

# The lichen flora of Levant Island (Port-Cros National Park, Var, France)

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**Abstract.** As part of the Stoechas project, an inventory of the lichen flora of the Levant Island was started in May 2021 and completed in April 2022. Its lichen flora had been little studied previously, unlike the other islands of the Hyères archipelago, particularly Port-Cros and Porquerolles. During this mission, several environments were surveyed, from the coastal areas of the supralittoral zone to the scrubland of theridges. This inventory, based on 505 specimens, enabled 184 lichen infrageneric taxa to be recorded, including three previously reported in the Var department but not confirmed (*Cladonia suburgida*, *Hydropunctaria rheitrophila*, *Lichinella stipatula*), 10 lichens newly reported from the Var department (*Athallia alnetorum*, *Bacidia sipmanii*, *Coniocarpon fallax*, *Diploschistes scruposus* morpho. *violarius*, *Endohyalina ericina* var. *ericina*, *Lecania hutchinsiae*, *Micarea micrococca* s.l., *Physcia mediterranea*, *Rinodina nimisii*, *Ingaderia sorediata*) and one non-lichenicolous fungus new from the Var (*Sphinctrina turbinata*). The study, carried out on all the populations of saxicolous, terricolous and corticolous lichens, revealed 27 lichen communities that could be attached to previously described associations (17 saxicolous, all on siliceous rocks, 7 corticolous and epiphytic, 1 lignicolous and epiphytic, 2 terricolous and calcifuge). Some interesting or threatened species are discussed, and a few conclusions are drawn regarding lichen biodiversity studies in the future.

**Keywords:** inventory, lichens (corticolous, lignicolous, saxicolous, terricolous), Mediterranean island, threatened species.

**Résumé.** La flore lichénique de l'île du Levant (Parc national de Port-Cros, Var, France). Dans le cadre du projet Stoechas, un inventaire de la flore lichénique a été initié en mai 2021 et réalisé en avril 2022 sur l'île du Levant. Sa flore lichénique avait été peu étudiée auparavant, contrairement aux autres îles de l'archipel d'Hyères, notamment Port-Cros et Porquerolles. Au cours de cette mission, plusieurs milieux ont été prospectés, des zones côtières de l'étage supralittoral au maquis des crêtes. Cet inventaire, basé sur 505 spécimens collectés a permis de recenser 184 taxons infragénériques, dont trois signalés dans le Var mais non confirmés (*Cladonia suburgida*, *Hydropunctaria rheitrophila*, *Lichinella stipatula*) et 10 lichens nouvellement signalés dans le Var (*Athallia alnetorum*, *Bacidia sipmanii*, *Coniocarpon fallax*, *Diploschistes scruposus* morpho. *violarius*, *Endohyalina ericina* var. *ericina*, *Lecania hutchinsiae*, *Micarea micrococca* s.l., *Physcia mediterranea*, *Rinodina nimisii*, *ingaderia sorediata*) et un champignon lichénicole non lichénisé nouveau pour le Var (*Sphinctrina turbinata*). L'étude réalisée sur toutes les populations de lichens saxicoles, terricoles et corticoles, a révélé 27 groupements lichéniques pouvant être rattachés à des associations déjà décrites (17 saxicoles, tous sur roches siliceuses, 7 épiphytes corticoles, 1 épiphyte lignicole, 2 terricoles calcifuges). Quelques espèces intéressantes ou menacées sont discutées, et quelques conclusions sont formulées concernant des études futures sur la biodiversité des lichens.

**Mots-clés:** espèces patrimoniales, île méditerranéenne, inventaire, lichens (corticoles, lignicoles, saxicoles-calcifuges).

