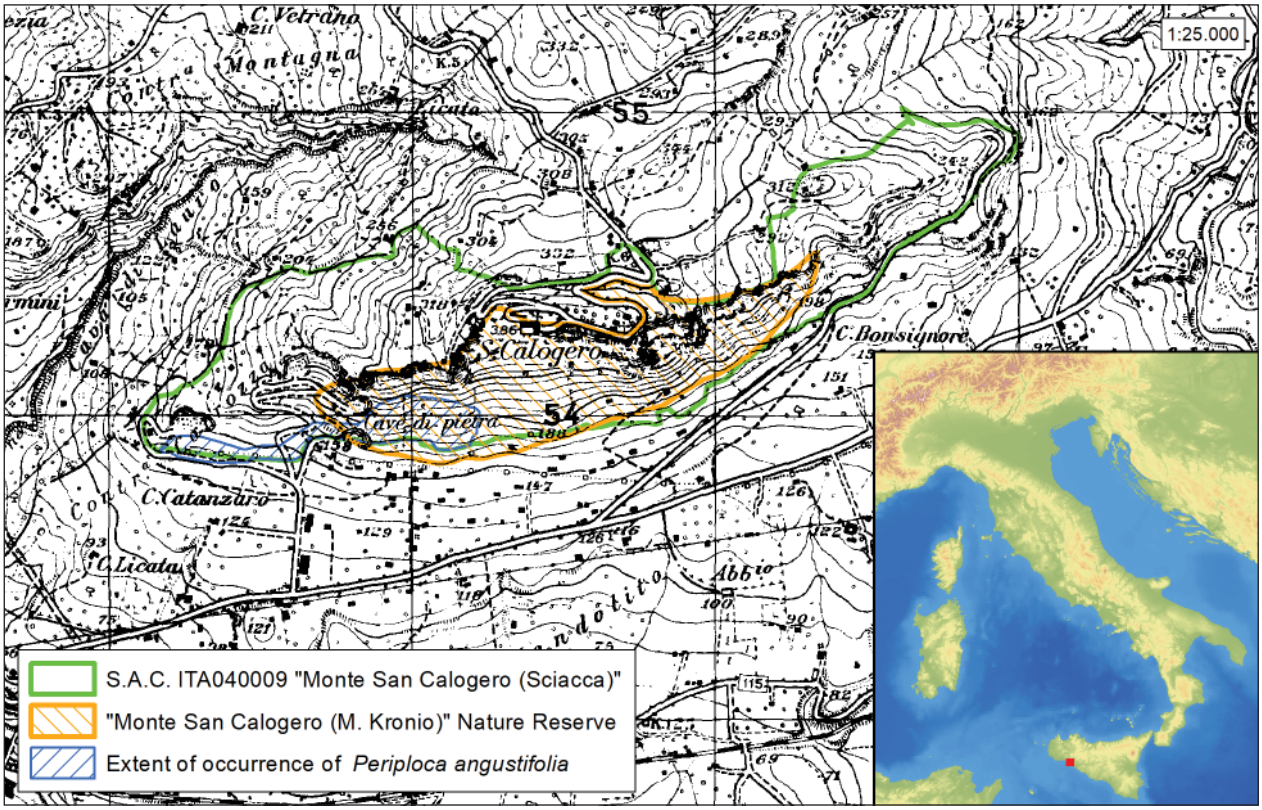


Figure 3. Area of S.A.C. ITA040009 and "Monte San Calogero (M. Kronio)" Nature Reserve, with distribution of *Periploca angustifolia* populations.

Moreover, from a geological perspective, this sector of Sicily has recently been considered by some authors as part of the foreland, similar to the Hyblaean area, whose territories may also have emerged (at least partially) after the deposition of pelagic carbonates, called "Trubi" (Ferranti et al. 2019). According to this hypothesis, the biological colonization of this area could have been even earlier, with a phytogeographical evolution potentially very different and highly significant for Sicily itself (Geraci et al. 2009; Troia et al. 2012; Ilardi et al. 2020).

Climatic features, bioclimate, and biogeographical characterization

From a climatic perspective, the mean annual precipitation is 564 mm, distributed over an average of 65 rainy days; precipitation peaks in winter, while a pronounced and prolonged minimum occurs during the spring–summer period (La Mantia et al. 2025). The mean annual temperature is 17.9 °C, with minimum average temperatures in February (7.9 °C) and maximum average temperatures in July (30.6 °C). According to the bioclimatic classification of Rivas-Martínez et al. (2004), the area falls within the lower dry Thermomediterranean belt (La Mantia et al. 2025).

From a biogeographical standpoint, the area is classified within the Mediterranean Region and the Central Mediterranean Subregion (Rivas-Martínez et al. 2004), and further assigned to the Sicilian Province, Eusiculo Sector, Western Subsector, and Drepano–Panormitano District (Brullo et al. 1995).

Land use and historical landscape evolution

The land use of the Mount San Calogero area reflects a long history of human activity, from prehistoric therapeutic and religious visits to quarrying, agriculture, and afforestation. Historical toponyms such as *Thermae Selinuntinae* and *Aquae Labodes* attest to the region's thermal heritage (Verde 2021). Quarrying of limestone outcrops ("Cave di pietra") and extensive agriculture, including dry cultivation of carob and almond trees and sheep grazing, once shaped the landscape. Around the rocky areas, naturalized stands of *Opuntia ficus-indica* and *Agave* species mark past human cultivation.

Today, much of the territory forms part of the Sciacca publicly owned Forest within a regional nature reserve managed by the Sicilian Forestry Service. Since 1988, afforestation—mainly with *Pinus halepensis*, *Cupressus sempervirens*, and *Eucalyptus camaldulensis*—has altered the original low maquis dominated by *Periploca angustifolia*. The area has suffered repeated wildfires, notably in 1997, leading to the loss of large, forested zones and recurrent vegetation degradation (La Mantia et al. 2025). In recent years, additional fires have occurred, highlighting a trend of increasing frequency. According to data from the Regional Forestry Information System, fires in this area have recurred almost annually since 2008, except in 2013 and 2022 (La Mantia et al. 2025). In the same fire-cleared clearings, numerous *Periploca angustifolia* individuals have regenerated from seeds, evidently dispersed by wind from residual plants located along hedges and at the margins of afforested areas. More developed shrubs are sometimes found entwined with dried branches or even the charred trunks of old conifers consumed by fire. The species tends to create sparse garrigue and low maquis, part of a complex phytocoenotic mosaic, interspersed with the more extensive *Hyparrhenia hirta* grasslands, as secondary aspects of two distinct native vegetation series: i) *Olea europaea* on rock outcrops; ii) *Searsia tripartita* on stony-detritic substrates.

In the surrounding coastal belt, ongoing residential expansion has further transformed the landscape, encroaching toward borders of the protected area. Other land-use types are also notable in the adjacent coastal strip, where in recent decades, intense residential urban expansion has been recorded, approaching some parts of the aforementioned protected areas.

Previous botanical investigations

From a floristic and phytosociological viewpoint, the area was little known until now, except in general terms. In fact, the toponym "Sciacca at Monte S. Calogero" (or "Monte Kronio") is scarcely mentioned in the most important classical floristic works, such as those by Gussone (1827, 1843) and Lojacono (1888–1889, 1891, 1902–1903, 1904–1907, 1906, 1908–1909). As also noted in Giardina et al. (2007), for this locality there are only sporadic bibliographic references, mainly concerning Gussone's collections from 1827 and 1828. In particular, these include: *Searsia tripartita* (La Mantia et al. 2025), *Astragalus caprinus* subsp. *huetii*, *Micromeria microphylla* (Gussone 1834), *Stipa barbata* [Sciacca at S. Calogero (Gussone 1827)].

For other taxa, some specifically listed in the Standard Form of the Natura 2000 site (ORBD 2025c), there are only general bibliographic references (e.g., "Sciacca"), as in the cases of *Lonas annua*, *Malva flava* (sub *Lavatera agrigentina*), and *Glandora rosmarinifolia* [sub *Lithodora rosmarinifolia*]. For these taxa, given the absence of specific exsiccata from the area and/or the rarity of their preferred habitats, confirmation of their actual presence within the Natura 2000 site is necessary.

Indeed, among other geobotanical publications for this area, only a few reports can be be mentioned: the sites of the endemic *Brassica villosa* subsp. *tineoi* (Ottonello 1978; Raimondo et al. 1991), and forest aspects of *Olea europaea* stands of habitat 9320, *sensu* Directive 92/43/EEC (Rivieccio et al. 2021), as well as a more recent study on a small residual maquis patch of *Searsia tripartita* (La Mantia et al. 2025).

However, comprehensive monographic studies—both on the flora and the vegetation of this protected area—are still lacking. Such investigations would be highly desirable, particularly in light of recent and unexpected discoveries of species with North African affinities, including *Searsia tripartita* and *Periploca angustifolia*.

