



The lichens of Roccamonfina volcano (southern Italy)

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With 5 figures and 2 tables

Abstract: The extinct volcano of Roccamonfina covers a 380 square Km area, partly occupied by a species-rich natural reserve that is currently endangered due to increasing urbanization and human activity. With the aim to integrate the current knowledge on the lichens of this area, sampling was conducted on 25 sites at different altitudes and with different degrees of human disturbance. Data were submitted to multivariate analysis, including morpho-functional attributes. Overall, 195 taxa were identified, including 13 epiphytic species needing protection. Crustose and foliose lichens were the most frequent (50% and 37%, respectively), followed by fruticose (10%) and squamulose species (3%). Most species reproduce sexually by ascospores (67%), the remaining part vegetatively by lichenised propagules. The number of species per station was found to increase with altitude, though a relative decrease was detected at the highest elevations. Both the number and the quality of species confirmed the high naturalistic value of the Roccamonfina complex. Altitude and disturbance were identified as the most relevant drivers of lichen diversity, both being related with the conservation and continuity of the most ancient chestnut stands, a fact that should be considered for future conservation policies.

Key words: biodiversity, chestnut, endangered species, lichen flora, Lobaria.

Introduction

No area was left on our planet that did not experience changes, directly or indirectly connected to human activities. The Mediterranean Basin is one of the richest hotspots of biodiversity, hosting many species which today are endangered by the intense rate of environmental change (Conti et al. 2005, Meyers 1988). Among the endangered organisms, lichens as well are globally challenged, due to a complex of factors such as habitat loss and fragmentation, climate change, air pollution, invasion by alien species (Scheidegger & Werth 2009). Assessing and monitoring natural resources is

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the preliminary step to successfully implementing environmental and conservation policies (Loppi et al. 1999). Accurate censuses are necessary for characterizing the biodiversity value of a given area. At present, this type of knowledge is still lacking for several areas of southern Italy, particularly as far as lichens are concerned. Recent papers have analyzed the lichen flora of selected areas of the Campania region (e.g. Aprile et al. 2001, Garofalo et al. 2010), but much work is needed to fully describe its lichen flora. In a very ancient work, Terracciano (1873) provided a list of lichens from the Caserta district; Ferrero (1873) published a list of lichens generically referred to the Roccamonfina Volcano, although without sufficiently clear locations. In more recent times, some research has been conducted in this area, with a floristic inventory (Catalano & Aprile 2009), a study on the use of lichens as air quality indicators (Aprile et al. 2011) and two studies on lichen bioindication in forest environments (Catalano et al. 2010, Nascimbene et al. 2013a).

With this work we provide a further contribution to the knowledge of the lichens of the Roccamonfina complex, based on material gathered during recent field work.

Materials and methods

STUDY AREA: The study area covers a 380 square Km mountain region, with most of the sampling plots inside the Roccamonfina-Foce Garigliano Natural Park. The altitude ranges from c. 50 to 1000 m (Fig. 1, Table 1). Sampling was conducted in an area approximately ranging from 409710 m to 427910 m along the East direction and from 4560186 m to 4579249 m along the North direction (UTM-WGS84-system metric coordinates).

The area was interested by active volcanism from 630,000 to 50,000 years ago (De Rita & Giordano 1996), and today has the typical land form of a caldera, which originated after the collapsing of the original stratovolcano. A rather contrasting set of environmental drivers affect the ecology of the area, as increasing urbanization and human activities are partly balanced by protection and restoration programs. The Natural Park also includes the disjointed integral reserve of "Lago delle Corree", a small lake behaving as an "island habitat", suffering a dramatic reduction of plant diversity due to the impact of the surrounding agricultural matrix (Croce et al. 2012). All areas contiguous to the Regional Park are now experiencing a rapid process of industrial reconversion (Aprile et al. 2011). The average yearly rainfall ranges from about 880 mm at the lower altitudes to 1120 mm in upland areas, with a relatively intense drought period during summer, whose extent tends to reduce with altitude. Average temperatures get maximum values during July and August, minimum values during January, with yearly averages ranging from c. 16°C in the foothills to 14°C in upland areas. Cold-dry winter winds blow from North-East, whereas western seawinds tend to predominate during summer. Above 400 m, the vegetation is dominated by chestnuts, orchards and coppice stands. In the most typical stands, chestnuts (*Castanea sativa* Miller) are associated with *Quercus cerris* L., *Acer campestre* L. and *Acer neapolitanum* Ten. Below 400 m, the original *Quercus ilex* L. Mediterranean forest has been replaced since very long time by human-grown olive trees (*Olea europaea* L.) and vineyards. Mediterranean maquis is represented in several areas, with scattered sclerophyllous shrubs such as *Arbutus unedo* L., *Myrtus communis* L., *Erica arborea* L. Wherever the soil is not cultivated, small woods of *Populus* sp. and shrubs of *Cytisus scoparius* (L.) Link or *Cistus* sp. tend to cover the area, as well as some isolated populations of *Pinus pinaster* Aiton subsp. *pinaster*.

FIELD SAMPLING: field sampling was carried out from 2006 to 2010 on 25 sites located at different altitudes and with different degrees of disturbance (Table 1). Each area was extensively sampled in all the available substrates. Thalli were collected and brought to laboratory for identification, that was done referring to Clauzade & Roux (1985), Nimis (1987, 1992), Nimis & Bolognini (1993) and Nimis & Martellos (2004). For some critical groups, the monographs of Versegly (1962), Puntillo (1989), Vitikainen (1994), Giordani et al. (2002, 2003), were also checked. Nomenclature follows

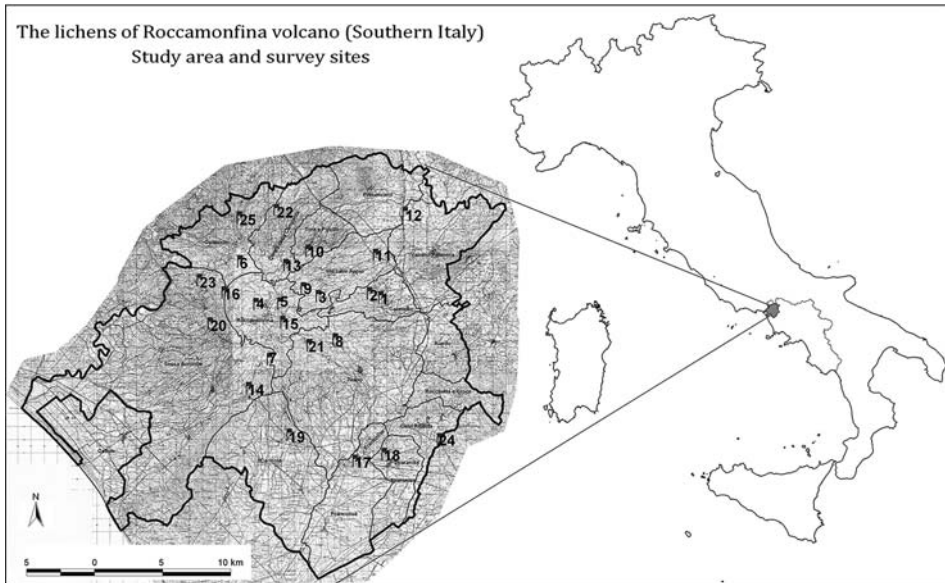


Fig. 1. Map of the study area.

the "Index Fungorum" database (<http://www.indexfungorum.org>), also taking into account the Information System on Italian Lichens (Nimis & Martellos 2008).

