

The lichens in a relic wood of *Juniperus turbinata* Guss. (Pinales Cupressaceae) with a new record for Sicily

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ABSTRACT

This paper regards a research conducted on terrestrial and epiphytic lichen flora growing in an extensive juniper bush, *Juniperus turbinata* Guss. (Pinales Cupressaceae), in southeast Sicily. The flora recorded, although small in number, 29 species in all, includes several species quite rare in Italy or Sicily. One in particular, *Heppia adglutinata* (Kremp.) A. Massal. is new for Sicily and it is however rather rare in the Mediterranean area. Some considerations about the distribution and ecology of the found species are done.

KEY WORDS

Epiphytic lichens; terrestrial lichens; *Heppia adglutinata*; juniper woodland; Mediterranean.

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INTRODUCTION

Juniperus turbinata Guss. (Pinales Cupressaceae) is a threatened tree species occurring in the Mediterranean area; it grows mainly in the coastal belt; only in north Africa it reaches high altitudes (Mazur et al., 2015). It is listed as a vulnerable species in the Red Book of Italian plants and its various communities are included in Annex I of the Habitats Directive 92/43/EEC as a priority habitat for conservation. The recent discovery of a very big population in south Sicily (Minissale & Scian-drello, 2013) has led us to conduct a research on the lichen flora of this site (Fig. 1), taking into account that the good conservation and big age of the population could be a favorable condition for a high and peculiar lichen biodiversity regarding both epiphytic and terricolous taxa.

The lichen flora growing on the Mediterranean junipers is still poorly known and only some

bibliographic references are available. The first studies were carried out by Sarrión & Burgaz (1995) Aragón & Martínez (1997) in Spain; later Aragón et al. (2004) made a study on the lichen flora growing on *Juniperus oxycedrus* L. The same taxon was investigated by Zedda & Sipman (2001) for Sardinia.

Regarding the soil lichens of Mediterranean juniper communities, literature data are rather scarce. Gallego Fernández & Díaz Barradas (1997) give some information on dunal lichens into *Juniperus turbinata* woodlands of south western Spain, while Cogoni et al. (2011) examine terricolous lichens and briophytes of well-preserved native *Juniperus* woodlands of Sardinia.

The aim of this study is to increase the knowledge of the lichen flora of a *Juniperus turbinata* woodland growing in a very arid site that is Piano Pirrera near Acate (Ragusa) in south eastern Sicily (Fig. 2).

MATERIAL AND METHODS

The examined material has been collected during a several field trips during January and February 2014. Many trees of *Juniperus* have been analyzed in order to produce a complete epiphytic lichen flora. Samples were collected both on the trunk and on the branches. Other samples on the ground have been collected. For the identification a Zeiss Axiostar Plus binocular (10 x) microscope was used to observe the specimens with objectives having factors of magnification of 5X, 10X, 40X, 100X oil immersion. The following keys were used: Clauzade & Roux (1985, 1987), Nimis et al. (1993), Nimis & Martellos (2008). Spot tests, C, K and I, have been used for testing some species. The nomenclature follows Nimis (1993).

Study area

The study area covers the sandy hill of Piano Pirrera (Acate, province of Ragusa, Sicily, Italy) situated approximately seven kilometers from the coast of the Gulf of Gela. It is mainly composed of Pleistocene substrates such as calcarenites and sand deposits. Juniper community grows mainly on south-facing slopes. Following the phytogeographic subdivision of Sicily by Brullo et al. (2011), this area, characterized by sand deposits, belongs to the Camarino-Pachinense district included in the southern Sicilian subsector, together with the Hyblaeen district. According to the bioclimatic classification proposed by Rivas-Martinez (1993, 2004), the study area falls within the Mediterranean pluviaseasonal

oceanic bioclimate, with thermotypes ranging from the lower thermomediterranean to upper thermomediterranean, and ombrotypes from the lower semiarid to upper semiarid. The *J. turbinata* community covers an area of about 14 hectares and the population was judged to exceed 12,000 individuals, some of which are more than 6 meters high, really the largest known population for Quaternary sand deposits in Sicily (Minissale & Sciandrello, 2013). *Juniperus turbinata* is the dominant species associated with other shrubs such as *Pistacia lentiscus*, *Ephedra fragilis*, *Euphorbia dendroides*, *Rosmarinus officinalis*.