Materials and methods

Target species

Periploca angustifolia is a shrubby liana belonging to the Apocynaceae family, reaching 2(–3) m in height and adapted to particularly hot and dry climatic conditions (see Suppl. material 1). It has perennial stems with longitudinally striated bark, bearing short, rigid branches, sometimes twisted at the tips, with small terminal shoots. The leaves are lanceolate, coriaceous, either evergreen or summer-deciduous, the upper opposite; the blade is narrowly ovate to oblong-lanceolate, cuneate at the base and obtuse at the apex, glabrous, and subsessile. Flowers are grouped (2–15) in small axillary cymes; they have a corolla about 1 cm in diameter, with glabrous petals, lobes yellowish-green and purplish-brown on the inside. The fruits are narrowly conical follicles (0.6 × 6–10 cm), often paired and divergent. Seeds are dark (7 mm), with white woolly hairs (25–40 mm) that are easily dispersed by wind (anemochory) (Fig. 4a). Although it produces latex, the species is particularly appreciated by livestock, especially in the arid environments of North Africa; in Tunisia it also has medicinal value (Dghim et al. 2018).

Phytosociological investigation

The study was conducted through preliminary field surveys, initiated at the beginning of spring 2025, following the incidental discovery of *Periploca angustifolia* by one the authors, documented by photographs posted on posted on the web (Acta Plantarum 2025). Several excursions were subsequently carried out, aimed at spatially locating the population, monitoring the ecological-stational features of the site, and conducting a preliminary survey of the flora and vegetation of the garrigue and low maquis it forms, as well as the role it plays within the landscape. Relevant literature was also consulted, along with herbarium investigations at the Herbaria of Palermo (PAL) and Catania (CAT), to define an updated distribution range of the species in the regional context, previously known only from some small circum-Sicilian islands (Linosa, Lampedusa, Pantelleria, Marettimo, Levanzo, Favignana), as well as the Maltese Islands, but not from Sicily itself.

For the geolithological characterization of the area, we mainly referred to Basilone (2018) and Lentini and Carbone (2014), as well as to various other publications concerning the geomorphological and hydrothermal aspects of the site (Badino 2013; Verde 2021). Climatic data were derived from the nearby thermopluviometric station of Sciacca (La Mantia et al. 2025), considering the dataset from 1926–1985 analyzed by Duro et al. (1996).

The geobotanical investigation was expanded to include a phytosociological, synecological, and syndynamic characterization of the vegetation landscape, with particular attention to the shrub formations of *Periploca angustifolia*, primarily established in clearings within afforested areas along the southwestern slope of the hill. Twelve phytosociological relevés were performed in spring, on homogeneous patches of low maquis-garrigue vegetation, although partly discontinuous and of limited extent. The sampled surfaces ranged between 50–100 m², at elevations between 143 and 278 m a.s.l. The relevés were then assembled into a phytosociological table (Table 1). Moreover, it was used for further floristic–phytocoenotic comparison with other analogous communities dominated by *Periploca angustifolia* and/or related taxa (included in the alliance *Periplocion angustifoliae*), so far described for the islands of the Sicilian Channel. A synoptic table was subsequently compiled (Table 2), including 22 phytosociological tables and 184 relevés, with the aim of distinguishing groups of characteristic and differential elements within the various syntaxa, as well as the most representative companion species.

Species identification was primarily based on Pignatti et al. (2017–2019), whereas the taxonomic nomenclature followed the Portal to the Flora of Italy (2025), except for *Searsia tripartita* and *Lycium schweinfurthii* [according to Plants of the World Online (POWO 2025)]. The phytosociological nomenclature follows the criteria of the International Code of Phytosociological Nomenclature (ICPN: Theurillat et al. 2021), while syntaxonomic classification was based on Mucina et al. (2016) and Brullo et al. (2009, 2020).

The communities reported in the above synoptic table were further classified through cluster analysis, in which frequency classes were converted into numerical values according to van der Maarel scale (1979). Hierarchical cluster analysis was performed using the Bray–Curtis dissimilarity index. An agglomerative hierarchical clustering algorithm with Ward.D2 linkage was applied, minimizing within-group variance. NMDS (Non-metric Multidimensional Scaling) was used to graphically represent floristic relationships among the relevés in a two-dimensional space. Furthermore, a PERMANOVA (Permutational Multivariate Analysis of Variance) was carried out to test whether the studied associations differed significantly in composition, based on a Bray–Curtis distance matrix. Analyses were conducted with R software, version 4.5.1 (R Core 2025), using the "vegan" package (Oksanen et al. 2006) for NMDS, PERMANOVA, and Bray–Curtis distance matrix computation. The "cluster" and "stats" libraries were used for hierarchical clustering, while "ggplot2" and "matplotlib" (via Python) were employed for graphical visualization.

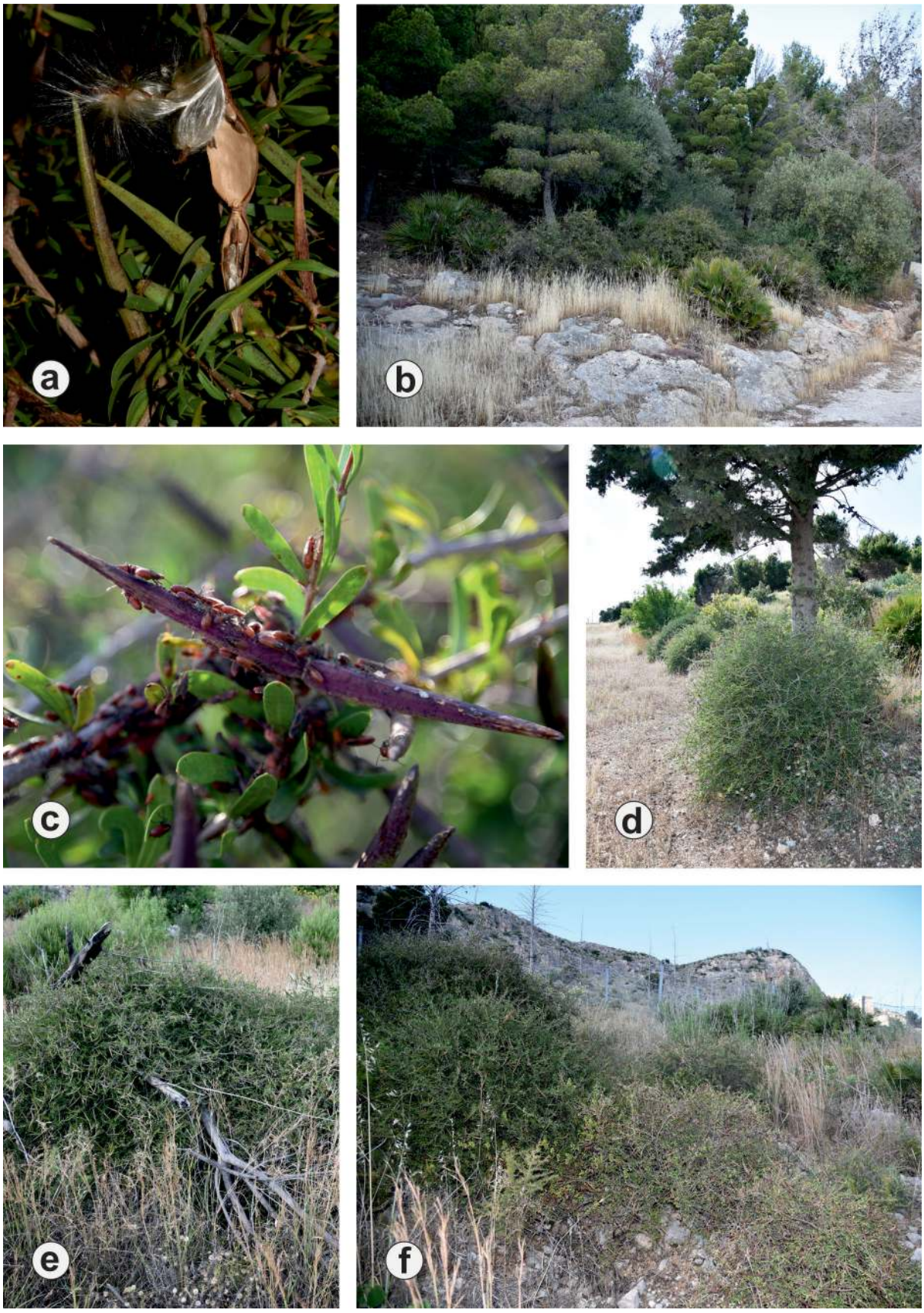


Figure 4. a. *Periploca angustifolia* at Mt. S. Calogero (Sciacca, Italy): twigs in fruiting and dissemination (anemochory); **b.** *Asparago albi-Periplocetum* scrub, among the clearings of the afforestation; **c**. Follicles of *P. angustifolia* with nymphs of the host insect *Caenocoris nerii* (Lygaeidae); **d.** Other scrub areas along the firebreaks, on the south-eastern edge of Mount S. Calogero; **e.** Plant established in areas affected by fire; **f.** Scrub and grassland areas with *Hyparrhenia hirta*, colonizing the slopes denuded by the fires.