DATA ANALYSIS: Classification and ordination analysis were applied to the most frequent lichen species. The species represented in at least 30% of the stations (82 taxa) were included in the data matrix for multivariate analysis, whereas all low-frequency species were considered only in further steps of data analysis. Multivariate analysis was based on presence/absence of species in the sampling stations and included a cluster analysis with weighted pair-group method with averaging (WPGMA) and Sorensen distance, and a 2-axis non-metric multidimensional scaling (NMDS) with Sorensen index of distance. SINTAX 2000 package (Podani 2001) was used for all the analysis. In a second step, an analysis was carried out on some functional attributes reported in the ITALIC database (Nimis & Martellos 2008), among which: substrate, thallus morphology and reproductive strategy. The biodiversity value of the sampled areas was also evaluated on the basis of the red lists for Italian lichens (Nimis & Martellos 2008), and the catalogue of critical epiphytic lichens reported by Nascimbene et al. (2013a).

CATALOGUE: The species are arranged in alphabetical order, and, for each species, information is provided about the main substrates. Sample plots (referred as "Loc.") are numbered according to the list in Table 1. For species already recorded in the study area, literature references are provided. An asterisk precedes the species which are new to Campania.

Results

LIST OF SPECIES:

Acrocordia conoidea (Fr.) Körb. – Saxicolous. Frequent on shady rocks. Loc. 1, 2, 3, 5, 6, 7, 9, 13, 15, 16, 25.

Table 1. Localization of the sampling sites.

Station	WGS 84		Altitudinal range (m a.s.l.)	Location
1	423474	4572596	160–200	Caianello
2	422613	4572917	230	Santa Lucia
3	418730	4572704	360	Campagnola
4	414005	4572087	800–1000	Monte Santa Croce
5	415820	4572141	500–600	Roccamonfina
6	412797	4575317	570–630	Sipicciano
7	415019	4567906	350–450	Valogno
8	420019	4569414	180–350	Teano
9	417590	4573292	270–360	Marzano Appio
10	417963	4576135	300	Tora e Picilli
11	423020	4575839	90–130	Lago delle Corree
12	425268	4579126	100	Lago di Vairano
13	416269	4575060	600–680	Conca della Campania
14	413443	4565719	200–300	Cascano
15	416038	4570739	560	Garofali
16	411573	4572982	900	Monte la Frascara
17	421514	4560186	50–100	Francolise
18	423719	4560694	150–200	Sparanise
19	416520	4562174	100–150	Croce di Casale
20	410538	4570620	400	Cescheto
21	418022	4568990	400	Casafredda
22	415538	4579249	380–450	Mignano Montelungo
23	409710	4573927	390–490	San Carlo di Sessa Aurunca
24	427910	4561822	100–150	Calvi Risorta
25	412734	4578685	300	Galluccio

Acrocordia gemmata (Ach.) A.Massal. – Epiphytic. Sporadic on the bark of various trees. Loc. 3, 5, 6, 9.

Acrocordia macrospora A.Massal. – Saxicolous. Rare on siliceous rocks. Loc. 5, 6, 9.

Alyxoria varia (Pers.) Ertz & Tehler – Epiphytic. Rare on *Castanea*. Loc. 6.

Amandinea punctata (Hoffm.) Coppins & Scheid. – Epiphytic. Most common on the bark of various trees. Loc. 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 21, 22, 25.

Anaptychia ciliaris (L.) Körb. – Epiphytic. Common on the bark of *Castanea* and *Quercus pubescens*. Loc. 4, 5, 6, 7, 8, 9, 13, 14, 15, 16, 21, 22.

Arthonia atra (Pers.) A. Schneid. – Epiphytic. Common on the smooth bark of various trees. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 21, 22, 23, 24.

Arthonia punctiformis Ach. – Corticolous. Fairly common on the bark of *Quercus ilex* L., *Olea* and other trees. Loc. 12, 17, 18, 19, 20, 21.

Arthonia radiata (Pers.) Ach. – Epiphytic. Frequent on the bark of various trees. Loc. 1, 2, 8, 10, 11, 12, 17, 18, 19, 20, 23, 24.

Arthopyrenia cinereopruinosa (Schaer.) A.Massal. – Epiphytic. Rare on the trunks of *Fraxinus ornus*. Loc. 8.

Aspicilia caesiocinerea (Nyl. ex Malbr.) Arnold – Saxicolous. Sporadic on basalt. Loc. 5, 6, 9, 10.

Aspicilia cinerea (L.) Körb. – Saxicolous. Sporadic, often with the previous species. Loc. 5, 6, 9, 10. (Terracciano: Roccamonfina).

Aspicilia contorta (Hoffm.) Kremp. **subsp. hoffmanniana** S.Ekman & Fröberg – Saxicolous. Very common on walls. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18, 19, 20, 21, 24, 25.

Aspicilia intermutans (Nyl.) Arnold – Saxicolous. Sporadic on basalt. Loc. 4, 5, 6, 7, 8, 9, 10, 13, 20, 23, 24.

Bacidia rosella (Pers.) De Not. – Epiphytic. Very rare on the bark of *Castanea*. Loc. 6, 7, 8. This species is in the Red List of lichens for Italy (Nascimbene et al. 2013a). It seems to be declining in N Italy, whereas it is still abundant in some areas of S Italy (Nimis & Martellos 2008). In the study area it is not frequent.

Bacidia rubella (Hoffm.) A.Massal. – Epiphytic. Extremely rare, with the previous species. Loc. 6, 7.

Bacidina phacodes (Körb.) Vězda – Epiphytic. Rare on *Castanea*. Loc. 5, 6, 7.

Baeomyces rufus (Huds.) Rebert. – Saxicolous. Rare on sandstones. Loc. 4.

Bagliettoa cazzae (Zahlbr.) Vězda & Poelt – Saxicolous. Very rare on calcareous rocks. Loc. 16.

Calicium abietinum Pers. – Epiphytic. Extremely rare in bark fissures of *Castanea*. Loc. 6.

Caloplaca arenaria (Pers.) Müll.Arg. – Saxicolous. Common on roadside walls. Loc. 1, 2, 3, 5, 8, 9, 10, 12, 13, 15, 17, 18, 19, 20, 22, 23, 24.

Caloplaca cerina (Hedw.) Th.Fr. **v. cerina** – Epiphytic. Sporadic on *Quercus pubescens* and *Olea*. Loc. 2, 3, 8, 10, 20, 25.

Caloplaca cerinella (Nyl.) Flagey – Epiphytic. Uncommon on *Quercus pubescens* and *Juglans*. Loc. 1, 2, 10, 11, 12, 17, 18.

Caloplaca citrina (Hoffm.) Th.Fr. – Saxicolous. Very common on rocks and roadside walls. Loc. 1, 2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Caloplaca ferruginea (Huds.) Th.Fr. – Epiphytic. Widespread in the study area. Frequent on *Quercus pubescens* and *Castanea*. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 14, 15, 16, 20, 21, 22, 23, 25. (Terracciano: Roccamonfina).