RESULTS AND DISCUSSION

Two annotated lists of the lichens collected in the examined site are presented, one of epiphytic lichens and another regarding terrestrial ones. The lichens are showed with information about their ecology in Italy and when significant in Sicily, as reported by Nimis & Poelt (1987) and by Nimis (1993) and their distribution in Europe based mainly on Nimis (1993) and Nimis & Martellos (2008).

THE LIST OF EPIPHYTIC LICHENS

Familia ARTHONIACEAE

Arthonia albopulverea Nyl

On twigs. In Italy it has been recorded only in a few regions (Nimis, 1993). In Sicily it has been



Figure 1. Study area localized by red square (Sicily map from Sémhur/Wikimedia Commons, 2015, modified).



Figure 2. *Juniperus turbinata* community at Piano Pirrera, Acate (Ragusa, Sicily).

recorded previously near to N-W coast and in the province of Ragusa (Grillo, 2004). Here it is reported for the first time from this locality.

Familia TELOSCHISTACEAE

Caloplaca cerina* (Hedw.) Th.Fr. v. *cerina

On twigs. *Caloplaca cerina*, sensu strictu, is an epiphytic lichen generally occurring in *Xanthorion* vegetation (Nimis & De Faveri 1981); in southern Italy is most frequent at lower altitudes. Distribution is holoartic (Nimis, 1993).

Familia CATILLARIACEAE

***Catillaria nigroclavata* (Nyl.) Schuler**

On twigs. A common species from Europe to North America, with a large ecological amplitude; it's frequent on eutrophic bark. In Italy is widespread at low altitudes (Nimis, 1993).

***Catillaria praedicta* Tretiach et Hafellner**

On twigs and on bark. *Catillaria praedicta* (Fig. 3) is closely related to *C. mediterranea*, but is distinguished by three morpho-anatomical characters: number of spores per ascus, spore size, and size of the apothecia. It occurs in natural or semi-natural vegetation, along the coasts and on some small islands (Marettimo - Egadi Islands, Mallorca) of the western Mediterranean basin (Tretiach & Hafellner, 1998); in Sicily it has been recorded from Grillo et al. (2002).

Familia PHYSCIACEAE

***Diploicia canescens* (Dicks.) A.Massal.**

On twigs. It is a common lichen in the islands and thyrrenic area. In Europe has been found on a wide variety of substrates incl. base-rich or eutrophicated bark, calciferous sandstone and limestone (Nimis & Martellos, 2008) and it is a species with a very wide ecological amplitude.

***Hyperphyscia adglutinata* (Flörke) H. Mayrhofer et Poelt**

On bark. This is a common lichen in all Italy, also in sites with high eutrophication, such as intensive agricultural areas (Nimis & Martellos, 2008).

***Physcia leptalea* (Ach.) DC.**

On twigs. It is a species common especially in the Mediterranean region. In Italy it is widespread in open woods, in communities of the *Xanthorion* (Nimis 1993). In south Italy it is common mostly on twigs and branches (Nimis & Martellos, 2008).

***Physconia venusta* (Ach.) Poelt**

On twigs. This species is confined to the Mediterranean region, in Italy is rather rare in the Alps, but it is abundant in central and south Italy (Nimis, 1993).

***Rinodina sophodes* (Ach.) A. Massal.**

On twigs. Lichen with a wide ecological range, pioneer on young twigs. It's present in all Italy, but isn't common (Nimis, 1993; Nimis & Martellos, 2008).