Results

The population of *Periploca angustifolia* on Mount S. Calogero (Sciacca) is mainly distributed across the lower and western sectors of the homonymous Nature Reserve (as well as SAC ITA040009), between the localities of Contrada Isabella, Cave di Pietra, and the easternmost part of the afforestation area (Fig. 3). The subarea occupies approximately 9 hectares, at elevations ranging from roughly 140 to 270 m a.s.l. The population is estimated at approximately 800–1000 individuals and appears to represent a relict, autochthonous nucleus well integrated into the environmental context of the area. The species grows in garrigue and low maquis vegetation, with small groups of residual individuals – including older plants in full fruiting – mostly found in clearings within the afforestation stands (Fig. 4b), as well as along the margins of firebreak strips (Fig. 4d). The population extends up to about 270 m a.s.l., even within rockfall protection barriers close to the cliffs (Fig. 4e, f). Here, the low maquis vegetation in which it occurs is common in areas stripped bare by fire and in clearings within the same afforestation stands, where it plays a clear constructive role in the recovery of more mature natural features of the local vegetation landscape.

Our surveys highlighted the presence of a particularly vigorous population of *Periploca*, with abundant fruiting and active anemochorous seed dispersal, as well as a rich presence of seedlings scattered throughout the area.

Distribution of the species on the islands of the Sicilian Channel

The first records of *Periploca angustifolia* in the Islands of the Sicilian Channel were provided by Gussone (1827) in the Aegadian Archipelago, where he reported it on the three largest islands (Favignana, Levanzo, and Marettimo). The same author later also indicated its presence on the islands of Pantelleria, Lampedusa, and Linosa (Gussone 1832). In the Maltese Archipelago, it was reported by Caruana Gatto (1890), under the name *Periploca laevigata*. Further mentions of the species were given by Riccobono (1906), within an account of his collections from Linosa and Lampedusa, where he also simultaneously indicated it in Sicily at "Modica and Girgenti." However, for these latter localities, no herbarium exsiccata are known, nor subsequent confirmations by other authors have been provided.

Another specimen of the species collected by the same author must also be noted, preserved at the Palermo Herbarium (PAL63537!). It consists of three portions of twigs of the species, on the label of which-handwritten by Riccobono himself-appears the note: "Foresta Capaci – Cultivated. 4/25/1887, Riccobono." This clearly indicates the origin of the sample, taken from a cultivated plant (in Contrada Carrubbella, where the toponym "Case Riccobono" still exists today).

In addition to this newly documented population on Mount S. Calogero, the current distribution of the species in the Sicilian Channel area—compiled from bibliographic references and unpublished data—includes the following additional localities:

- Marettimo island: Punta Bassana (Gianguzzi et al. 2006); - Favignana island: C.de Boschitto, Montagna Grossa o Grande, Punta Faraglione (Di Martino and Trapani 1967); - Levanzo Island: Faraglione, Pietre Varate, Costa Dogana, Serra Alberello, Cala Fredda (Di Martino and Trapani 1968; Romano et al. 2006); - Pantelleria island: C.da Fram, C.da Camilli, C.da Polacca, Punta Polacca, C.da Sataria (Brullo et al. 1977; Gianguzzi 1999); - Lampedusa (frequent along the coastal belt and in the dry rocky slopes; Bartolo et al. 1988) and Linosa Islands (common in rocky habitat in various localities, as Panzarella, Arena Bianca, Montagna Rossa and Monte Vulcano; Brullo and Siracusa 1996; Malta (Mistra Valley, Salina Bay, Ghar Lapsi, Naxxar, Mnajdra near Qrendi, Victoria Lines, Ghar Lapsi), Gozo (Xlendi Valley, Triq Kalati Punic) and Comino islands (Brullo et al. 2020).

Phytosociology

Table 1 reports 12 relevés carried out in the low maquis community with presence/dominance of *Periploca angustifolia*, localized within the study area, which is here proposed as a new association, described below.

***Asparago albi-Periplocetum angustifoliae* Gianguzzi, La Mantia et Cambria ass. nov.**

Holotypus: Rel. 3, Table 1

Phytosociological data: Table 1 and Table 2 (column 1).

Diagnostic species: *Periploca angustifolia* (dominant), *Asparagus albus*, *Ampelodesmos mauritanicus*, *Carlina sicula* subsp. *sicula*, *Pistacia terebinthus*, *Chamaerops humilis*.

Short description: Primary or secondary low maquis, 2–3 m tall, more or less dense or open, occurring on xeric, rocky-stony slopes, with high frequency and sometimes dominance of *Periploca angustifolia*. It is associated with several elements of the alliance *Oleo-Ceratonion siliquae* and the order *Pistacio lentisci–Rhamnetalia alaterni* (e.g., *Chamaerops humilis*, *Olea europaea*, *Pistacia lentiscus*, *Asparagus albus*, *Teucrium fruticans*, *Stachys major*, as well as of the class *Quercetea ilicis* (e.g., *Ampelodesmos mauritanicus*, *Asparagus acutifolius*, *Pistacia terebinthus*, *Arisarum vulgare*, *Allium subhirsutum*).

Based on the data reported in Table 1 and in the synoptic table (Table 2), the specific species combination that characterizes the new association, here proposed under the name *Asparago albi-Periplocetum angustifoliae*, includes the following differential taxa (all more or less frequent within the community, and rare or virtually absent on the small islands of the Strait of Sicily):

1. *Ampelodesmos mauritanicus*, diagnostic of the order *Pistacio-Rhamnetalia alaterni* and the class *Quercetea ilicis* (Rivas-Martínez et al. 2001, 2002; Gianguzzi et al. 2016). This species is very common in the studied community yet virtually absent from other *Periploca angustifolia* scrub communities of the Strait of

Table 1. *Asparago albi-Periplocetum angustifoliae* ass. nov., Sciacca, Riserva M. S. Calogero, 13.05.2025 [rel. 1 (37.51505°N, 13.1007°E), 2 (37.51513°N, 13.10071°E), 3 (37.51491°N, 13.10235°E), 4 (37.51491°N, 13.10183°E), 5 (37.51569°N, 13.11134°E), 6 (37.51638°N, 13.10997°E), 7 (37.51667°N, 13.11056°E), 8 (37.51646°N, 13.10985°E)] and 19.05.2025 [rels. 9 (37.5168883°N, 13.1105639°E), 10 (37.5163093°N, 13.1111889°E), 11 (37.5155780°N, 13.1113448°E), 12 (37.5154315°N, 13.1116401°E)]. The values indicated in brackets concern species which were identified visually during field surveys performed during vegetative dormancy (dried leaf residues). The asterisk indicates the type relevé. The presence classes are as follows: I = 1–20%; II: 21–40%; III: 41–60%; IV: 61–80%; V = 81–100%.