Caloplaca flavescens (Huds.) J.R.Laundon – Saxicolous. Common on basaltic rocks and walls. Loc. 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 20, 21, 22, 23, 24.

Caloplaca flavorubescens (Huds.) J.R.Laundon – Epiphytic. Very rare on trunks of *Castanea*. Loc. 4.

Caloplaca herbidella (Hue) H.Magn. – Epiphytic. Rare on wood and bark of *Castanea*. Loc. 4, 5, 6, 7. This species is in the Red List of lichens for Italy (Nascimbene et al. 2013a). According to Nimis & Martellos (2008) it is totally absent in the plains of N Italy. These authors also argue that the samples found in Mediterranean areas of southern Italy (e.g. on *Olea* and *Juniperus* spp.) could belong to a different taxon.

Caloplaca pyracea (Ach.) Th.Fr. – Epiphytic. Quite frequent on the bark of various *Quercus* species, *Juglans* and *Olea*. Loc. 1, 2, 8, 9, 10, 11, 12, 17, 20, 22, 24.

Caloplaca saxicola (Hoffm.) Nordin – Saxicolous. Extremely rare on rocks. Loc. 10.

Caloplaca teicholyta sensu auct. brit. p.p. – Saxicolous. Rare along roads and in urban areas. Loc. 1, 3.

Candelaria concolor (Dicks.) Arnold – Epiphytic. Found on the bark of various *Quercus* species, *Juglans* and *Castanea*. Loc. 1, 2, 5, 7, 8, 10, 11, 12, 14, 15, 19, 20, 21, 22, 23, 25.

Candelariella aurella (Hoffm.) Zahlbr. – Saxicolous. Very common on roadside walls. Loc. 1, 2, 3, 5, 6, 7, 8, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Candelariella reflexa (Nyl.) Lettau – Epiphytic. Sporadic on the trunks of various trees. Loc. 1, 2, 7, 8, 10, 11, 12, 20, 22.

Candelariella vitellina (Hoffm.) Müll.Arg. – Saxicolous. Common on basaltic rocks. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 20.

Candelariella xanthostigma (Pers. ex Ach.) Lettau – Epiphytic. Not frequent on the bark of *Castanea* and *Quercus*-species. Loc. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 20.

**Carbonea vitellinaria* (Nyl.) Hertel – Parasitic. Extremely rare on *Candelariella vitellina*. Loc. 5. New to Campania. In S Italy the only other records are from Basilicata and Calabria (Nimis & Martellos 2008).

Catillaria nigroclavata (Nyl.) J.Steiner – Epiphytic. Common on the trunks of various trees. Loc. 5, 6, 7, 8, 9, 10, 14, 15, 16, 22.

Chrysotrix candelaris (L.) J.R.Laundon – Epiphytic. Rather rare on the trunks of various trees. Loc. 1, 2, 8, 10, 11.

Cladonia coniocraea (Flörke) Spreng. – Terricolous and epiphytic. Frequently found on the soil or on trunks of *Castanea*. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 21, 22.

Cladonia convoluta (Lam.) Anders – Terricolous. Common on soil and in rock fissures. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 20, 21, 22, 23, 25.

Cladonia fimbriata (L.) Fr. – Terricolous. Sporadic on soil and wood. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 21.

Cladonia foliacea (Huds.) Willd. – Terricolous. Frequent on mosses on basaltic rocks, often with *C. convoluta*. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 20, 21, 22, 23.

Cladonia furcata (Huds.) Schrad. – Terricolous. Very rare on epilithic mosses. Loc. 5, 6.

Cladonia parasitica (Hoffm.) Hoffm. – Epiphytic. Rare on the basal part of the trunks of *Castanea*. Loc. 5, 6, 7, 9.

Cladonia pocillum (Ach.) O.J.Rich. – Terricolous. Rather rare on soil and epilithic mosses. Loc. 5, 6, 7, 8, 9, 15, 20.

Cladonia pyxidata (L.) Hoffm. – Terricolous and epiphytic. Fairly common on soil, in rock fissures and on moss-covered basal parts of trunks. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Cladonia rangiformis Hoffm. – Terricolous. Very common in clearings on plant detritus or on soil in rock cracks. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 18, 20, 21, 22, 23, 24, 25.

Cladonia subrangiformis L. Scriba ex Sandst. – Terricolous. Not very common, often found with the previous species. Loc. 5, 6, 7, 9, 20, 23.

Collema crispum Weber ex F.H.Wigg. var. *crispum* – Saxicolous. On walls and epilithic mosses. Loc. 6, 16.

Collema furfuraceum Du Rietz – Epiphytic. Very rare on the trunks of *Castanea* and *Quercus pubescens*. Loc. 6.

Collema nigrescens (Huds.) DC. – Epiphytic. Sporadic on the bark of *Quercus pubescens* and sometimes on *Castanea*. 1, 2, 4, 5, 6, 7, 8, 14.

Collema subflaccidum Degel. – Epiphytic. Rare on the old trunks of *Castanea*. Loc. 4, 6, 9, 13.

"*Dendrocaulon umhauense*" (Auersw.) – Epiphytic. Extremely rare on trunks of *Castanea*. Loc. 13. This species is actually the photomorph of *Ricasolia amplissima* (Scop.) De Not, and it corresponds to *Lobaria amplissima* (Scop.) Forssell var. *umhausensis* (Auersw.) Nimis, a taxon included in the Red List of lichens for Italy (Nascimbene et al. 2013a). Second site in Campania after the reports from Amalfi and Capo Palinuro (Nimis & Tretiach 2004).

Dermatocarpon minutum (L.) W.Mann – Saxicolous. Extremely rare on rocks. Loc. 10.

Diploicia canescens (Dicks.) A.Massal. – Epiphytic. Very rare on bark of *Olea*. Loc. 20.

Diploschistes muscorum (Scop.) R.Sant. – Terricolous. Uncommon on terricolous mosses. Loc. 3, 5, 6, 10.

Diploschistes ocellatus (Fr.) Norman – Saxicolous. Sporadic in rock fissures. Loc. 3, 5, 6.

Diploschistes scruposus (Schreb.) Norman – Saxicolous. Very rare on rocks. Loc. 5, 6.

Diplotomma alboatrum (Hoffm.) Flot. – Epiphytic. Very rare on old trunks of *Castanea*. Loc. 6.

Diplotomma turgidum A.Massal. – Epiphytic. Uncommon on smooth bark of various trees. Loc. 20, 23, 24.

Enchylium tenax (Sw.) Gray – Terricolous. On soil and epilithic mosses. Loc. 3, 4, 5, 6, 7, 8, 9, 15, 16, 22.

Evernia prunastri (L.) Ach. – Epiphytic. Frequent on the trunks of various trees. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25.

Flavoparmelia caperata (L.) Hale – Epiphytic. Very frequent on the bark of various trees and on epilithic mosses. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Fuscopannaria mediterranea (Tav.) P.M.Jørg. – Epiphytic. Extremely rare on the basal part of the trunks of *Castanea*. Loc. 6.