## 1 Introduction

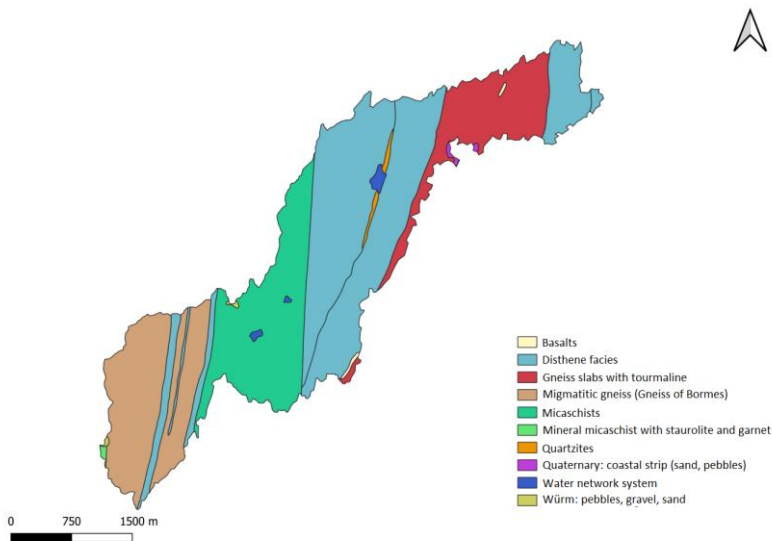
**Levant Island (île du Levant)** is the most easterly of the Hyères islands (Var, France), which arc across the Hyères bay and form part of the island domain of the Port-Cros National Park (PCNP). Most of the island is occupied by a military base with strictly regulated access (Fig. 1), while the rest is made up of private land grouped around Héliopolis on the western tip of the island. The whole of the island is located within the Port-Cros National Park protected area, although it is not part of the core zone of the park due to military activities (missile test and launch centre). The lichen inventory of Levant Island follows on from the inventory of cap Lardier (Bertrand and Valance, 2023) just opposite on the mainland, as part of the PCNP's Stoechas project. The island has never been the subject of any lichen inventories, despite the remarkable work of Jahandiez (1929) in the *Monographie des îles d'Or*, of which Levant Island is a part. Ranwell and James (1966) mention 37 lichens. Our inventory of the lichen flora relates essentially to the entire military territory and was carried out in May 2021 and in April 2022.

Levant Island, like all the other Hyères islands, is located in the commune of Hyères and covers an area of c. 996 hectares. The military base accounts for 95% of the island's total surface area, while the civilian part of Héliopolis covers around 50 hectares. The islands of Hyères are all located at a latitude of 43° north, corresponding to that of Cap Corse. The area covered in this study stretches from the Rioufred Cove in the western part to the Titan lighthouse in the eastern part. The topography is fairly pronounced, with steep slopes that are fairly uniform across the island; it is more or less crossed by a median ridge line encompassing the summits of Maupertuis (alt. 113 m), Héliopolis (alt. 138 m, the highest peak), la Madone (alt. 125 m), la Verrette (alt. 131 m), le Courcousson (alt. 128 m) and le Titan (alt. 95 m). The northern, south-western and eastern coasts are made up of cliffs several dozen meters high, while the southern part is more accessible and gently sloping.

There are no permanent watercourses on the island, although some temporary ones may flow late in the season and in places form permanent pools, or create seepages at the bottom of valleys or at the foot of cliffs. The Rioufred Valley (LEV 24) has also supported a few freshwater lichen species. In addition to these valleys, there are three hillside reservoirs (*étangs du Jas-Vieux* and *étang du Haut*, which feed the *barrage du Bas*), as well as the small *mare de l'Âne* (the donkey's pond) on the island's southern side.



The island's substratum is schisto-crystalline and consists, in the western part, of the *Bormes* gneiss (augen gneiss with beds of micaceous gneiss), in the central part, mainly of schists and micaschists and, in the eastern part, of micaschists resulting from more advanced metamorphism (biotite, staurotide and kyanite micaschists; Titan amphibolite) (see Fig. 2). A particular geological feature is the *roche de fer* (a local name meaning iron rock for a very hard iron-like stone. This rock consists of a few veins of fine-grained diabase (igneous rock of great hardness, mainly formed from small crystals of pyroxene and feldspar) was prospected at stations LEV 01 and LEV 02.



**Figure 2.** Geology of Levant Island (source: PCNP, Stoechas project).

The rocky nature of the bedrock also creates a fairly varied relief and a rather jagged coastline, favourable for the establishment of natural, mainly calcifuge, saxicolous and terricolous lichens, both on the coast and inland.

## 2.2 Climatology

The Levant Island weather station is located in the centre of the island, inside the military camp, at la Madone, at an altitude of 130 m. Temperature and rainfall data for the last 30 years are synthesized in the ombrothermic graph (Fig. 3; <https://www.infoclimat.fr/>).

Because of the insularity of the site, it is interesting to compare the data with those from two nearby and similar weather stations, but located on the mainland, Cavalaire and Cap Camarat (Bertrand and

Valance, 2023). Comparative global average data are shown in Table I.

**Table I.** Averaged climatological data for Levant Island compared to those of two stations located on the mainland just opposite (Cavalaire and Cap Camarat), period 1991–2020. The extreme values (minimum and maximum) are historical values recorded over the same period but should not be considered as normal values.