No. of relevé	**1**	**2**	**3***	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		**F**
Elevation (m a.s.l.)	**143**	**144**	**146**	**150**	**227**	**239**	**278**	**271**	**261**	**226**	**201**	**190**	**P**	**R**
Slope (°)	**11**	**15**	**15**	**12**	**20**	**15**	**22**	**25**	**15**	**20**	**10**	**15**	**R**	**E**
Aspect	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**E**	**Q.**
Surface (m²)	**150**	**150**	**120**	**120**	**150**	**100**	**100**	**150**	**100**	**100**	**50**	**50**	**S**	
Total cover (%)	**95**	**100**	**95**	**95**	**95**	**100**	**85**	**90**	**90**	**90**	**90**	**90**	**E**	**C**
Cover of the woody layer (%)	**85**	**90**	**80**	**90**	**90**	**80**	**75**	**85**	**70**	**75**	**85**	**80**	**N**	**L**
Cover of the herb layer (%)	**35**	**35**	**45**	**60**	**65**	**30**	**75**	**50**	**75**	**70**	**70**	**75**	**C**	**A**
Average height of the woody layer (m)	**1.5**	**1.3**	**1.3**	**1.3**	**1.7**	**2.8**	**2.2**	**2.5**	**1.3**	**1.4**	**1.7**	**1.3**	**E**	**S**
No. of taxa	**31**	**34**	**35**	**31**	**25**	**24**	**30**	**23**	**24**	**23**	**22**	**24**		**S**
Characteristic and differential association and alliance *Periplocion angustifoliae* (#)														
#*Periploca angustifolia* (dom.)	2	3	3	3	3	3	3	3	2	2	3	2	12	V
Asparagus albus	2	1	2	2	2	3	2	2	1	1	1	+	12	V
Ampelodesmos mauritanicus	2	2	1	1	1	+	1	1	3	+	+	1	12	V
Carlina sicula subsp. *sicula*	1	+	1	+	.	1	1	.	1	.	1	1	9	IV
Pistacia terebinthus	.	1	1	.	2	1	1	.	.	+	1	.	7	III
Characteristic order *Pistacio-Rhamnetalia alaterni* and class *Quercetea ilicis*														
Chamaerops humilis	3	3	2	2	2	2	1	1	1	1	3	2	12	V
Olea europaea	1	+	2	1	2	2	1	2	+	1	.	2	11	V
Teucrium fruticans	2	1	+	1	1	1	1	.	+	+	.	+	10	V
Pistacia lentiscus	1	2	2	2	.	+	+	.	+	1	1	.	9	IV
Asparagus acutifolius	1	2	1	+	+	.	.	+	+	.	.	1	8	IV
Stachys major	.	+	.	+	2	1	2	2	.	+	.	+	8	IV
Ruta chalepensis	1	+	1	.	.	2	1	.	1	.	+	+	8	IV
Ceratonia siliqua (cult.)	.	1	1	.	.	2	2	1	1	.	1	.	7	III
Arisarum vulgare	.	(+)	(+)	.	.	.	(+)	.	(+)	.	(+)	+	6	III
Allium subhirsutum	(+)	(+)	.	(+)	.	.	.	.	.	(+)	.	+	5	III
Pinus halepensis (cult.)	.	.	.	1	2	1	1	.	.	.	1	.	5	II
Cytisus infestus subsp. *infestus*	1	1	.	.	.	.	.	.	.	.	.	1	3	II
Euphorbia dendroides	.	.	.	.	.	.	.	2	.	3	.		2	I
Myrtus communis (cult.)	1	.	.	.	.	.	.	.	.	.	.	.	1	I
Artemisia arborescens	+	.	.	.	.	.	.	.	.	.	.	.	1	I
Cyclamen repandum	.	.	(+)	.	.	.	.	.	.	.	.	.	1	I
Rubia peregrina	.	.	.	+	.	.	.	.	.	.	.	.	1	I
Osyris alba	.	.	.	.	.	.	1	.	.	.	.	.	1	I
Cercis siliquastrum (cult.)	.	.	.	.	1	.	.	.	.	.	.	.	1	I
Other species														
Hyparrhenia hirta	2	1	4	2	4	+	5	2	1	2	2	2	12	V
Asphodelus ramosus	(+)	(1)	(+)	(1)	(1)	(1)	(1)	(+)	(+)	.	(+)	(1)	11	V
Bituminaria bituminosa	1	1	2	1	+	1	2	1	+	.	1	+	11	V
Foeniculum vulgare subsp. *vulgare*	1	+	1	+	2	+	2	1	1	+	+	.	11	V
Stipellula capensis	1	1	2	1	+	.	+	+	.	.	1	2	9	IV
Andropogon distachyos	1	1	+	+	.	.	+	+	.	.	+	+	8	IV
Phagnalon saxatile	1	+	+	+	.	.	1	+	+	.	.	+	8	IV
Mercurialis annua	.	+	+	.	+	1	+	+	.	+	.	+	8	IV
Brachypodium distachyon	+	+	1	.	.	+	.	+	+	.	+	.	7	III
Spartium junceum (cult.)	+	2	1	.	.	.	2	1	1	+	.	.	7	III
Squilla pancration	(1)	(1)	.	(1)	.	(1)	.	.	(+)	(1)	.	(+)	7	III
Convolvulus altheoides	+	.	+	.	+	.	+	+	.	+	.	.	6	III
Pallenis spinosa	1	+	1	+	+	.	.	.	.	.	.	1	6	III
Eryngium campestre	1	+	+	+	.	.	.	.	.	+	+	.	6	III
Lathyrus clymenum	.	.	+	.	+	+	+	+	.	.	+	.	6	III
Dactylis glomerata subsp. *hispanica*	1	.	.	+	1	.	+	.	.	.	.	1	5	II
Acanthus mollis	(+)	.	.	.	(+)	.	.	.	(+)	(+)	.	.	4	II
Galactites tomentosus	.	+	.	.	.	+	.	.	+	.	.	+	4	II
Sonchus oleraceus	.	.	+	.	+	.	.	.	+	+	.	.	4	II

No. of relevé	**1**	**2**	**3***	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**		**F**
Elevation (m a.s.l.)	**143**	**144**	**146**	**150**	**227**	**239**	**278**	**271**	**261**	**226**	**201**	**190**	**P**	**R**
Slope (°)	**11**	**15**	**15**	**12**	**20**	**15**	**22**	**25**	**15**	**20**	**10**	**15**	**R**	**E**
Aspect	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**E**	**Q.**
Surface (m²)	**150**	**150**	**120**	**120**	**150**	**100**	**100**	**150**	**100**	**100**	**50**	**50**	**S**	
Total cover (%)	**95**	**100**	**95**	**95**	**95**	**100**	**85**	**90**	**90**	**90**	**90**	**90**	**E**	**C**
Cover of the woody layer (%)	**85**	**90**	**80**	**90**	**90**	**80**	**75**	**85**	**70**	**75**	**85**	**80**	**N**	**L**
Cover of the herb layer (%)	**35**	**35**	**45**	**60**	**65**	**30**	**75**	**50**	**75**	**70**	**70**	**75**	**C**	**A**
Average height of the woody layer (m)	**1.5**	**1.3**	**1.3**	**1.3**	**1.7**	**2.8**	**2.2**	**2.5**	**1.3**	**1.4**	**1.7**	**1.3**	**E**	**S**
No. of taxa	**31**	**34**	**35**	**31**	**25**	**24**	**30**	**23**	**24**	**23**	**22**	**24**		**S**
Fumana laevipes	2	1	.	+	.	.	.	.	.	.	.	.	3	II
Crupina crupinastrum	+	.	.	+	.	.	.	.	.	.	+		3	I
Convolvulus cantabrica	.	+	.	.	.	+	.	.	1	.	.	.	3	I
Sideritis romana	.	+	.	.	.	.	+	.	.	+	.	.	3	I
Echium parviflorum	.	.	+	.	+	.	.	.	+	.	.	.	3	I
Urospermum dalechampii	.	.	+	+	.	.	.	.	.	.	.	.	2	I
Lantana camara	.	.	.	+	+	.	.	.	.	.	.	.	2	I
Micromeria graeca	.	.	.	.	.	.	1	+	.	.	.	.	2	I
Allium ampeloprasum	.	.	.	.	.	.	+	+	.	.	.	.	2	I
Capparis spinosa subsp. *rupestris*	.	1	.	.	.	.	.	.	.	.	.	.	1	I
Allium commutatum	.	.	r	.	.	.	.	.	.	.	.	.	1	I
Ononis viscosa subsp. *breviflora*	.	.	.	+	.	.	.	.	.	.	.	.	1	I
Allium obtusiflorum	.	.	.	+	.	.	.	.	.	.	.	.	1	I
Serapias cordigera	.	.	.	+	.	.	.	.	.	.	.	.	1	I
Prunus dulcis (cult.)	.	.	.	.	.	.	.	.	.	2	.	.	1	I
Plantago afra	.	.	.	.	.	.	.	.	.	.	+	.	1	I
Silene colorata	.	.	.	.	.	.	.	.	.	.	+	.	1	I

Sicily. In Sicily, however, it is also listed among the diagnostic elements of the following syntaxa:

a) *Ampelodesmo mauritanici-Quercetum ilicis* Gianguzzi et al. 2016, a *Quercus ilex* woodland found in inland areas, particularly in the Sicani Mountains (Gianguzzi et al. 2014a, 2014b);
b) *Ampelodesmo mauritanici-Juniperetum turbinatae* (Gianguzzi et al. 2012), a relict maquis community dominated by *Juniperus turbinata*, also restricted to the Sicani Mountains (central-western Sicily; Gianguzzi et al. 2016);
c) the alliance *Avenulo cincinnatae-Ampelodesmion mauritanici* Minissale 1994 and the class *Lygeo sparti-Stipetea tenacissimae* (Brullo et al. 2010), which encompasses secondary grassland aspects, typically developed on rocky meso-Mediterranean lithosols, rather steep and degraded by frequent fires. In Sicily, several associations have also been described where this species is structurally dominant (Minissale 1994).

2. *Asparagus albus*, another diagnostic taxon of the order *Pistacio lentisci-Rhamnetalia alaterni*, frequent within the community but absent on the circum-Sicilian islands (Brullo and Siracusa 1996; Giardina et al. 2007; Gianguzzi et al. 2006; Romano et al. 2006).
3. *Pistacia terebinthus*, a shrub relatively frequent in Sicily, also indicated as a characteristic element of the *Pistacio terebinthi-Celtidetum aetnensis* (Gianguzzi et al. 2014b), a maquis association dominated by *Celtis tournefortii*, with a fragmented distribution on Mt. Etna, the Nebrodi Mountains, the Sicani Mountains, and Rocca Busambra (Gianguzzi et al. 2014a).
4. *Carlina sicula* subsp. *sicula*, endemic to Sicily, linked to grassland, garrigue, and low scrub habitats, typical of rocky and xeric environments (Gianguzzi et al. 1996).
5. *Chamaerops humilis*, a diagnostic taxon of the order *Pistacio-Rhamnetalia alaterni*, dominant in some basiphilous scrub associations represented in Sicily (Brullo and Marcenò 1985; Brullo et al. 2009).

Substrates: Rocky calcareous and/or stony-debris slopes, edaphically poor or with shallow soils, occurring at the base of rock walls exposed to the South/South-East.