Fuscopannaria olivacea (M.Jørg.) P.M.Jørg. – Epiphytic. Extremely rare, with the previous species. Loc. 6.

Graphis scripta (L.) Ach. – Epiphytic. Common on the trunks of various trees, particularly on smooth bark. Loc. 1, 7, 8, 11, 12, 20, 22, 23, 25.

**Haematomma ochroleucum* (Neck.) J.R.Laundon *v. porphyrium* (Pers.) J.R.Laundon – Epiphytic. Rare on the basal part of old trunks of *Castanea*. Loc. 4, 6. First report for Campania of a species typical of mild-temperate climates, previously reported for S Italy only from Calabria (Nimis & Martellos 2008).

Hyperphyscia adglutinata (Flörke) H.Mayrhofer & Poelt – Epiphytic. Very common on young twigs of *Salix* sp., *Juglans*, *Populus* sp. and *Castanea*. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Hypogymnia physodes (L.) Nyl. – Epiphytic. Rare on the bark of *Castanea*. Loc. 4, 6.

Hypogymnia tubulosa (Schaer.) Hav. – Epiphytic. Rare, often with the previous species. Loc. 6.

Ingvariella bispora (Bagl.) Guderley & Lumbsch – Saxicolous. Very rare on brown leucitic tuff. Loc. 10.

Lecania cyrtella (Ach.) Th.Fr. – Epiphytic. Sporadic with *Xanthorion* species. Loc. 1, 2, 8, 10, 20.

Lecanora allophana (Ach.) Nyl. – Epiphytic. Sporadic on the bark of *Sambucus nigra* and *Castanea*. Loc. 7, 8, 10, 14, 20.

Lecanora campestris (Schaer.) Hue – Saxicolous. Not common on basaltic rocks. Loc. 3, 4, 5, 6, 7, 13, 14, 15, 21, 22. (Terracciano: Roccamonfina).

Lecanora carpinea (L.) Vain. – Epiphytic. Very common on the bark of *Quercus* sp. and *Castanea*. Loc. 4, 5, 6, 7, 9, 13, 14, 15, 21, 22.

Lecanora chlarotera Nyl. – Epiphytic. Ubiquitous on the bark of various trees. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Lecanora dispersa (Pers.) Röhl. – Saxicolous. Very common on a wide variety of rocks. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Lecanora expallens Ach. – Epiphytic. Not common on the bark of *Castanea*. Loc. 4, 5, 6, 7, 9, 15, 22.

Lecanora gangaleoides Nyl. – Saxicolous. Very rare on the leucitic tuffs of "Ciampate del Diavolo". Loc. 10.

Lecanora hagenii (Ach.) Ach. – Epiphytic. Frequent on the bark of various trees. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 20, 23, 25.

Lecanora horiza (Ach.) Röhl. – Epiphytic. Not common on the bark of various trees. Loc. 1, 8, 20, 23.

Lecanora pulicaris (Pers.) Ach. – Epiphytic. Rare on the bark of various trees. Loc. 4, 5, 6, 9, 13.

Lecanora pycnocarpa H. Magn. – Epiphytic. Common on the bark of *Castanea* and *Quercus pubescens*. Loc. 4, 5, 6, 7, 8, 9, 13, 21, 22.

Lecanora sambuci (Pers.) Nyl. – Epiphytic. Sporadic on the bark of *Sambucus nigra* and *Populus* sp. Loc. 1, 2, 4, 5, 8, 17, 18, 19, 20, 24, 25.

Lecanora sulphurea (Hoffm.) Ach. – Saxicolous. Very rare on basic silicates. Loc. 10,13.

Lecanora symmicta (Ach.) Ach. – Epiphytic. Rare on old trunks of *Castanea*. Loc. 5, 6, 7.

Lecidea fuscoatra (L.) Ach. – Saxicolous. Sporadic on roadside walls and basaltic rocks. Loc. 3, 4, 5, 6, 7, 13, 14, 15, 21, 22. (Terracciano: Roccamonfina and Teano).

Lecidella carpathica Körb. – Saxicolous. Rare, on walls. Loc. 3, 5.

Lecidella elaeochroma (Ach.) M.Choisy – Epiphytic. Very common throughout the study area on the trunks of various trees. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Leprocaulon microscopicum (Vill.) Gams – Epiphytic and terricolous. Frequent on the bark of *Castanea* and *Olea*; sporadic in rocks fissures. Loc. 4, 5, 6, 7, 9, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Leptogium cyanescens (Rabenh.) Körb. – Epiphytic. Very rare on the bark of old trees of *Castanea*. Loc. 6. The species is in the Red List of lichens for Italy (Nascimbene et al. 2013a).

Lichinella stipatula Nyl. – Saxicolous. Extremely rare on the leucitic tuffs of "Ciampate del diavolo". Loc. 10. This is the second report from Campania, after that by Nimis and Tretiach (2004) from one site on the Vesuvius.

Lobaria amplissima (Scop.) Forssell **var. amplissima** – Epiphytic. Sporadic on old trunks of *Castanea*, often with *Lobarion* species. Loc. 5, 6, 9. The species is in the Red List of lichens for Italy (Nascimbene et al. 2013a).

Lobaria pulmonaria (L.) Hoffm. – Epiphytic. Frequent on the trunks of *Castanea* and *Quercus pubescens*; sometimes on epilithic mosses. Loc. 4, 5, 6, 7, 9, 13. The species is in the Red List of lichens for Italy (Nascimbene et al. 2013a).

Lobarina scrobiculata (Scop.) Nyl. – Epiphytic. Rare on old trunks of *Castanea* . Loc. 5, 6. The species is in the Red List of lichens for Italy (Nascimbene et al. 2013a).

Lobothallia radiosa (Hoffm.) Hafellner – Saxicolous. Ubiquitous on roadside walls. Loc. 3, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 22, 24, 25.

Melanelixia fuliginosa (Fr. ex Duby) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch ssp. *fuliginosa* – Epiphytic. Frequent on the barks of various trees. Loc. 4, 5, 6, 7, 9, 13, 14, 15, 16, 21, 22, 25.

Melanelixia glabra (Schaer.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – Epiphytic. Very common all over the study area on the bark of various trees. Loc. 3, 4, 5, 6, 7, 9, 13, 14, 15, 16, 21, 22.

Melanelixia subaurifera (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – Epiphytic. Common on the trunks of various trees. Loc. 3, 4, 5, 6, 7, 9, 13, 14, 15, 16, 20, 21, 22.

Melanohalea elegantula (Zahlbr.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – Epiphytic. Sporadic on the bark of *Castanea*. Loc. 4, 5, 6, 7, 8, 14.

Melanohalea exasperata (De Not.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – Epiphytic. Like the previous species, but even more sporadic, and generally found together with *Xanthoria parietina*. Loc. 3, 4, 5, 6, 7, 9, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Melanohalea exasperatula (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – Epiphytic. Very common on various trees. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 21, 22, 23, 24, 25.

Melanohalea laciniatula (Flagey ex H. Olivier) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – Epiphytic. Frequent on trunks of *Castanea*. Loc. 3, 4, 5, 6, 7, 8, 9, 13, 14, 15, 16.