Familia LECANORACEAE

***Lecanora chlarotera* Nyl.**

On twigs and on bark. A most common epiphytic *Lecanora* in Italy, widespread in almost all the country. It is common on isolated deciduous trees, mostly in *Xanthorion* communities (Nimis & Bolognini, 1981 1993).

***Lecidella elaeochroma* (Ach.) M.Choisy**

On twigs and on bark. It is a very common epiphytic lichen in Italy, with a wide ecological amplitude, in conditions from very weak to a rather high eutrophication and broad altitudinal range (Nimis & Martellos, 2008). Usually pioneer on young twigs is frequent in *Xanthorion* communities (Nimis, 1993).

Familia OPEGRAPHACEAE

***Opegrapha vulgata* Ach.**

On twigs. Widespread in all Italy, but non common. It is a suboceanic species widespread from southern Scandinavia to Mediterranean region (Nimis, 1993).

Familia PORINACEAE

***Porina aenea* (Wallr.) Zahlbr.**

On bark. Species widespread in the Northern hemisphere, rather rare in all Italy (Nimis, 1993).

Familia ROCCELLACEAE

Schismatomma dirinellum (Nyl.) Zahlbr.

On bark. A mediterranean-atlantic species, in Italy is very rare and not present in all country, (Nimis & Martellos, 2008). In Sicily it has been recorded by Grillo et al. (2002).

Familia TELOSCHISTACEAE

Xanthoria parietina (L.) Th. Fr.

Saxicolous; on twigs and on bark. This species is present in all continents except Antarctica, in Italy is a very common epiphytic lichen (Nimis, 1993). This species is present also in heavily polluted areas, but not such as epiphytic lichen, rather as epilithic lichen (Nimis & Martellos, 2008).

THE LIST OF TERRESTRIAL LICHENS

Familia TELOSCHISTACEAE

Caloplaca variabilis (Pers.) Müll. Arg.

On calcareous sandstone. Species extremely variable and common in all Italy, widespread in temperate regions of the Northern hemisphere, (Nimis, 1993).

Fulgensia fulgens (Sw.) Elenkin f. *subbracteata* (Nyl.) Nimis

On calcareous soil. Species reported in sub-Mediterranean areas; it is found on calciferous soil in clearings of grasslands and shrublands. Rather common in Italy, but not present in all regions (Nimis, 1993).

Familia CLADONIACEAE

Cladonia convoluta (Lam.) Anders

On calciferous soil. This species is widespread in Mediterranean and submediterranean Europe; in Italy it's very common, (Nimis, 1993).

Cladonia pyxidata (L.) Hoffm.

On sandy soil. Temperate species with an ample ecological tolerance, it occurs on different substrata from the lowlands to the alpine belt; it occurs both

on calcareous and siliceous substrata, also on bark and wood (Nimis, 1993).

Familia PORPIDIACEAE

Clauzadea monticola (Schaer.) Hafellner et Bellem.

On a small limestone rocks. It's common throughout Italy (Fig. 4), to lowlands to the alpine belt, with an ample ecological range. It's widespread from the Arctic to the Mediterranean zones (Nimis, 1993).

Familia COLLEMATACEAE

Collema tenax (Sw.) Ach.

On sandy soil. Species very variable and with cosmopolitan distribution. It's found on disturbed ground, on walls, on rock, and in all Italy is very common (Nimis, 1993).

Familia THELOTREMATACEAE

Diploschistes gypsaceus (Ach.) Zahlbr.

On sandy soil. It has a wide range in Europe, rare in Italy, not present in some regions, (Nimis & Martellos, 2008).

Diploschistes muscorum (Scop.) R. Sant.

Parasite on squamule of *Cladonia*. Rather common in all Italy, it is an holarctic lichen (Fig. 5). Generally on mosses and plant debris in dry grasslands on limestone (Nimis & Martellos, 2008).