Bioclimate: Mediterranean oceanic pluviseasonal; lower thermomediterranean thermotype; lower dry ombrotype, tending toward semiarid conditions.

Syntaxonomic notes: The *Asparago albi-Periplocetum angustifoliae* ass. nov. is framed within the alliance *Periplocion angustifoliae* (order *Pistacio-Rhamnetalia alaterni*, class *Quercetea ilicis*). The distribution area of the alliance comprises the various islands of the Strait of Sicily [where 10 different associations have been described, summarized in the synoptic table (Table 2)], the small southern Aegean islets (Brullo and Guarino 2000), and extends across the Mediterranean fringe of Africa as far as southern Spain (Rivas-Martínez 1975).

Vegetation series: In its most typical form, the association *Asparago albi-Periplocetum angustifoliae* ass. nov. constitutes a garrigue or low maquis vegetation, acting as a transitional community linked to the following two xerophilous vegetation series: i) the *Ruto chalepensis-Oleo sylvestris sigmetum* is widespread on rocky carbonate substrates (Gianguzzi and Bazan 2020; Bazan et al.

Table 2. Simplified synoptic table of the Sicilian Region associations referred to the alliance *Periplocion angustifoliae*: **1** – *Asparago albi-Periplocetum angustifoliae* Gianguzzi, La Mantia et Cambria ass. nov., table 1; **2** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Linosa Island (from Brullo and Siracusa 1996, table 1); **3** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Pantelleria Island (from Brullo et al. 1977, table 2); **4** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Lampedusa Island (from Bartolo et al. 1988, table 2); **5** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Marettimo Island (from Brullo and Marcenò 1983, table 2); **6** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Marettimo Island at Punta Bassana (from Brullo et al. 2009, table 1a, ril. 1–7); **7** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Levanzo Island (from Brullo et al. 2009, table 1a, ril. 8–21); **8** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Favignana Island (from Brullo et al. 2009, table 1b, ril. 1–8); **9** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Levanzo Island (from Brullo et al. 2009, table 1b, ril. 9–14); **10** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Malta islands (from Brullo et al. 2020, table 5.3); **11** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *euphorbietosum papillaris*, Levanzo Island (from Brullo et al. 2009, table 1c, ril.1–7); **12** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *euphorbietosum papillaris*, Favignana Island (from Brullo et al. 2009, table 1c, ril. 8–13); **13** – *Periploco angustifoliae-Juniperetum turbinatae* subass. *typicum*, Lampedusa Island (from Bartolo et al. 1988, table 1); **14** – *Periploco angustifoliae-Juniperetum turbinatae* subass. *brassicetosum insularis*, Pantelleria Island (from Gianguzzi 1999, table 4); **15** – *Periploco angustifoliae-Rhoetum tripartitae*, Linosa Island (from Brullo et al. 2009, table 1d); **16** – *Calicotomo infestae-Rhoetum tripartitae*, Southeastern Sicily (from Brullo and Marcenò 1985, table 30); **17** – *Calicotomo infestae-Rhoetum tripartitae*, Sciacca at M. Kronio (from La Mantia et al. 2025, table 30); **18** – *Ephedro fragilis-Pistacietum lentisci*, Gela at Manfria (from Brullo et al. 2000, table 18); **19** – *Ephedro fragilis-Pistacietum lentisci*, Ragusa at Cava Randello (from Turrisi et al. 2002, table 7); **20** – *Asparago horridi-Retametum gussonei*, Gela at Manfria (from Brullo et al. 2000, table 17); **21** – *Asparago acutifolii-Ziziphetum loti*, Palermo at Allaura (Gianguzzi et al. 1996, table 4); **22** – *Asparago aphylli-Tetraclinetum articulatae*, Malta islands (from Brullo et al. 2020, table 5.2). The grey cells highlight the characteristic species of each association.

Association table	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
No. relevés	**2**	**8**	**14**	**10**	**5**	**7**	**14**	**8**	**6**	**13**	**7**	**5**	**8**	**4**	**4**	**19**	**6**	**5**	**7**	**8**	**14**	**10**
Characteristic and differential species of associations																						
Ampelodesmos mauritanicus	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carlina sicula subsp. *sicula*	IV	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pistacia terebinthus	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.
Euphorbia dendroides	I	V	V	V	III	V	V	V	V	V	V	V	.	4	2	III	V	IV	.	.	.	.
Euphorbia papillaris	.	.	.	.	.	.	.	.	.	.	V	V	.	.	.	.	.	.	.	.	.	.
Juniperus turbinata	.	.	.	.	.	.	.	.	.	.	.	.	V	4	.	.	.	.	.	.	.	.
Brassica insularis	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.
Cytisus infestus subsp. *infestus*	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	IV	III	.	.	.	.
Searsia pentaphylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.
Ephedra fragilis	.	.	.	.	II	I	.	.	.	.	.	.	.	.	.	.	.	V	V	V	.	.
Retama raetam subsp. *gussonei*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.
Characteristic of alliance *Periplocion angustifoliae*																						
Periploca angustifolia	V	V	V	V	III	V	V	V	V	V	V	V	IV	4	4	.	.	.	.	.	.	V
Searsia tripartita	.	.	II	.	.	.	.	.	.	.	.	.	.	.	4	V	V	.	.	.	.	.
Lycium intricatum	.	V	.	.	.	.	.	.	.	.	.	.	II	2	.	.	.	V	V	V	.	.
Asparagus horridus	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	III	.	V	.	V	.	.
Ziziphus lotus subsp. *lotus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.
Tetraclinis articulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Lycium schweinfurthii	.	.	III	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.
Characteristic of order *Pistacio-Rhamnetalia alaterni*																						
Pistacia lentiscus	IV	V	V	V	V	II	V	V	V	IV	V	III	V	4	4	V	.	V	V	III	.	III
Stachys major	IV	V	V	V	IV	.	V	V	IV	V	III	V	V	4	.	V	V	V	V	III	.	V
Olea europaea	V	III	II	IV	III	III	III	IV	I	II	II	IV	V	.	.	IV	V	.	.	.	II	V
Teucrium fruticans	V	.	.	V	II	V	IV	V	III	V	V	IV	V	.	.	V	V	.	.	.	.	V
Ceratonia siliqua	III	.	.	V	II	.	I	.	.	III	.	II	II	.	.	V	.	.	.	.	.	V
Rhamnus lycioides subsp. *oleoides*	.	.	.	.	IV	.	II	V	III	III	I	IV	.	.	.	.	.	.	.	.	.	V
Clematis cirrhosa	.	III	.	II	III	I	.	.	.	.	.	I	II	.	.	II	.	.	.	.	.	.
Asparagus albus	V	.	I	.	.	.	.	IV	.	.	.	V	.	.	.	III	V	.	.	.	I	.
Chamaerops humilis	V	.	.	.	.	.	.	IV	.	.	.	I	.	.	.	V	V.	.	.	.	.	.
Rhamnus alaternus	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	I	.	.	V	.	I	II
Myrtus communis	I	.	II	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia arborescens	I	.	.	.	III	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	.
Osyris alba	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.

Association table	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
No. relevés	**2**	**8**	**14**	**10**	**5**	**7**	**14**	**8**	**6**	**13**	**7**	**5**	**8**	**4**	**4**	**19**	**6**	**5**	**7**	**8**	**14**	**10**
Characteristic of class *Quercetea ilicis*																						
Asparagus acutifolius	IV	III	V	V	V	I	V	V	V	.	V	III	V	.	.	V	I	IV	V	IV	IV	.
Rubia peregrina subsp. *longifolia*	I	II	V	IV	.	.	II	.	.	III	.	II	V	3	.	IV	III	IV	V	III	IV	V
Arisarum vulgare	III	III	.	.	V	III	II	V	.	III	II	II	II	.	.	V	.	.	I	V	V	IV
Ruta chalepensis	IV	IV	.	I	IV	I	IV	V	I	.	I	IV	.	.	.	III	V	.	.	.	I	.
Phillyrea latifolia	.	.	IV	I	.	I	II	III	I	.	II	.	III	4	.	III	.	V	.	.	.	.
Smilax aspera	.	.	III	.	.	.	.	.	.	IV	.	I	II	1	.	II	.	.	.	.	II	II
Asparagus aphyllus	.	IV	.	V	.	.	.	.	.	V	.	.	V	.	.	.	.	V	.	III	.	V
Lonicera implexa	.	.	III	.	IV	.	.	.	.	III	.	I	.	3	.	.	.	.	.	.	.	V

2021) and its regressive stages are represented by grasslands dominated by *Hyparrhenia hirta* (*Hyparrhenietum hirto-pubescentis*) and by small therophytic grasslands with *Trachynia distachya* (class *Stipo-Trachynietea distachyae*); ii) the *Calicotomo infestae-Searsio tripartitae sigmetum* is typical of xeric stony-detrital substrates along eroded slopes. Its secondary aspects are again represented by the same vegetation types described for the previous series. The potential area of these two vegetation series is heavily disturbed by anthropogenic activities (e.g., afforestation, cultivation, more or less urbanized zones). In the upper part of Mount San Calogero, the same series are in catenal contact with the microgeosigmetum of cliffs, marked by sparse chasmophytic aspects referred to the alliance *Dianthion rupicolae* (class *Asplenietea trichomanis*) or to the association *Capparidetum rupestris* (class *Parietarietea judaicae*); in the lower part, they likely extend almost to the coast (Fig. 5).

