

Preliminary Red List of the lichens of the Valencian Community (eastern Spain)

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Abstract

The present contribution is a tentative Red List of the lichens of the Valencian Community, mainly based on a recent catalogue of the area, which included 569 taxa. The Red List includes 61 threatened lichens as defined by IUCN categories. From our list two species are probably extinct in the region, three are critically endangered, 17 are endangered and 38 are vulnerable. Species threats in relation to habitat are discussed.

Keywords: lichens, Red List, conservation, Spain, Valencian Community

1 Introduction

This is a preliminary Red List of the lichens of the Valencian Community (eastern Spain), which includes the provinces of Alicante, Castellón and Valencia. It has been compiled as a contribution to the Life Program project (Habitats Directive 92/43/EC) on the conservation of cryptogamic species in the Valencian Community (PUCHE *et al.* 1998).

To date, no such Red List has yet been prepared either for Spain as a whole or for the Valencian Community. For this latter territory a first attempt at a list appeared in BARRENO *et al.* (1998), which presented a list of lichens with conservation needs included in a general list of cryptogamic species such as bryophytes and other non-lichenized fungi.

2 Material and methods

The present Red List is primarily based on a catalogue of 569 lichens compiled from the published literature (ATIENZA and SEGARRA 1999a). The lichens were selected from distribution maps showing the abundance of records for each species in the Valencian Community. A computer database was set up according to PUCHE *et al.* (1998), so as to include a record of each of the species in a lichen check-list for the Valencian Community. The records include maps and further detailed information collected for each species regarding ecology, distribution in Spain and internationally, and conservation needs in the Valencian Community, as well as in other areas of the Iberian peninsula and Mediterranean countries. This information

was further supplemented by fieldwork (see below for a list of places visited), which has increased the number of known taxa (ATIENZA and SEGARRA 1999b) and our knowledge of their distribution patterns. Distribution data for lichen species given in some recent publications by FOS (1998) and FOS and BARRENO (1998, 1999) have been also considered. The opinions of other colleagues with extensive field experience with these species was also taken into account. All the compiled information is held by the "Conselleria de Agricultura y Medio Ambiente" a Valencian Government Department.

All the species in the database were then assessed and their conservation status was classified using the IUCN World Conservation Union guidelines.

Threat categories are given following the new system set up by IUCN (1994), described in CHURCH *et al.* (1996), since the system offers a range of alternative associated criteria for each category which makes it easier to follow. The categories applied are: Extinct (EX), critically endangered (CR), endangered (EN), vulnerable (VU) and lower risk (near threatened (LR(nt))). Due to the absence of previous data it was not possible to estimate the rate of population decline for many species and their extinction probability could not be quantified either. Therefore the associated criteria A, C, and E given in IUCN (1994) were not used. Criterion B was applied to species which occupy a restricted area and have been found in few localities, and their populations are in decline or are expected to decline in the future. The area of occupancy was interpreted for each species as the number of 10 x 10 km square grids in which a species has been recorded. Criterion D was used for lichens with very small or restricted populations containing fewer than 1000 mature individuals (sub-criterion D1) or present in four or fewer localities (sub-criterion D2).

The list of taxa is presented in alphabetical order in Tables 1 and 2. For each taxon its name in current use and Red List status according to the already mentioned IUCN categories also applied in the European Community Red List (SÉRUSIAUX 1989) are given. The species' habitat preferences are also listed. Table 2 includes lower risk species.

List of places visited:

Alicante province: 1. Alcoy, Font Roja, grid UTM 30SYH136825; 2. Jávea, Cabo San Antonio, grid UTM 31SBC555997; 3. Villena, Cabezo del Chicolaino, grid UTM 30SXH837750.

Castellón province: 1. Alcudia de Veo, pico de Espadán, grid UTM 30SYK243204; 2. Islas Columbretes, Illa Grossa, grid UTM 31SCE022193; 3. Pina de Montalgrao, Sta. Bárbara de Pina, grid UTM 30TYK026342.

Valencia province: 1. Alcira, Barranco de la Murta, grid UTM 30SYJ286346; 2. El Saler, Pujol Nou, grid UTM 30SYJ314595; 3. Puebla de San Miguel, cerro Calderón, grid UTM 30TXK628383.