Micarea prasina Fr. – Epiphytic. Very rare, on the bark of *Castanea*. Loc. 4.

Naetrocymbe punctiformis (Pers.) R.C. Harris – Epiphytic. Rather common on the bark of various trees, often on *Populus* sp. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 21, 22, 23, 24.

Nephroma laevigatum Ach. – Epiphytic. Extremely rare on trunks of *Castanea*. Loc. 5, 6.

Normandina pulchella (Borrer) Nyl. – Epiphytic. Sporadic on bark of *Quercus*-species. Loc. 1, 2, 3.

Ochrolechia arborea (Kreyer) Almb. – Epiphytic. Uncommon on bark of *Castanea*. Loc. 4, 5, 6, 7, 13.

Ochrolechia balcanica Verseghy – Epiphytic. Frequent on bark of *Castanea*. Loc. 3, 4, 5, 6, 7, 9, 13, 14, 16.

Ochrolechia pallescens (L.) A. Massal. – Epiphytic. Often with previous species, but very rare. Loc. 5, 6, 7.

Ochrolechia parella (L.) A. Massal. – Saxicolous. Common on basaltic rocks. Loc. 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Ochrolechia subviridis (Høeg) Erichsen – Epiphytic. Rare on trunks of *Castanea*. Loc. 6.

Pannaria conoplea (Ach.) Bory – Epiphytic. Very rare on moss-covered basal parts of the trunks of *Castanea*. Loc. 6. The species is in the Red List of lichens for Italy (Nascimbene et al. 2013a).

Parmelia saxatilis (L.) Ach. – Epiphytic. Very common on the bark of various trees and on epilithic mosses above 400 m. Loc. 4, 5, 6, 7, 9, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Parmelia sulcata Taylor – Epiphytic. Common on the bark of various trees and on epilithic mosses. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Parmeliella triptophylla (Ach.) Müll.Arg. – Epiphytic. Rare on basal parts of the trunks of *Castanea*. Loc. 6. The species is in the Red List of lichens for Italy (Nascimbene et al. 2013a).

Parmelina pastillifera (Harm.) Hale – Epiphytic. Very common on the bark of various trees and on epilithic mosses, often with *Parmelia saxatilis*. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23.

Parmelina quercina (Willd.) Hale – Epiphytic. Common on the bark of *Quercus*-species and *Castanea*. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Parmelina tiliacea (Hoffm.) Hale – Epiphytic. Found all over the study area on the trunks of various trees. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23.

Parmotrema perlatum (Huds.) M.Choisy – Epiphytic. Widespread on epilithic mosses and various trees. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Parmotrema reticulatum (Taylor) M.Choisy – Epiphytic. Very rare, only three thalli were found on the trunks of *Castanea*. Loc. 6.

Pectenia atlantica (Degel.) P.M.Jørg., L.Lindblom, Wedin & S.Ekman – Epiphytic. Very rare on the bark of *Olea*. Loc. 20, 23. This species corresponds to *Degelia atlantica* (Degel.) P.M. Jørg. & P. James, a taxon included in the Red List of lichens for Italy (Nascimbene et al. 2013a). According to Nimis & Martellos (2008), it is very rare in humid sub-Mediterranean areas and has a mainly western distribution in Italy, along the Tyrrhenian coast.

Pectenia plumbea (Lightf.) P.M.Jørg., L.Lindblom, Wedin & S.Ekman – Epiphytic. Extremely rare on bark of *Castanea*. Loc. 6. This species corresponds to *Degelia plumbea* (Degel.) P.M.Jørg. & P. James, a taxon included in the Red List of lichens for Italy (Nascimbene et al. 2013a).

Peltigera canina (L.) Willd. – Terricolous. Sporadic, on epilithic bryophytes in dense woodland. Loc. 3, 16.

Peltigera collina (Ach.) Schrad. – Epiphytic. Rare on moss-covered trunks of *Castanea* with *Lobarion*-species. Loc. 3, 5, 6.

Peltigera degenii Gyeln. – Terricolous. Not common, mainly on moss-covered soil in moist, shady places. Loc. 5, 6, 13, 16.

Peltigera elisabethae Gyeln. – Terricolous. Extremely rare on terricolous mosses in shady areas. Loc. 6.

Peltigera horizontalis (Huds.) Baumg. – Terricolous. Very common, particularly on mosses and on basal parts of trunks often *Peltigera praetextata*. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 21, 22, 25.

**Peltigera hymenina* (Ach.) Delise – Terricolous. Extremely rare in humid areas on epiphytic mosses. Loc. 6. First report from Campania. The species is not very frequent in the Southern and Central areas of the Italian peninsula, being known only from Tuscany and Basilicata (Nimis & Martellos 2008).

Peltigera polydactylon (Neck.) Hoffm. – Terricolous and epiphytic. Rare, mainly on terricolous bryophytes in shady areas and on the bark of various trees. Loc. 4, 6, 13, 16.

Peltigera praetextata (Flörke ex Sommerf.) Zopf – Terricolous. Very common on terricolous mosses; this is the most common species of *Peltigera* in the study area. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Peltigera rufescens (Weiss) Humb. – Terricolous. Rare, often with *Peltigera degenii*. Loc. 5, 6.

**Peltula euploca* (Ach.) Poelt – Saxicolous. Rare on the basic silicates of "Ciampate del Diavolo". Loc. 10. First record from Campania, hitherto reported in S Italy only from Puglia and Calabria (Nimis & Martellos 2008).

Pertusaria albescens (Huds.) M.Choisy & Werner – Epiphytic. Frequent on the bark of various trees. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Pertusaria amara (Ach.) Nyl. – Epiphytic. Common, often with the previous species. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Pertusaria flavida (DC.) J.R.Laundon – Epiphytic. Common on the bark of various species of *Quercus*. Loc. 4, 5, 6, 7, 8, 9, 13, 15, 16, 20, 21, 22, 23, 25.

Pertusaria hymenea (Ach.) Schaer. – Epiphytic. Sporadic on trunks of various deciduous trees. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23.

Pertusaria leioplaca DC. – Epiphytic. Less frequent than the previous species, and at higher elevations. Loc. 4, 5, 6, 16.

Pertusaria pertusa (L.) Tuck. – Epiphytic. Frequent on the bark of *Castanea*. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Pertusaria rupicola (Fr.) Harm. – Saxicolous. Sporadic on basaltic rocks. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Phaeophyscia ciliata (Hoffm.) Moberg – Epiphytic. Very rare on the bark of *Fraxinus* sp. Loc. 20.

**Phaeophyscia nigricans* (Flörke) Moberg – Epiphytic and saxicolous. Extremely rare, on rocks. Loc. 4. Second report from S Italy after that from Basilicata (Nimis & Tretiach 1999). First record from Campania.

Phaeophyscia orbicularis (Neck.) Moberg – Epiphytic. Most common on the bark of various trees in sunny stations. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Phlyctis agelaea (Ach.) Flot. – Epiphytic. On the bark of various trees. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23.

Phlyctis argena (Ach.) Flot. – Epiphytic. Sporadic on trunks of various deciduous trees. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23.