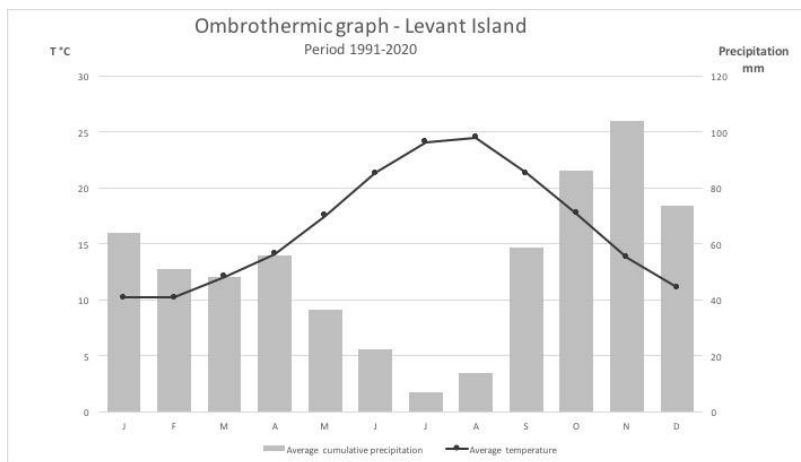
|                                                        |     | Cavalaire | Ramatuelle-Cap Camarat | Levant Island |
|--------------------------------------------------------|-----|-----------|------------------------|---------------|
| Annual average temperature                             | ° C | 17.3      | 16.5                   | <b>16.5</b>   |
| Extreme maximum temperature recorded during the period | ° C | 37.9      | 37.0                   | <b>38.3</b>   |
| Annual average maximum temperature                     | ° C | 21.6      | 20.1                   | <b>19.5</b>   |
| Annual average minimum temperature                     | ° C | 12.9      | 12,9                   | <b>13.5</b>   |
| Extreme minimum temperature recorded during the period | ° C | -1.8      | -8.6                   | <b>-8.2</b>   |
| Average annual precipitation                           | mm  | 702.3     | 822.0                  | <b>621.5</b>  |

The climatological data, with three months of drought, and despite a slightly lower average annual total rainfall than on the mainland (621 mm compared to 700–800 mm), correspond to a sub-humid ombroclimate.

With an average maximum in the hottest month of 28.4 °C and an average minimum in the coldest month of 8 °C, the Emberger coefficient calculated on the basis of 1991–2020 data, Q2 = 104, places the Levant Island in the sub-humid Mediterranean zone with mild winters, in a similar way to the continental coastline opposite (Q2=102 in the case of the cap Lardier area - Bertrand and Valance, 2023).

Precipitation is lower on Levant Island than on the mainland coast; this can be explained by the island's exposed position in relation to the winds from the Gulf of Genoa.

There is also the influence of maritime ingress and haline fog from the east, either covering the easterly rocky coasts or sweeping into the small valleys. This exposure to fog drenching makes them favourable to the establishment of certain lichen communities.



**Figure 3.** Monthly ombroclimate for the period 1991-2020 (source: [www.infoclimat.fr](http://www.infoclimat.fr)).

### 2.3 Vascular vegetation

The Levant Island is mainly covered by tall scrub with a few trees (e.g. *Erica arborea*, *Arbutus unedo*, *Myrtus communis*, *Phillyrea angustifolia*), which is impenetrable in some places and often lacks a lichen flora. In places, particularly in the valleys, there are a few stands of large trees (*Pinus halepensis*, *Quercus ilex*). These have been surveyed (étang du Haut, chemin de la Douane, chemin des Moines au Courcousson, anse du Liserot) and have revealed a range of interesting lichen communities.

### 2.4 Disturbance of the natural environment by fires

The island has been the scene of three fires of varying importance: the historic fire of October 1866 (corresponding to the revolt at the children's prison on Levant Island), and the large-scale fires that affected the south-eastern part of the island in 1926 and September 1990. Each of these fires disrupted the woodlands and their maturity. That explains the frequent lack of long-established lichen populations, which are now restricted to certain protected valleys and untouched areas.

A forest fire hazard map for the commune of Hyères, drawn up by the Var Prefecture in 2021, indicates that almost all of Levant Island is at a very high risk. Firebreaks maintained over the years are spread around the island in the vicinity of areas used for defence purposes, as part of the island's general fire protection measures. However, these firebreaks do not form too large a grid and seem to have little impact on the island's lichen flora.