Familia VERRUCARIACEAE

Endocarpon pusillum Hedw.

On calcareous soil. Species widespread from Arctic to Mediterranean regions in Europe; not very common in Italy (Nimis, 1993).

Heteroplacidium imbricatum (Nyl.) Breuss;

On calcareous soil. Species known along the coast of the Mediterranean sea and Macaronesia; is very rare in Italy (Nimis, 1993).

Placidium rufescens (Ach.) A. Massal.

On sandy soil. Common species in Europe except in the northern part (Nimis, 1993). In Italy is rare.

Familia HEPPIACEAE

Heppia adglutinata (Kremp.) A.Massal.

On sandy soil. A very rare species in Italy, previously recorded only from Piedmont and Sardinia (Nimis, 1993; Nimis & Martellos, 2008), but with a wide distribution, from arid areas of Namibia, South Africa, North America in USA and South America with only a record in Brazil (GBIF 2013; Schultz et al., 2009). There are few records for Europe mainly from north and central Europe (GBIF, 2013; Henssen, 1994). This is a new record from Sicily and it is important because the species is almost unknown in the Mediterranean region

with a distribution likely to be better defined by appropriate investigations (Figs. 7, 8).

Heppia solorinoides (Nyl.) Nyl.

On sandy soil. Species reported only in Apulia, Calabria and Sicily (Nimis & Martellos, 2008; Cataldo & Minissale, 2013), widespread from Macaronesia to southern part of the Mediterranean area (Nimis, 1993) (Fig. 6).

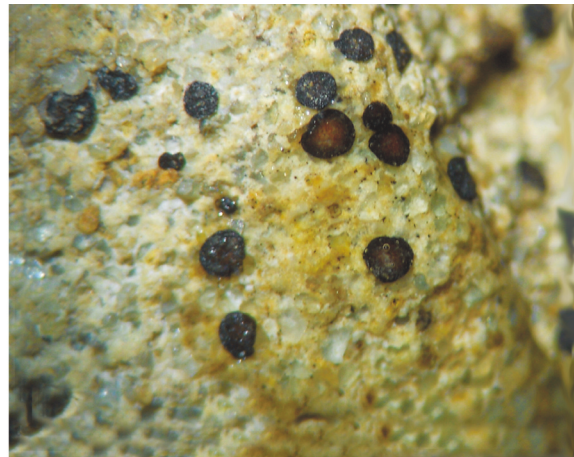
Familia PSORACEAE

Psora decipiens (Hedw.) Hoffm.

On sandy soil. It's common throughout Italy (Fig. 9), frequent in open dry grasslands (Nimis, 1993).



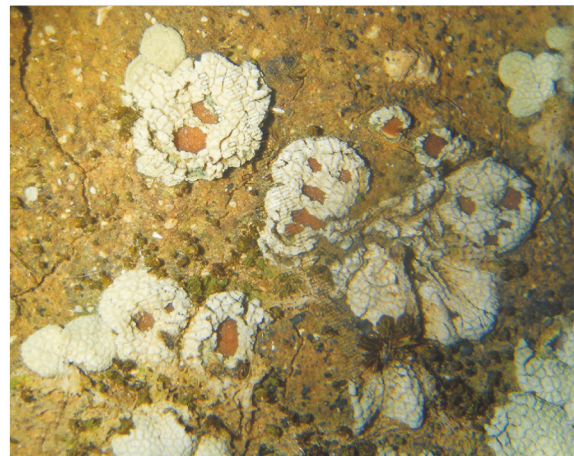
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Figures 3–6. Images of collected lichens observed by binocular microscope (magnification 20X). Fig. 3: *Catillaria praedicta*. Fig. 4: *Clauzadea monticola*. Fig. 5: *Diploschistes muscorum*. Fig. 6: *Heppia solorinoides*.