Physcia adscendens (Fr.) H.Olivier – Epiphytic and saxicolous. Very common, together with *Xanthoria parietina* on rocks and on the bark of various trees. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Physcia aipolia (Ehrh. ex Humb.) Fűrnrh. – Epiphytic. Ubiquitous on the bark of various trees. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Physcia biziana (A.Massal.) Zahlbr. v. *biziana* – Epiphytic. Sporadic on acid bark, particularly of *Quercus* species. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24.

Physcia biziana (A.Massal.) Zahlbr. v. *leptophylla* Vězda – Epiphytic. Common on the bark of *Quercus* sp. in disturbed areas. Loc. 1, 11, 12, 17, 18, 19.

Physcia clementei (Turner) Lynge – Epiphytic. Very rare on the bark of *Castanea*. Loc. 5.

Physcia leptalea (Ach.) DC. – Epiphytic. In sunny places, on the bark of fruit-trees and especially at the tips of terminal branches. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Physcia stellaris (L.) Nyl. – Epiphytic. Rare on the bark of *Fagus* at higher elevations. Loc. 16.

Physconia distorta (With.) J.R.Laundon – Epiphytic. Frequent on *Castanea*, often with *Physconia venusta*. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Physconia grisea (Lam.) Poelt ssp. *grisea* – Epiphytic. Sporadic on the bark of *Quercus pubescens*. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Physconia servitii (Nádv.) Poelt – Epiphytic. Very rare on the trunks of *Castanea*. Loc. 5, 6, 16.

**Physconia subpulverulenta* (Szatala) Poelt v. *subpulverulenta* – Epiphytic. Extremely rare, found only once on the bark of *Castanea*, above 700 m. Loc. 4. Third report from the Italian Peninsula, after those from Calabria and Basilicata (Nimis and Tretiach 1999).

Physconia venusta (Ach.) Poelt – Epiphytic. Frequent on the bark of various trees and sometimes on rocks. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Placynthium nigrum (Huds.) Gray – Saxicolous. Common on roadside walls. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Platismatia glauca (L.) W.L.Culb. & C.F.Culb. – Epiphytic. Only one thallus was found, on a trunk of *Castanea*. Loc. 4.

Pleurosticta acetabulum (Neck.) Elix & Lumbsch – Epiphytic. Common on the bark of various trees in Xanthorion-communities. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 21, 22, 23, 24.

Protoblastenia rupestris (Scop.) J.Steiner – Saxicolous. Sporadic on roadside walls. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 21, 22, 23, 24.

Protoparmeliopsis bolcana (Pollini) § – Saxicolous. Sporadic on rocks. Loc. 4, 16.

Protoparmeliopsis muralis (Schreb.) M.Choisy – Saxicolous. Widespread both in rocky habitats and on walls. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25. (Terracciano: Roccamonfina).

Pseudevernia furfuracea (L.) Zopf v. *furfuracea* – Epiphytic. Very rare, only two small thalli were found on the bark of *Castanea*. Loc. 4.

Punctelia borreri (Sm.) Krog – Epiphytic. Common on the bark of various trees, above 400 m. Loc 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23.

Punctelia subrudecta (Nyl.) Krog – Epiphytic. Very common on *Quercus*-species and on young trunks of *Castanea*. Loc. 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Ramalina farinacea (L.) Ach. – Epiphytic. Most common on the bark of various trees. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25.

Ramalina fastigiata (Pers.) Ach. – Epiphytic. Very common on the trunks of various trees; this is the most common species of *Ramalina* in the study area. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25.

Ramalina fraxinea (L.) Ach. – Epiphytic. Rare on the trunks of *Castanea* and *Fagus* in humid areas. Loc. 4, 5, 6, 16.

Rhizocarpon geographicum (L.) DC. subsp. *geographicum* – Saxicolous. Sporadic on sunny rocks. Loc. 4, 5, 6, 13, 16.

Rinodina exigua (Ach.) Gray – Epiphytic. Common on the bark of *Quercus pubescens*, *Olea*, and other trees. Loc. 1, 2, 3, 5, 7, 8, 10, 11, 12, 17, 18, 19, 20, 21, 23, 24.

Rinodina pyrina (Ach.) Arnold – Epiphytic. Sporadic on twigs of various trees. Loc. 1, 2, 3, 5, 7, 8, 10, 11, 12, 17, 18, 19, 20, 21, 23, 24.

Rinodina sophodes (Ach.) A.Massal. – Epiphytic. Common on the bark of *Fraxinus* sp. and *Quercus pubescens*. Loc. 1, 2, 3, 5, 7, 8, 10, 11, 12, 17, 18, 19, 20, 21, 23, 24, 25.

Sarcogyne regularis Körb. v. *regularis* – Saxicolous. Uncommon on roadside walls. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24. (Terracciano: Roccamonfina and Teano).

Scytinium lichenoides (L.) Otálora, P.M.Jørg & Wedin – Epiphytic. Rare on the bark of *Castanea* and on epilithic mosses. Loc. 4, 5, 6, 7.

- Scytinium palmatum* (Huds.) Gray – Terricolous. Rare on epilithic mosses. Loc. 6.
- Stereocaulon vesuvianum* Pers. – Saxicolous. Very rare, only three thalli were found. Loc. 4, 6. (Terracciano: Roccamonfina). Species reported in the Red List of lichens for Italy (Nimis & Martellos 2008) as worthy of protection.
- Teloschistes chrysophthalmus* (L.) Norman ex Tuck. – Epiphytic. Very rare, a few thalli only were found on twigs of *Prunus* sp. Loc. 7. Already reported by Terracciano (1873) from the Royal Palace of Caserta. The species is in the Red List of lichens for Italy (Nascimbene et al. 2013a).
- Tephromela atra* (Huds.) Hafellner **var. atra** – Saxicolous. Sporadic on basaltic rocks. Loc. 5, 6, 10.
- Tephromela atra* (Huds.) Hafellner **var. torulosa** (Flörke ex Flot.) Hafellner – Epiphytic. Widespread on trunks of *Juglans*. Loc. 1, 2, 3, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 22, 23, 25.
- Toninia plumbina* (Anzi) Hafellner & Timdal – Epiphytic. Parasitic on the apothecia of *Degelia plumbea*. Loc. 6. The species is in the Red List of lichens for Italy (Nascimbene et al. 2013a).
- Toninia sedifolia* (Scop.) Timdal – Terricolous. Common in fissures of rocks. Loc 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24.
- Varicellaria hemisphaerica* (Flörke) Schmitt & Lumbsch – Epiphytic. Very rare on a trunk of *Castanea*. Loc. 6. (Terracciano: Roccamonfina and Teano).
- Verrucaria lecideoides* (A.Massal.) Trevis. – Saxicolous. Sporadic on rocks. Loc. 4, 16.
- Verrucaria macrostoma* Dufour ex DC. – Saxicolous. Common on roadside walls. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24.
- Verrucaria muralis* Ach. – Saxicolous. Together with the previous species. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 25.
- Verrucaria nigrescens* Pers. – Saxicolous. Widespread. Loc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.
- Xanthoparmelia conspersa* (Ehrh. ex Ach.) Hale – Saxicolous. Common on basaltic rocks. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25. (Terracciano: Roccamonfina).
- Xanthoparmelia loxodes* (Nyl.) O.Blanco, A.Crespo, Elix, D.Hawksw. & Lumbsch – Saxicolous. Often with the previous species. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25.
- Xanthoparmelia protomatrae* (Gyeln.) Hale – Saxicolous. Sporadic on various rocks. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25.
- Xanthoparmelia pulla* (Ach.) O.Blanco, A.Crespo, Elix, D.Hawksw. & Lumbsch – Saxicolous. Common on rocks. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Table 2. List of the 13 species included in the red list of lichens needing protection.