Table 1. Red list of the lichens of the Valencian Community.

Species	Status	EC Status	Habitat preference
<i>Acarospora placodiiformis</i> H. Magn.	EN (B)	—	Gypsum soils
<i>Acarospora reagens</i> Zahlbr.	VU (B)	—	Gypsum soils
<i>Acrocordia cavata</i> (Ach.) R.C. Harris	VU (D2)	—	<i>Quercus ilex/Q. faginea</i> forest
<i>Agrestia hispida</i> (Mereschk.) Hale & W.L. Culb.	EN (B)	—	Cold grassy plains soils
<i>Anaptychia runcinata</i> (With.) J. R. Laundon	VU (D1)	—	Siliceous rocks
<i>Anema prodigulum</i> (Nyl.) Henssen	VU (D2)	—	Coastal calcareous rocks
<i>Anema suffruticosum</i> Moreno & Egea	CR (D1)	—	Coastal calcareous rocks
<i>Arthonia meridionalis</i> Zahlbr.	VU (D2)	—	Coastal calcareous rocks
<i>Arthothelium taediosoides</i> Giralt & Grube	VU (D2)	—	Coastal <i>Quercus coccifera</i> garrigue
<i>Aspicilia fruticulosa</i> (Eversm.) Flagey	EN (B)	R	Cold grassy plains soils
<i>Buellia fusca</i> (Anzi) Kernst.	VU (D2)	—	Siliceous rocks
<i>Buellia sardiniensis</i> Steiner	VU (D2)	—	Siliceous rocks
<i>Caloplaca littorea</i> Tav.	VU (D2)	—	Coastal calcareous rocks
<i>Catapyrenium divisum</i> (Zahlbr.) Breuss	EN (D)	—	Calcareous rocks
<i>Collema occultatum</i> Bagl.	VU (D1)	—	<i>Quercus suber</i> forest
<i>Dirina immersa</i> Müll. Arg.	VU (D2)	—	Coastal calcareous cliffs
<i>Fulgensia desertorum</i> (Tomin) Poelt	VU (B)	—	Gypsum soils
<i>Fulgensia poeltii</i> Llimona	EN (B)	—	Gypsum soils
<i>Fuscopannaria saubinetii</i> (Mont.) P.M. Jørg.	CR (D1)	E	<i>Quercus ilex</i> forest
<i>Gloeoheppia turgida</i> (Ach.) Gyeln.	VU (D2)	—	Calcareous rocks fissures
<i>Gyalecta geoica</i> (Wahlenb.) Ach.	VU (D2)	—	<i>Quercus ilex</i> forest
<i>Gyalecta liguriensis</i> (Vězda) Vězda	VU (D2)	—	<i>Quercus ilex</i> forest
<i>Gyalecta truncigena</i> (Ach.) Hepp	VU (D2)	—	<i>Quercus ilex/Q. faginea</i> forest
<i>Harpidium rutilans</i> (Flot.) Körber	VU (D2)	—	Siliceous rocks
<i>Heppia gigantea</i> Egea & Llimona	VU (D2)	—	Clay-marl soils
<i>Ingaderia troglodytica</i> Feige	CR (D1)	—	Coastal calcareous cliffs
<i>Lecanographa subgrumulosa</i> (Egea, Torrente & Manrique) Egea & Torrente	EN (D)	—	Coastal calcareous cliffs
<i>Lecidea circinarioides</i> Casares & Hafellner	EN (B)	—	Gypsum soils
<i>Leptogium cyanescens</i> (Rabenh.) Körber	VU (D2)	—	<i>Quercus ilex/Q. suber</i> forest
<i>Leptogium furfuraceum</i> (Harm.) Sierk	EN (D)	—	<i>Quercus ilex</i> forest
<i>Lobaria pulmonaria</i> (L.) Hoffm.	EX?	—	Siliceous rocks/Epiphytic
<i>Massalongia carnososa</i> (Dickson) Körber	EX?	—	Muscicolous/Saxicolous
<i>Megaspora verrucosa</i> (Ach.) Hafellner & V. Wirth v. mutabilis (Ach.) Nimis & Cl. Roux	VU (B)	—	<i>Quercus ilex, Q. faginea, Juniperus thurifera</i> forest
<i>Moelleropsis nebulosa</i> (Hoffm.) Gyeln.	VU (D)	—	Siliceous rocks fissures
<i>Opegrapha lutulenta</i> Nyl.	VU (D2)	—	Coastal volcanic rocks
<i>Opegrapha niveoatra</i> (Borrer) J. R. Laundon	VU (B)	—	<i>Quercus suber</i> forest
<i>Opegrapha rufescens</i> Pers.	VU (D2)	—	<i>Quercus ilex/Q. faginea</i> forest
<i>Opegrapha subelevata</i> (Nyl.) Nyl.	VU (D2)	—	Coastal calcareous rocks
<i>Opegrapha variaeformis</i> Anzi	VU (D2)	—	Coastal calcareous rocks
<i>Parmelia camtschadalis</i> Ach.	EN (B)	—	Cold grassy plains soils
<i>Parmelia laciniatula</i> (H. Olivier) Zahlbr.	VU (D2)	—	<i>Quercus ilex/Q. faginea</i> forest