Familia ACAROSPORACEAE

Sarcogyne regularis Körb. v. *regularis*

On limestone. Species very common in all Italy, it colonizes an ample variety of calcareous substrata, it's common in the urban area also (Nimis & Martellos, 2008).

Familia STEREOCAULACEAE

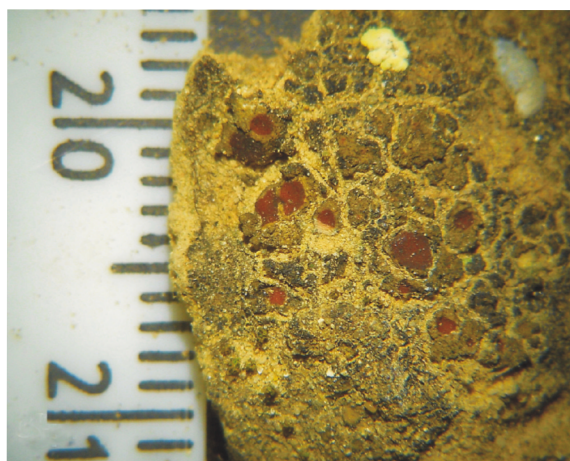
Squamarina lentigera (Weber) Poelt

On limestone. It's a species widespread from central Europe to the Mediterranean areas (Fig. 10); in Italy is present in almost all the regions, but it's not common (Nimis, 1993).

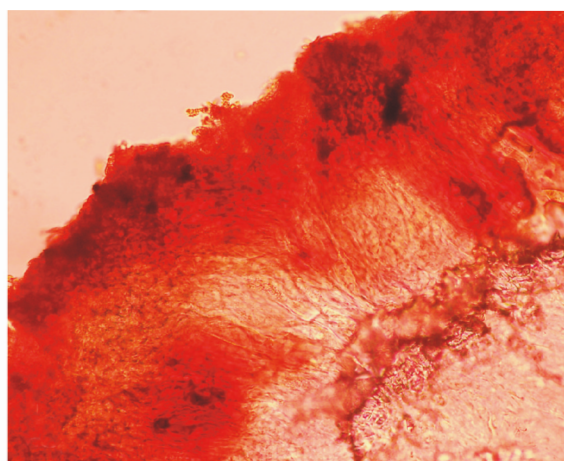
DISCUSSION AND CONCLUSIONS

On the whole, 15 taxa (14 genera) of lichens were found on *Juniperus turbinata* L., and 16 taxa (13 genera) on soil in the locality of Acate (Ragusa, Italy). One species of the lichen flora is recorded for the first time from Sicily. By way of comparison in a coastal area of south eastern Sicily, Cataldo & Minissale (2013) have found 14 terrestrial taxa of which 8 are in common with the current area of study. Among these *Heppia solorinoides* very rare species, even in Vendicari only on sandy substrates.

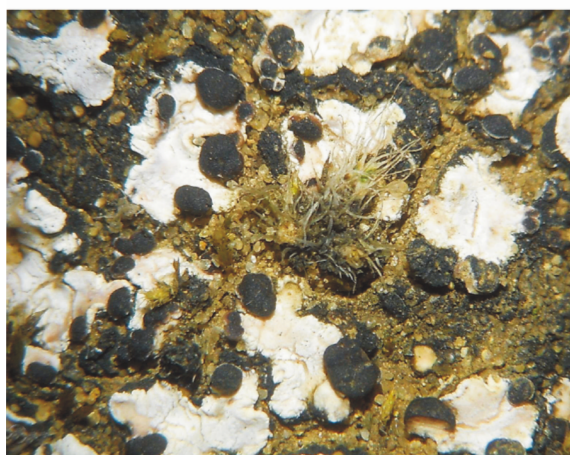
The most widespread growth form on the total flora surveyed is the crustose type, (58%), the squamulose form follows (19%), then foliose form (16%) at the end the dimorphic form (6%).