Synchorology: The association is endemic to this portion of the southern Sicilian coast near Sciacca, representing a geographical vicariant of association *Periploco-Euphorbietum dendroidis*, which is found on several small islands of the Strait of Sicily (Brullo and Marcenò 1985; Brullo et al. 2009; Gianguzzi et al. 2016).

Cluster analysis and ordination of the Sicilian communities

The dendrogram resulting from the cluster analysis performed on the associations listed in the synoptic table (Table 2) highlights the presence of two main clusters (Fig. 6). The first includes the associations *Asparago acutifolii-Ziziphetum loti*, *Ephedro fragilis-Pistacietum lentisci*, and *Asparago horridi-Retametum gussonei*, all occurring only in Sicily (where *Periploca angustifolia* is entirely absent), while the second brings together a more complex and diverse set of communities, subdivided into 10 groups.

Within the first group of this second cluster, two associations dominated by *Searsia tripartita* can be distinguished: the *Calicotomo infestae-Rhoetum tripartitae* (also restricted to Sicily and lacking *Periploca angustifolia*) and the *Periploco angustifoliae-Rhoetum tripartitae* (exclusive to the island of Linosa).

The remaining associations are distributed across the other 9 groups, as follows:

1. *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum* (Island of Marettimo; Aegadian Archipelago);
2. *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum* and *Periploco angustifoliae-Euphorbietum dendroidis* subass. *euphorbietosum papillaris* (both on the Island of Levanzo; Aegadian Archipelago);
3. *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum* (Island of Marettimo; Aegadian Archipelago);
4. *Asparago albi-Periplocetum angustifoliae* ass. nov. (southern Sicily);
5. *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum* and *Periploco angustifoliae-Euphorbietum dendroidis* subass. *euphorbietosum papillaris* (Island of Favignana; Aegadian Archipelago);
6. *Asparago aphylli-Tetraclinetum articulatae* and *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum* (both located in the Maltese Islands);
7. *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum* and *Periploco angustifoliae-Juniperetum turbinatae* subass. *brassicetosum insularis* (both on the Island of Pantelleria);
8. *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum* (Island of Linosa);
9. *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum* and *Periploco angustifoliae-Juniperetum turbinatae* subass. *typicum* (both on the Island of Lampedusa).

Overall, it emerges that the most frequent and widely recognized syntaxon across the different islands of the Strait of Sicily—the association *Periploco angustifoliae-Euphorbietum dendroidis*—shows a certain floristic heterogeneity, splitting into different subclusters depending on geographical provenance. All other communities, on the other hand, tend to separate rather clearly from one another, owing to their markedly different floristic composition.

As for the *Asparago albi-Periplocetum angustifoliae* ass. nov., it shows a certain autonomy compared to the other communities considered, displaying greater similarity with the aspects of *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum* found on Favignana Island (Aegadian Archipelago).

The NMDS analysis (Fig. 7) yields similar results, with the relevés of *Periploco angustifoliae-Euphorbietum dendroidis* broadly grouped into a rather wide and irregular

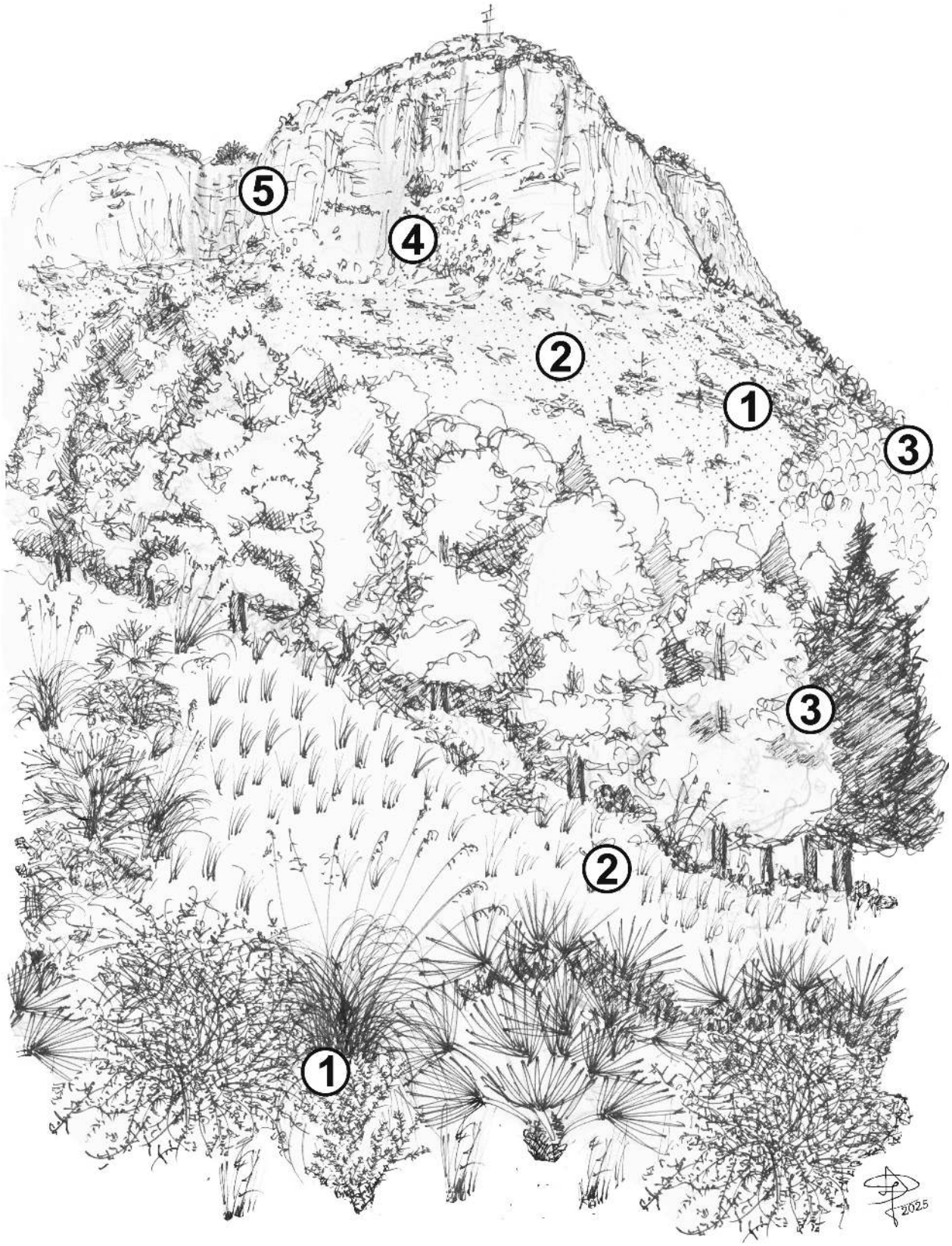


Figure 5. Scheme of the vegetation units co-occurring in the study area: (1) maquis with *Periploca angustifolia* (association *Asparago albi-Periplocetum angustifoliae* ass. nov.); (2) perennial grassland with *Hyparrhenia hirta* (association *Hyparrhenietum hirto-pubescentis*); (3) afforestation with *Pinus halepensis and Cupressus* spp. (4) chasmophytic community (alliance *Dianthion rupicolae*); (5) maquis with *Olea europaea* (association *Ruto chalepensis-Oleetum sylvestris*).

cluster, while the other communities remain fairly distant from each other.

Regarding the *Asparago albi-Periplocetum angustifoliae* ass. nov., also in this case it shows greater affinity with the relevés of *Periploco angustifoliae-Euphorbietum dendroidis* from the Aegadian Archipelago, geographically the closest.

Finally, the PERMANOVA analysis highlights significant differences in the floristic composition of the various communities investigated ($F = 3.52$; $p < 0.001$), confirming that the dissimilarities among the different associations are greater than their internal variability, and thus justifying the syntaxonomic treatment proposed.

Discussion

According to some authors (Brullo et al. 1995; Médail and Quézel 1997; Médail 2022), for *Periploca angustifolia* and other species previously confined to Northern Africa, evidence suggests that their northward expansion is linked to the Messinian Salinity Crisis (Late Miocene, ~5.96–5.33 Ma). This major geological event, caused by repeated closures of the Strait of Gibraltar, led to the desiccation of the Mediterranean Sea (Hsü et al. 1973; Fauquette et al. 2006), creating widespread arid environments and new land connections between North Africa and parts of southern Europe, as Sicily, southern Italy, Sardinia, Corsica, and the Aegean region (Roveri et al. 2014; Médail 2017).