Table 1 continued.

Species	Status	EC Status	Habitat preference
<i>Parmotrema hypoleucinum</i> (Steiner) Hale	EN (D)	V	Coastal <i>Quercus coccifera</i> garrigue
<i>Parmotrema reticulatum</i> (Taylor) Choisy	EN (D)	—	<i>Quercus ilex</i> forest
<i>Peltula obscuratula</i> (Nyl.) Poelt ex Egea	EN (D)	—	Coastal calcareous rocks
<i>Peltula omphaliza</i> (Nyl.) Wetmore	VU (D2)	—	Siliceous/volcanic rocks
<i>Peltula patellata</i> (Bagl.) Swinscow & Krog	VU (D2)	—	Siliceous rocks fissures
<i>Peltula placodizans</i> (Zahlbr.) Wetmore	VU (D2)	—	Calcareous rocks fissures
<i>Polyblastiopsis subericola</i> de Lesd.	EN (B2b,e)	—	<i>Quercus suber</i> forest
<i>Polychidium muscicola</i> (Sw.) Gray	VU (D2)	—	muscicolous, calcareous soils
<i>Psora saviczii</i> (Tomin) Follmann & Grespo	EN (B)	—	Gypsum soils
<i>Ramalina lacera</i> (With.) J. R. Laundon	VU (D2)	—	Coastal <i>Quercus coccifera</i> garrigue
<i>Ramalina obtusata</i> (Arnold) Bitter	VU (D2)	E	<i>Quercus faginea</i> forest
<i>Ramonia subsphaeroides</i> (Tav.) Vězda	EN (D)	—	<i>Quercus ilex/Q. faginea</i> forest
<i>Rinodina euskadiensis</i> Crespo & M. B. Aguirre	EN (D)	—	<i>Quercus suber</i> forest
<i>Schismatomma albocinctum</i> (Nyl.) Zahlbr.	EN (D)	—	Coastal <i>Quercus coccifera</i> garrigue
<i>Schismatomma ricasolii</i> (Massal.) Egea & Torrente	EN (D)	—	<i>Quercus ilex/Q. faginea</i> forest
<i>Solorina saccata</i> (L.) Ach.	VU (D2)	—	Calcareous rocks fissures
<i>Strigula mediterranea</i> Etayo	VU (D2)	—	<i>Quercus ilex/Q. faginea</i> forest
<i>Umbilicaria polyphylla</i> (L.) Baumg.	VU (D2)	—	Siliceous rocks
<i>Vulpicida pinastris</i> (Scop.) J. E. Mattsson & M. J. Lai	VU (B)	—	Epiphytic on <i>Pinus nigra</i>
<i>Waynea stoechadiana</i> (Abassi & Cl. Roux) Cl. Roux & P. Clerc	VU (D2)	—	Coastal <i>Quercus coccifera</i> garrigue

Table 2. Lower risk list of the lichens of the Valencian Community.