Species	Category
<i>Bacidia rosella</i> (Pers.) De Not.	NT
<i>Caloplaca herbidella</i> (Hue) H.Magn.	NT
" <i>Dendriscoaulon umhauense</i> " (Auersw.)	NT
<i>Leptogium cyanescens</i> (Rabenh.) Körb.	NT
<i>Lobaria amplissima</i> (Scop.) Forssell var. <i>amplissima</i>	NT
<i>Lobaria pulmonaria</i> (L.) Hoffm.	LC
<i>Lobarina scrobiculata</i> (Scop.) Nyl.	NT
<i>Pannaria conoplea</i> (Ach.) Bory	NT
<i>Parmeliella tryptophylla</i> (Ach.) Müll.Arg.	NT
<i>Pectenaria atlantica</i> (Degel.) P.M.Jørg., L.Lindblom, Wedin & S.Ekman	LC
<i>Pectenaria plumbea</i> (Lightf.) P.M.Jørg., L.Lindblom, Wedin & S.Ekman	NT
<i>Teloschistes chrysophthalmus</i> (L.) Norman ex Tuck.	NT
<i>Toninia plumbina</i> (Anzi) Hafellner & Timdal	NT

Xanthoparmelia tinctina (Maheu & A. Gillet) Hale – Saxicolous. Together with the previous species. Loc. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 20, 21, 22, 23, 25.

Xanthoria calcicola Oksner– Saxicolous. Uncommon on walls. Loc. 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

Xanthoria parietina (L.) Beltr. – Epiphytic and saxicolous. Most common on the bark of various trees, sometimes on rocks. Loc 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25.

COMMENTS TO THE FLORISTIC CATALOGUE: Overall, 195 taxa were identified. Many of them are new to the Roccamonfina area (186 taxa), 5 are new to the Campania Region. Lichen diversity is relatively high, both in terms of number of taxa and of their floristic quality. Concerning growth-forms, crustose and foliose lichens are the most numerous (50% and 37%, respectively), followed by fruticose (10%) and squamulose lichens (3%). As for the substrate, 61% are epiphytic, 28% saxicolous and 11% terricolous. Sixty-seven percent of the species reproduce sexually by ascospores, 33% vegetatively by lichenised propagules (isidia 12%, soredia 19%, thallus fragmentation 2%). The catalogue also includes 13 epiphytic species mentioned in the red list of lichens needing protection (Nascimbene et al. 2013a), 11 of which in the NT category (near threatened species) and 2 in the LC category (lower concern) (Table 2). Criteria for assessing the conservation status of lichens according to the IUCN categories are those proposed by Nascimbene et al. (2013a), who adapted to Italian lichens those proposed by Dahlberg and Mueller (2011) for non-lichenised fungi. According to Nascimbene et al. (2013a), the NT category includes lichens found in at least five Italian regions, that are apparently declining, linked to a declining habitat, and quite sensitive to human disturbance. The LC category includes lichens found in at least five Italian regions with no negative trend.

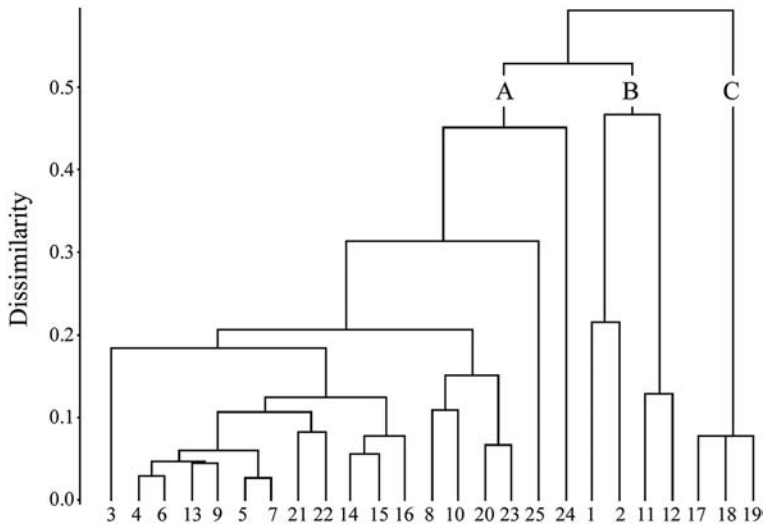


Fig. 2. Dendrogram resulting from a cluster analysis applied to the 25 sampling stations. Three main clusters are formed, labeled with capital letters A, B and C. See Table 1 for site label legend.

CLASSIFICATION AND ORDINATION: Three main groups of stations were evident after classification analysis (Fig. 2). A major cluster includes 18 mountain sites and has the highest average number of species (cluster A), whereas two relatively smaller clusters (B and C) include sites located at lower elevation, characterized by a higher disturbance level and a lower number of species.

NMDS converged on two axis with a small final stress (0.072). Overall, stations in cluster A are dispersed in the right-upper quadrant of the ordination analysis, whereas those of clusters C are positioned in the left-lower quadrant (Fig. 3), with cluster B assuming intermediate positions on both left and right lower quadrants. The number of species per station is correlated with altitude (Fig. 4), though a relative decrease is found at the highest elevations.

Discussion

This lichen census of Roccamonfina volcano highlights the high naturalistic value of this area, as well as the need to elaborate accurate policies to prevent the risk of losing part of its relevant diversity value. Interestingly, the areas with the highest diversity were found at the highest elevations. This partly corresponds to a general trend of lichen diversity response to altitude, but, in this case, it also depends on the relatively lower impact of human disturbance in mountain sites, where a good cover of continuous chestnut stands still remains. The highest number of species was found in the stations of cluster A, mainly those located inside the perimeter of the Regional

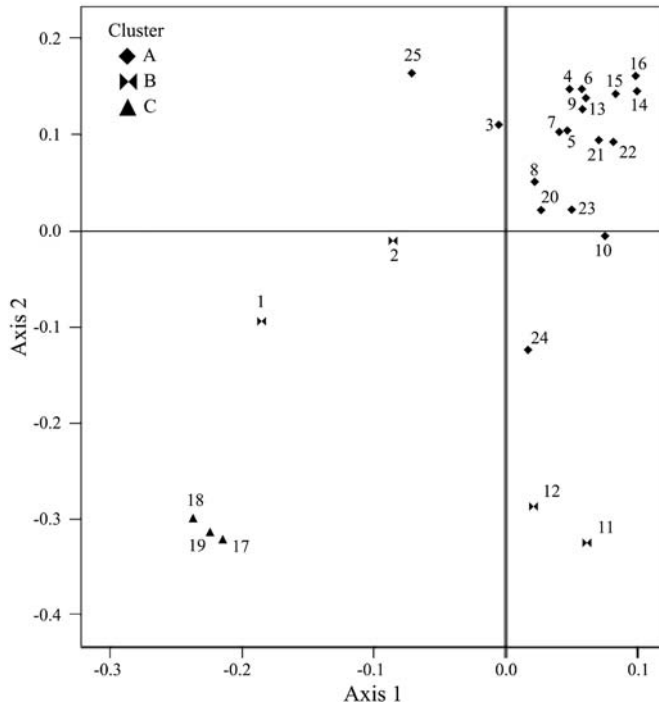


Fig. 3. Non-metric multidimensional scaling (NMDS) applied to the 25 sampling stations. Markers were assigned according to the clusters plotted in Fig. 2. See Table 1 for site label legend.