These conditions facilitated biogeographical exchanges and the dispersal of drought-adapted taxa (Krijgsman et al. 1999). Xerophilous and halophilous species expanded northwards from North Africa into newly emergent territories, contributing to the distinctive South-Mediterranean floristic elements still observed today (Brullo et al. 1995). In Sicily, such taxa occupy diverse dry and saline habitats, including dunes, salt marshes, riverbeds, badlands, gypsum outcrops, steppe grasslands, and garrigues.

Within this context, *Periploca angustifolia* represents a relict South-Mediterranean xerophyte, surviving today on Mount San Calogero under marginal ecological conditions. Its limited distribution likely reflects historical habitat loss and human disturbance, as well as intrinsic ecological constraints. The species serves as an indicator of infra- and thermo-Mediterranean semiarid to dry environments, although its narrow elevational range suggests vulnerability to even minor environmental changes.

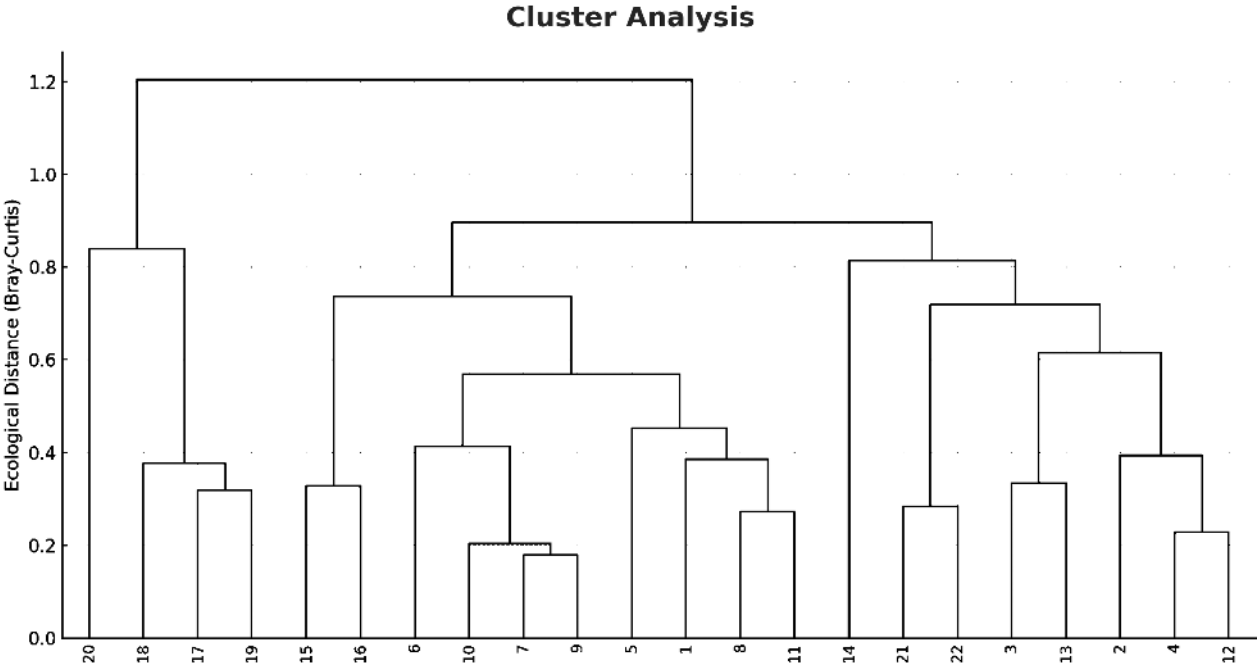


Figure 6. Cluster analysis of the communities belonging to *Periplocion angustifoliae* occurring in Sicily and nearby islands: *Periplocion angustifoliae*: **1** – *Asparago albi-Periplocetum angustifoliae* ass. nov. **2** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Linosa Island; **3** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Pantelleria Island; **4** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Lampedusa Island **5, 6** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Marettimo Island; **7, 9** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Levanzo Island; **8** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Favignana Island; **10** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *typicum*, Malta islands; **11** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *euphorbietosum papillaris*, Levanzo Island; **12** – *Periploco angustifoliae-Euphorbietum dendroidis* subass. *euphorbietosum papillaris*, Favignana Island; **13** – *Periploco angustifoliae-Juniperetum turbinatae* subass. *typicum*, Lampedusa Island; **14** – *Periploco angustifoliae-Juniperetum turbinatae* subass. *brassicetosum insularis*, Pantelleria Island; **15** – *Periploco angustifoliae-Rhoetum tripartitae*, Linosa Island; **16** – *Calicotomo infestae-Rhoetum tripartitae*, Southeastern Sicily; **17** – *Calicotomo infestae-Rhoetum tripartitae*, M. Kronio (Sciacca); **18** – *Ephedro fragilis-Pistacietum lentisci*, Gela at manfria; **19** – *Ephedro fragilis-Pistacietum lentisci*, Ragusa at Cava Randello; **20** – *Asparago horridi-Retametum gussonei*, Gela at Manfria; **21** – *Asparago acutifolii-Ziziphetum loti*, *Palermo at Allaura*; **22** – *Asparago aphylli-Tetraclinetum articulatae*, Malta islands.

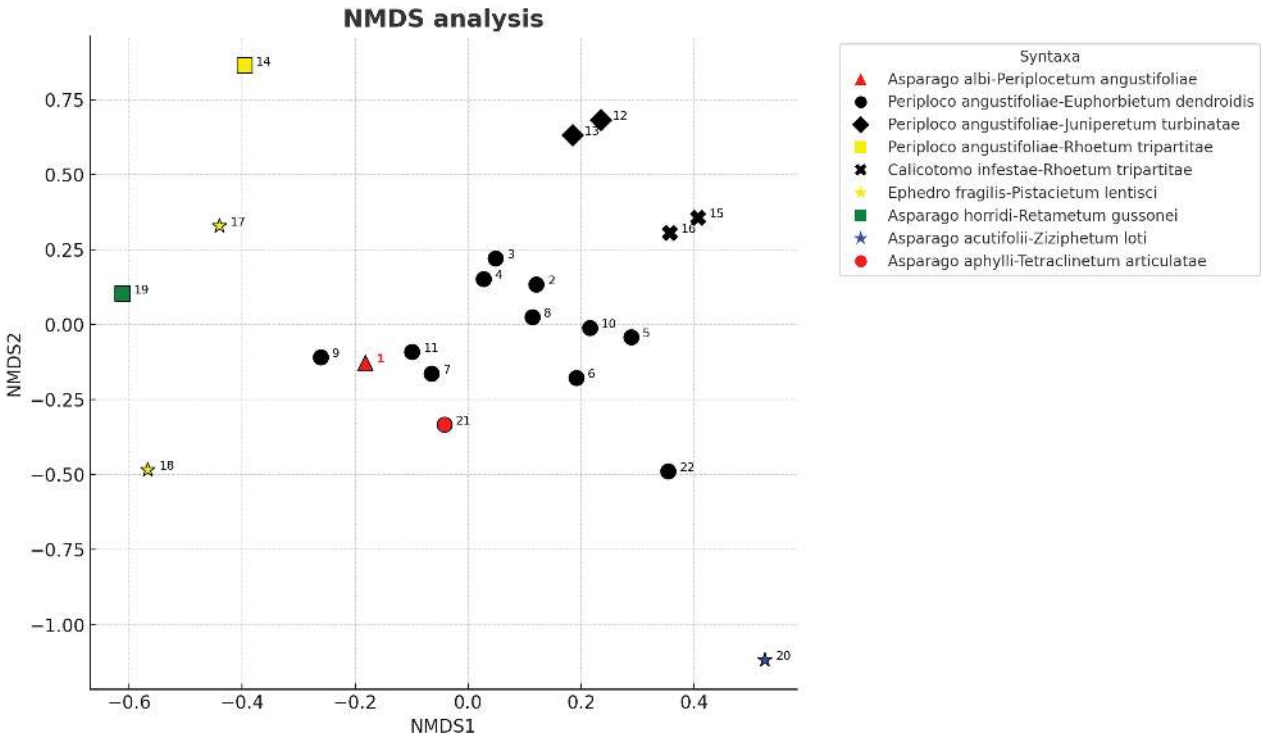


Figure 7. NMDS analysis of the communities belonging to the alliance *Periplocion angustifoliae* occurring in Sicily and nearby islands. Stress value = 0.182.

The new population grows in a low shrubland, which has been proposed as a new syntaxon (*Asparago albi-Periplocetum angustifoliae* ass. nov.), strictly endemic of this area, where it displays a clear relict character.

The new association is classified within the alliance *Periplocion angustifoliae* (order *Pistacio-Rhamnetalia alaterni*, class *Quercetea ilicis*). In agreement with various other authors (Brullo and Marcenò 1985; Mucina et al. 2016), it includes the "thermomediterranean semiarid deciduous relict low matorral of the coastal regions" of the southwestern Mediterranean (Rivas-Martínez 1975), characterized by the frequency/dominance of thermo-xerophilous shrubs with a North African affinity. In addition to *Periploca angustifolia*, other characteristic shrubs occurring in Sicily are listed (all summer-deciduous and very rare), such as *Ziziphus lotus*, *Lycium intricatum*, *Lycium schweinfurthii* (Portal to the Flora of Italy 2025; POWO 2025), *Searsia tripartita*, *S. pentaphylla* (Brullo et al. 2009; La Mantia et al. 2025), as well as *Asparagus horridus*; on the island of Malta, *Tetraclinis articulata* is also present, and considered a characteristic species of the alliance.