Species	EC Status	Habitat preference
<i>Arthonia granosa</i> de Lesd.	—	<i>Quercus ilex/Q. suber</i> forest
<i>Arthonia melanophthalma</i> Dufour	—	Coastal <i>Quercus coccifera</i> garrigue
<i>Arthothelium sardoum</i> Bagl.	—	Coastal <i>Quercus coccifera</i> garrigue/ <i>Q. suber</i> forest
<i>Caloplaca navasiana</i> Nav.-Ros. & Cl. Roux	—	Coastal calcareous rocks
<i>Caloplaca subochracea</i> (Wedd.) Werner v. subochracea	—	Coastal calcareous rocks
<i>Caloplaca tavaresiana</i> Nav.-Ros. & Cl. Roux	—	Coastal calcareous rocks
<i>Catinaria atropurpurea</i> (Schaerer) Vězda & Poelt	—	<i>Quercus suber</i> forest
<i>Diploschistes diacapsis</i> (Ach.) Lumbsch	—	Gypsum soils
<i>Julella lactea</i> (Massal.) M. E. Barr.	—	Coastal epiphytic
<i>Opegrapha celtidicola</i> (Jatta) Jatta	—	Coastal epiphytic
<i>Physcia clementei</i> (Turner) Maas Geest.	E→O	<i>Quercus ilex/Q. suber</i> forest
<i>Physconia servitii</i> (Nádv.) Poelt	—	<i>Quercus ilex/Q. faginea</i> forest

3 Results

Although lichen distribution patterns are still in need of further study in this region, Table 1 shows a preliminary list of 61 threatened lichens, arranged in alphabetical order. They represent 10.5% of the total known lichen flora within the investigated area. From this list two species can be considered as being probably extinct in the region, three species as critically endangered, 17 as endangered and 38 as vulnerable. A second list (Table 2) includes 12 taxa affected by a lower risk. This analysis might need modification as more data regarding the floristic as well as conservation status of particular species become available.

From our data, it appears that, of the threatened lichens, terricolous species account for 26% of the list. Some of them live on gypsum (six species), marl (one species) or prefer rock fissures (five species), and are sometimes found living on mosses (one species). Three of them are very interesting as they have a vagrant form of life. Saxicolous lichens make up 30% of the total, 11 of which grow on calcareous rocks, and seven species on siliceous ones.

The rest of the taxa are epiphytic species, 25 in total, accounting for 41%. Among the epiphytic taxa, five species are found in coastal localities including on *Quercus coccifera* garrigue which is a degraded form of *Quercus ilex* forest. Another five species are found in *Quercus suber* forests; and the rest, 15 species, live in *Quercus ilex/Quercus faginea* forests or *Juniperus thurifera* forests in the most continental localities of the region. Two species: *Lobaria pulmonaria* and *Massalongia carmosa* have not been recorded in the area since the nineteenth century (CLEMENTE 1864, COLMEIRO 1867). Therefore they are considered extinct in this region, although they might be present in adjacent regions (Teruel or Cuenca provinces).

Most of the species in the Red List are known from natural habitats, which have been classified by the Habitats Directive 93/43/EC of the European Union Council as areas of common interest for conservation, e.g. gypsophilous grass plans, Mediterranean vegetation of coastal rocky shores, coastal *Quercus coccifera* garrigue, *Quercus faginea* forests, cold grassy plains with Mediterranean endemic forest of *Juniperus* species, *Quercus suber* forests and rocky calcareous and siliceous habitats.

4 Discussion

4.1 Terricolous Red List lichens

Gypsum soil lichen communities were studied in Spain by LLIMONA (1974), CRESPO and BARRENO (1975) and CASARES-PORCEL and GUTIERREZ CARRETERO (1993). In the European Community Red List (SÉRUSIAUX 1989) these areas were recommended as in urgent need of protection. Interesting species such as *Acarospora placodiiformis* (Fig.1), *Fulgensia poeltii*, *Psora saviczii* and *Lecidea circinarioides* are found in gypsum soil in Northern Africa and Spain. In the Valencian region they are located mainly in warm and dry areas in the Alicante province. The main threats to their habitat are trampling and/or fire. Further threats to these species may be related to air pollution from traffic, which may do considerable damage to terricolous lichens found in areas near roads and cities, and also to the establishment of rubbish tips in the area.