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Figures 7, 8. *Heppia adglutinata* collected near Acate. Fig. 7: the lichen observed by binocular microscope with scale in millimeters. Fig. 8: Section of the same lichen (magnification 40X, coloured with J_Iodine). Figures 9, 10. Images of collected lichens observed by binocular microscope (magnification 20X). Fig. 9: *Psora decipiens*. Fig. 10: *Squamarina lentigera*.

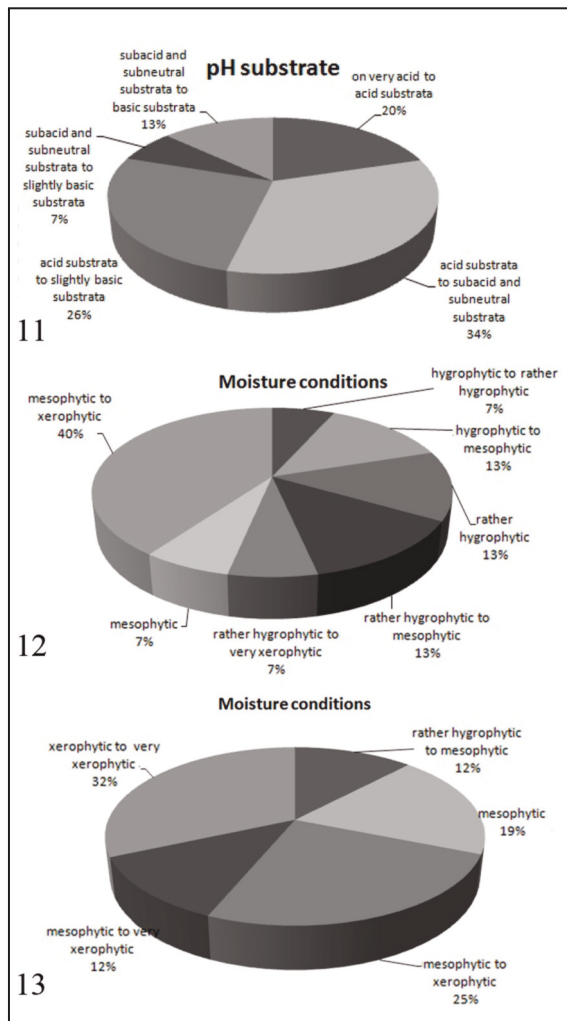


Figure 11. Ecological preferences spectrum of epiphytic lichens-pH substrate.

Figure 12. Ecological preferences spectrum of epiphytic lichens-moisture conditions.

Figure 13. Ecological preferences spectrum of terrestrial lichens-moisture conditions.

Regarding the ecological preferences the 34% of epiphytic species list are characteristic for acid to subneutral substrata (Fig. 11) indicating a weak acid bark similarly to what has been reported in other species of juniper (Aragon et al., 2004; Scarborough et al., 2009); a small group of species, 7%, is characteristic for acid to slightly basic substrata (*Catillaria praedicta*, *Lecidella elaeochroma*, *Physcia leptalea*, *Xanthoria parietina*).

The 40% of these species are characteristic of mesophytic to xerophytic environment. An another 40% is characteristic of hygrophytic to xerophytic environment (Fig. 12).

About the 30% of terrestrial species list are characteristic of xerophytic to very xerophytic environment (Fig. 13).

The epiphytic flora of Acate (Ragusa, Sicily) is poor if compared with the surveyed flora on *J. oxycedrus* at Campu su Disterru in Sardinia (Zedda & Sipman, 2001); this difference can be attributed to different climatic conditions, as shown in the graphs, more shallows in Acate compared to humid conditions and the highest altitude of Sardinia.

Lichenic flora's significance of Piano Pirrera territory, is especially qualitative, in fact among the reported lichens *Heppia adglutinata* is new to Sicily and many species are from extremely rare to rare for Italy.

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