The classification carried out through cluster analysis as well as NMDS highlighted its clear differentiation from the other associations of the alliance represented in this central-Mediterranean sector, apart from the *Periploco-Euphorbietum dendroidis*. Indeed, the new association is considered to act as vicariant with respect to the latter community, which is also marked by the frequency/dominance of *Periploca angustifolia*. However, the *Asparago albi-Periplocetum angustifoliae* ass. nov. is clearly differentiated by its floristic assemblage, characterized by the presence of several significant species, such as *Ampelodesmos mauritanicus*, *Carlina sicula*, *Pistacia terebinthus*, *Asparagus albus* and *Chamaerops humilis*; the first three are completely absent, while the latter two are quite rare, in the other association of the small circum-Sicilian islands.

The distribution of the *Asparago albi-Periplocetum angustifoliae* ass. nov. is concentrated on the south-western slope of Mount San Calogero, where it had so far escaped botanical and naturalistic observations; this despite the fact that the site lies within a protected area (namely the Natural Reserve "Monte San Calogero", and also the Natura 2000 site ITA040009), apparently well known from a floristic point of view. Equally surprising is that a similar coincidence had already occurred in this area with *Searsia tripartita*, another very interesting xerophytic shrub of pre-desert vegetation, although found in a nearby locality (La Mantia et al. 2025). This further highlights the floristic richness of Sicily, a major biodiversity hotspot of the Mediterranean (Cowling et al. 1996; Myers et al. 2000; Mittermeier et al. 2004; Testolin et al. 2024), where field explorations continue to provide new discoveries.

On some individuals of *P. angustifolia*, we observed a notable presence of *Caenocoris nerii* (Germar, 1847 (Heteroptera: Lygaeidae)) (Fig. 4c), an interesting oligophagous insect associated with Apocynaceae and also commonly found on *Nerium oleander* L. (Pericart 1998; Olivieri 2013), but relatively rare in Sicily (Pokharel et al. 2021). This insect exhibits a South Mediterranean and Paleotropical distribution, with occurrences in certain European countries, and has previously been recorded on *Periploca angustifolia* in the islands of the Sicilian Channel (Pisciotta et al. 2011; Zito et al. 2011, 2013).

These species, which are subject to pressures and threats, including afforestation interventions carried out in the area. These were implemented in past decades—partly

even before the establishment of the natural reserve and the SAC—but it is evident that such interventions negatively interfered with native formations, almost completely erasing the relict patches of *Periploca angustifolia* shrublands (here classified to the association *Asparago albi-Periplocetum angustifoliae* ass. nov.) and the even smaller patches of *Searsia tripartita* (in turn referred to the association *Calicotomo-Rhoetum tripartitae*; Brullo et al. 2009; La Mantia et al. 2025). Both associations were confined by human activities—formerly agricultural, more recently forestry—confined to ever smaller spaces, and driven nearly to extinction. It is also evident that they were favored by the wildfires of recent years, which partially destroyed forest plantations.

Indeed, the new spaces opened up by fire have created clearings and grassland habitats more favorable to the *Asparago albi-Periplocetum angustifoliae* ass. nov., starting from the plants and small vegetation nuclei that had survived along hedges or at the margins of afforestations. This has led to an evident recovery of this shrub vegetation on the more xeric slopes, where the aforementioned community shows its climacic potential.

A comparable case to *Periploca angustifolia* is that of *Ptilostemon greuterii*, a Tertiary relict shrub endemic to northwestern Sicily and originally known from a single, very small population on Mount Inici (Raimondo and Domina 2006; Domina and Castellano 2012; Rossi et al. 2013; Gianguzzi et al. 2022). The species was already critically endangered due to anthropogenic conifer afforestation, which altered the local microclimate by increasing shade and inhibiting growth and regeneration. The situation appeared to worsen after a wildfire destroyed much of the pine plantation, but the event ultimately proved beneficial: thanks to a persistent soil seed bank, *P. greuterii* regenerated quickly once open, sunny, nutrient-rich conditions were restored. This led to the development of a new plant community, *Malvo parviflorae–Ptilostemetum greuterii*.

This case exemplifies how disturbance events, such as fire, can unexpectedly promote the resilience and regeneration of rare Mediterranean taxa when they restore natural habitat conditions, emphasizing the ecological importance of seed banks and habitat openness for relict and endemic species survival. These examples highlight the need for careful consideration, given the numerous afforestations efforts across Sicily and the Mediterranean—both historically and today—sometimes even in ecologically unique biotopes. Such interventions, often undertaken for hydrogeological protection or environmental restoration can disrupt native vegetation, alter ecosystem processes, and threat biodiversity. The popular notion of "planting a million trees to save the planet" is insufficient if actions lack scientific guidance and fail to use species suited to local ecosystems. Inappropriate afforestations can cause habitat regression, degradation, and loss of biodiversity, placing rare communities and endemic species at particular risk due to their heightened sensitivity to ecological changes (Capotorti et al. 2020; Casavecchia et al. 2021). The goal should be the restoration of native vegetation, emphasizing the reintroduction of characteristic species often lost due to human impact. Poorly planned interventions can degrade ecosystems and threaten sensitive species, particularly in protected areas and Natura 2000 sites, contradicting the conservation objectives of the Habitats Directive (92/43/EEC).

Conclusions

In addition to reporting a new stand of *Periploca angustifolia*, so far unrecorded for mainland Sicily, this study provided an updated distribution of this interesting species, while also clarifying its synecological and phytosociological features. In agreement with the opinion of several authors, its presence at this specific site in Sicily is probably due to the ancient territorial connections with North Africa during the Messinian, when many species reached Sicily.

Finally, the newly described community *Asparago albi–Periplocetum angustifoliae* illustrates how fire can enhance the regeneration of rare Mediterranean taxa in areas impacted by improper afforestations. Therefore, this remark should be considered when formulating the conservation measures planned for this community within the "Monte San Calogero (Sciacca)" Natura 2000 site (SAC ITA040009). This is of particular importance also because it pertains to the priority habitat "5220* Matorral arborescent with *Ziziphus*," which is listed in Annex I of the Habitats Directive (92/43/EEC) due to its rarity and the need for strict protection.

Syntaxonomic scheme

Quercetea ilicis Br.-Bl. ex A. et O. Bolòs 1950
Pistacio lentisci-Rhamnetalia alaterni Rivas-Martínez 1975
Periplocion angustifoliae Rivas-Martínez 1975
- *Calicotomo infestae-Rhoetum tripartitae* Bartolo, Brullo et Marcenò 1982
- *Asparago acutifolii-Ziziphetum loti* Gianguzzi, Ilardi et Raimondo 1996
- *Ephedro fragilis-Pistacietum lentisci* Brullo, Guarino et Ronsisvalle 2000
- *Asparago horridi-Retametum gussonei* Brullo, Guarino et Ronsisvalle ex Brullo, Giusso, Siracusa et Spampinato 2001
- *Periploco angustifoliae-Juniperetum turbinatae* Bartolo, Brullo, Minissale et Spampinato 1990
  - subass. *typicum*
  - subass. *brassicetosum insularis* Brullo, Gianguzzi, La Mantia et Siracusa 2009
- *Periploco angustifoliae-Rhoetum tripartitae* Brullo, Gianguzzi, La Mantia et Siracusa 2009
- *Periploco angustifoliae-Euphorbietum dendroidis* Brullo, Di Martino et Marcenò 1977
  - subass. *typicum*
  - subass. *euphorbietosum papillaris* Brullo, Gianguzzi, La Mantia et Siracusa 2009
- *Asparago aphylli-Tetraclinetum articulatae* Brullo, Brullo C., Cambria et Giusso Del Galdo 2019
- *Asparago albi-Periplocetum angustifoliae* Gianguzzi, La Mantia et Cambria ass. nov.

Author contributions

Conceptualization, L.G., A.L.M., S.C.; methodology, L.G., A.L.M., R.R., A.V., S.C.; investigation, L.G., A.L.M., R.R., A.V., S.C.; data curation, L.G., A.L.M., R.R., A.V., S.C.; data elaboration, L.G., A.L.M., S.C.; writing—original draft preparation, L.G., S.C.; writing—review and editing, L.G., A.L.M., R.R., A.V., S.C.; drawings, L.G. All authors have read and agreed to the final version of the manuscript.

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Supplementary material 1

Taxonomic treatment and selected specimens examined

Authors: Lorenzo Gianguzzi, Antonino La Mantia, Riccardo Rocca, Andrea Volpe, Salvatore Cambria

Data type: docx

Explanation note: The supplementary file includes the taxonomic treatment and selected specimens examined.

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