Terricolous lichens growing in most inland areas of the Valencia (Rincón de Ademuz) and Castellón provinces include a special vagrant lichen community living in places that are arid due to the continental climate or desertification, and also to strong winds and eutrophication. Associated species are *Agregia hispida*, *Aspicilia fruticulosa* (Fig.2), *Parmelia camtschadalis*

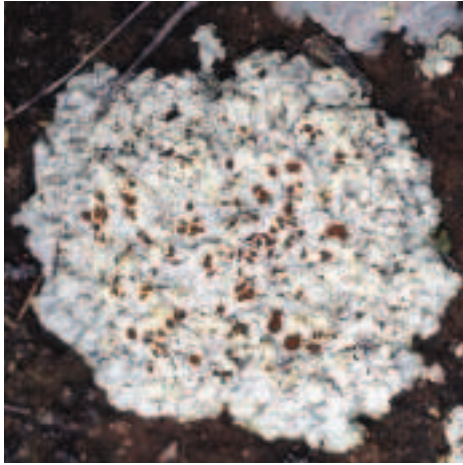


Fig. 1. *A. carospora placodiiformis*.



Fig. 2. *A. spicilia fruticulosa*.

and *Coelocaulon aculeatum*, amongst others. These lichens grow in Spain in the so-called Iberian Paramera, as well as in the clearings of the thyme and grassland communities (*Festuco-Poion ligulatae*), between 1200 and 1400 m above sea level. The optimum distribution area of this lichen community is in the Irano-Turanian Region and in the mountains of Astrakan and Tauria in Russia (CRESPO and BARRENO 1978). In the Valencian Community the lichen community occurs in open *Juniperus thurifera* and *J. sabina* forests. The structure of these forests was formerly maintained by herbivores under the traditional management of wood pasture. The reasons for the decline of these lichens are related to changes in managed grazing routines, leading to an invasion by scrub or coarse grasses, with the subsequent loss of terricolous species. The European Community Red List (SÉRUSIAUX 1989) mentioned these special habitats as being in urgent need of protection.

In more humid inland localities we found *Solorina saccata* growing on soil, especially soil accumulated in rock fissures over calcareous substrata. It grows sparsely in the supramediterranean belt (CLEMENTE 1864; ATIENZA and SEGARRA 1999b), and the main threats to its habitat are eutrophication caused by human activities and the use of inorganic fertilisers and fire.

4.2 Saxicolous Red List lichens

Special coastal habitats for saxicolous lichens are located in the NE of the Alicante province between the cities, Denia and Altea, (Cabo San Antonio, Cabo de la Nao). Here a special group of species may be found growing on NW vertical calcareous cliffs directly exposed to sea spray. The lichens include *Ingaderia troglodytica* (Fig. 3), *A. nema suffruticosum*, *Lecanographa subgrumulosa*, among others.

Ingaderia troglodytica is known on the island of Menorca and the SE coast of Spain: Alicante and Almeria (FEIGE and LUMBSCHE 1993), and also from Sardinia and Sicily (NIMIS 1993). Only two populations with a few number of individuals are located mainly in small caves in shady places. Associated species are *Dirina massiliensis*, *Opegrapha durieui*, *Lecanographa grumulosa* and *Roccella phycopsis*.

At present, only one population of *Anema suffruticosum* is known in Cabo de la Nao (Javea, Alicante), growing on vertical calcareous cliffs in a coastal area near the sea, exposed to sea spray (MORENO and EGEA 1992). The last two Red List species *Ingaderia troglodytica* and *Anema suffruticosum* are Critically Endangered since their already small populations are threatened with the possibility of urbanization of the site.

Lecanographa subgrumulosa is found in Morocco and SE Spain (EGEA and TORRENTE 1994). It grows near the sea in El Montgó, Denia, in the Alicante province, on limestone rocks which are moderately shaded. It is found with *Dirina massiliensis*, *Opegrapha variaeformis* and *Roccella phycopsis*.

Most coastal areas of the Valencian Community are under threat due to tourist development and the spread of construction sites.

Saxicolous siliceous habitats are scarce and isolated in the Valencian region. Siliceous species from selected habitats such as *Anaptychia runcinata*, *Harpidium rutilans*, *Umbilicaria polyphylla*, etc. have either just single or very limited populations. Their main threat is habitat deterioration, which makes it difficult for them to recolonize.