Park. These areas are characterized by a relatively higher air humidity and are basically covered by mature chestnut stands. Their lichen flora is mainly composed by species with a suboceanic distribution, most of which show a low tolerance to air pollution and anthropic impacts. Important threatened lichens were found in this group of stations, among which *Lobaria pulmonaria* (Fig. 5a), *Lobarina scrobiculata* (Fig. 5b), *Parmeliella tryptophylla* and *Teloschistes chrysophthalmus*. The presence of these species is generally assumed to be a reliable indicator of ecological continuity and of good forestry management (Rose 1976, Ellis & Coppins 2007, Nascimbene et al. 2010, Nascimbene et al. 2013b, Brunialti et al. 2015). As forest continuity has long been recognized among the most critical drivers affecting lichen diversity (Brunialti et al. 2012), it is very important to monitor the state of these populations, also as a mean to identify the areas where limitation of human disturbance is recommended for conservation policies (Giordani & Incerti 2008, Matteucci et al. 2012). On the other hand, Cluster B includes four stations situated at relatively lower elevations, in moderately disturbed environments, due to the lower presence of human activity of the secondary and tertiary sectors. The most representative species found here are *Caloplaca pyracea* and *Hyperphyscia adglutinata*, two ubiquitous species usually found on isolated trees or in disturbed habitats. Thus, the lower diversity value of

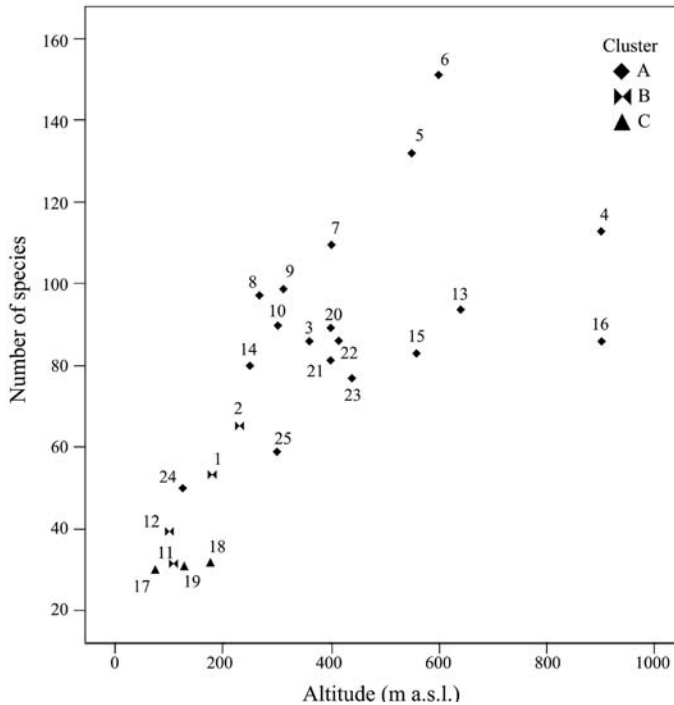


Fig. 4. Relationships between altitude of the stations and the number of lichen species per station. The stations are marked according to their respective clusters, as reported in Fig. 2. See Table 1 for station number labels.

these stations does not only depend on the natural trend of decreasing lichen species number at lower altitudes, but it is also determined by the lower naturalistic quality of the species assemblages. The lower end of this gradient of decreasing naturalistic quality is represented by Cluster C, consisting of three stations situated in agricultural lands and heavily anthropized environments. This is the most species-poor assemblage, with most of the species belonging to the *Xanthorion parietinae* (Barkman 1958) vegetation, hosting very common species, typically found in sunny and dry stands on isolated trees, with a relatively high ability to tolerate environmental pollution (Nimis & De Faveri 1980, Piervittori & Maffei 2001). Similar assemblages of species, with the dominance of nitrophytic and ubiquitarian lichens, are frequent in disturbed areas of Campania (Aprile et al. 2011). The most representative species of this group is *Physcia biziana* var. *leptophylla*, which prefers isolated trees in open, sunny situations and also growing in urban sites, where it seems to tolerate a wide range of pollutants (Catalano et al. 2015).

In conclusion, the high naturalistic value of the forest stands found in upland areas of Roccamonfina volcano is attested by the presence of several assemblages of lichen species that are commonly associated with the continuity over space and time of

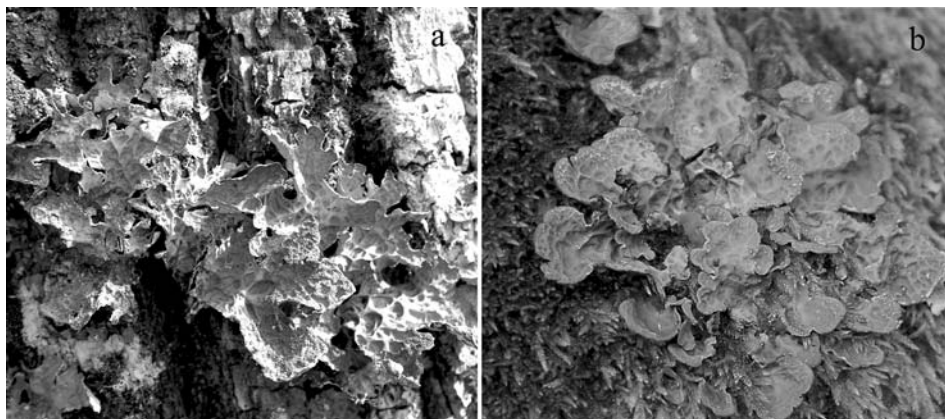


Fig. 5. Threatened epiphytic lichens found in the natural reserve of Roccamonfina. a) *Lobaria pulmonaria*, considered one of the best indicators of forest ecological continuity; b) *Lobarina scrobiculata*, quite rare in Italy due to the impact of human activities on most forest habitats.

mature undisturbed forest cover. The results also evidenced the presence of at least 11 near-threatened species, accounting for almost half the total number of lichen species associated with this category over all the Italian chestnuts (Nascimbene et al. 2013a). These communities are now strongly challenged by the wide diffusion of *Cynipidae* over chestnut stands. Given the high fragmentation of land tenure in this area and the lack of a strong conservation policy over the Regional Park, very ancient chestnut trees are now risking to be felled and replaced by younger trees of more resistant cultivars. This practice would not be free of consequences for the survival of the most sensitive lichen species. It is recommended that appropriate conservation measures are quickly adopted to avoid further damages to such a relevant biotope.

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