Fig. 3. *Ingaderia troglodytica*.

4.3 Epiphytic Red List lichens

Along the coast in the Valencian Community, where the climate is typically Mediterranean, there are only a few sites with woodlands or forest vegetation. Crops, roads, industry and cities cover the main part of the territory. Most of the areas with *Quercus coccifera*/*Q. ilex* woods are today only tiny fragments of the original forest. *Quercus coccifera* garrigue forests (degraded stages of *Quercus ilex* forest) provide a refuge for epiphytic lichens. The decline of phorophytes affects the presence of epiphytic lichens such as *Arthothelium taediosoides*, *Parmotrema hypoleucinum* (Fig. 4), *P. reticulatum*, *Ramalina lacera*, *Schismatomma albocinctum*, and *Waynea stoechadiana*. These species usually grow on the bark of evergreen trees and shrubs, but mainly on *Quercus coccifera*, *Q. ilex*, *Pistacia lentiscus*, *Ceratonia siliqua*, and *Pinus halepensis*. The main threat to all of these species range from eutrophication caused by the inorganic fertilisers used in agriculture to air pollution and fires associated with increased tourism in areas where the dry season coincides with the touristic season. Although fire is a natural component of the ecology of the Mediterranean forest, it could cause the extinction of the lichen flora because of the fragmented nature of the remaining forest. Fire is particularly harmful when it occurs frequently and is not due to natural causes.

The loss of lichen species with a narrow ecology such as *Gyalecta truncigena*, *Ramonia subsphaeroides*, etc. after fires in Mediterranean *Quercus ilex* forests has been demonstrated by LONGAN *et al.* (1999).

In *Quercus suber* forests epiphytic species are also affected by cork extraction. The periodical removal of the tree bark negatively affects taxa such as *Polyblastiopsis subericola*, *Opegrapha niveoatra*, *Collema oculatum* amongst others.

In *Quercus ilex*/*Q. faginea* forests in more inland areas of the region, we can find two rare species: *Fuscopannaria saubinetii* and *Leptogium furfuraceum*. The former lichen has a typically Mediterranean range, but also extends into Central Europe, although it is not found in high mountains. However, the habitat requirements of this species are not well known. It seems to prefer regions with a dry, warm microclimate, but as it is found on the base of trees, it evidently needs protection against too much dryness. It was recorded on the island of Mallorca (JØRGENSEN 1978), but only two specimens are known from the Iberian peninsula: one of them was collected from the base of a big oak, growing directly on the bark, in Vallibona, Castellón province (ATIENZA and BARRENO 1991) and the other was recently recorded in the Gerona province (LONGAN and GÓMEZ-BOLEA 1999). *Leptogium furfuraceum* is found in a few localities in southern Europe most of which have a humid climate. Specimens from Valencia were collected from the base of old oaks in the North of the Castellón province (ATIENZA and BARRENO 1991). Other threatened species in the North Castellón area are *Ramalina obtusata* and *Vulpicida pinastri*; the last one was found growing on *Pinus nigra*. The death of these trees due to disease, is the most serious threat for this species.

Another important threat to all of these epiphytic species is the increasing pressure of cattle grazing, which encourages the growth of species that tolerate eutrophication and dryness, as in several members of the Teloschistaceae, i.e. *Xanthoria* spp., *Caloplaca* spp., and *Teloschistes chrysophthalmus*. Epiphytic species may be also affected by industrial air pollution. The sensitivity of lichens in the area to air pollution has been documented by CALATAYUD *et al.* (1996).

Finally, it needs to be mentioned that nowadays some localities containing several of the already mentioned critical habitats e.g. gypsum soil sites, *Juniperus thurifera* forests and coastal calcareous cliffs, have attained a certain degree of protection, as they have been designated as Micro-nature reserves of Flora (including lichen-forming fungi), under the protection of the local administration department known as The Species Protection Service from the "Conselleria de Agricultura y Medio Ambiente" (Valencian Government) (LAGUNA 1997).



Fig. 4. *Parmotrema hypoleucinum*.

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