### 3 Previous knowledge

Several works have been published on the lichen flora of the islands of Hyères in general (Flahault and Hue, 1899; de Crozals in Jahandiez, 1929) or on the lichen flora of the island of Port-Cros in particular (Rondon, 1971, 1972; Rondon-Seidenbinder, 1983; Abbassi Maaf and Roux, 1984a, 1984b; Roux and Sigoillot, 1987; Valance, 2018) and the island of Porquerolles (Rondon, 1957); only one publication (Ranwell and James 1966) is devoted to Levant Island. Those relating to the islands of Hyères are as follows:

- Flahaut and Hue (1899), in *Lichens du massif des Maures et des environs d'Hyères (Var)*, list collections (69 species) made between Hyères and Brégançon, as well as on the islands of Hyères, but only on the Giens peninsula (3 species) and on the island of Port-Cros (36 species). No mention was made of Porquerolles Island or Levant Island.

- de Crozals (1924) in *Les lichens du massif des Maures*, presents the most important early work carried out in the Maures massif, listing 370 species collected throughout the Maures massif. Several references are made to the Hyères Islands: Giens Peninsula (46 species), Port-Cros Island (63 species) and Porquerolles Island (11 species). No mention is made of Levant Island.

- de Crozals (1929), in *Les lichens des îles d'Hyères* (in the monograph on the islands of Hyères by E. Jahandiez, 1929), presents some 223 species of lichens found in the islands of Hyères and the Giens Peninsula. These include: Porquerolles Island (51 species), Port-Cros Island (121 species), Giens Peninsula (126 species), Levant Island (1 species, *Cladonia pyxidata* at Pierres de fer, on soil).

- Molinier (1937), in his phytosociological study of the Hyères Islands, added to his earlier studies, and his observations on Levant Island, as he mentioned 5 lichen species among the cryptogam records.

- Ranwell and James (1966) drew up a bibliographical list of the species collected on Levant Island by their predecessors and established a list of 33 species collected by D. S. Ranwell on the island in 1960 (including only one species recorded before: *Cladonia foliacea*. The five other species previously mentioned by Jahandiez and Molinier were not refound).

- The inventory of the islands of Hyères was completed by Rondon (1957) for the Island of Porquerolles, by Rondon (1971, 1972, 1973, 1977) respectively on epiphytic, rupicolous and terricolous lichens (28 terricolous species listed) but only for the

Island of Port-Cros, and by Rondon-Seidenbinder (1983), who gave a list of 87 corticolous species, again only for the Island of Port-Cros.

Abbassi Maaf and Roux (1984a, 1984b) described a new species, *Hypocenomyce stoechadiana* (= *Waynea stoechadiana*), and mentioned several new additions to the French lichen flora, some of which resulted from surveys on the Island of Port-Cros. In 1987, they also described the corticolous lichen associations of the *Quercus ilex* forest and the maquis on the Island of Port-Cros (Abbassi Maaf and Roux, 1987). However, there is no mention of Levant Island.

- A few sparse records by Bricaud and Roux (1990) also relate to the islands of Hyères, with a single mention, that of *Caloplaca ora*, on Levant Island, at a place called "crique de la Galère" (according to the label of the specimen collected by J. Lambinon on April 28, 1965 and preserved in the Clauzade herbarium housed in MARSSJ – C. Roux, pers. comm.). However, no "crique de la Galère" appears to exist on the Levant Island, but only on the east coast of the Island of Port-Cros or on the east coast of the Island of Porquerolles. There may have been a mix-up in the attribution of the place.

- Bricaud and Roux (1991) describe the *Zamenhofietum coralloideae* Roux & Bricaud nov. ass.

- O. Bricaud mentions, in his thesis (1996, published in 2004), several phytosociological surveys on the island of Porquerolles as support for the description of *Wayneetum stoechadianae* Abbassi Maaf & Roux and *Zamenhofietum coralloideae* Roux & Bricaud 1991. However, no records are mentioned on Levant Island.

- A few calcifugous saxicolous surveys were carried out on the island of Porquerolles by T. Ménard in his thesis (1997; Ménard, 2009) on the phytosociological and ecological study of calcifugous saxicolous lichen communities in south-eastern France, but none on the other islands in the archipelago.

To summarise, in the end, unlike its neighbours in the Hyères Archipelago, Levant Island's lichen flora has been very little surveyed and the list of species previously identified there is largely based on Ranwell and James (1966). The following list of confirmed species, updated with the new nomenclature, totals 36 lichen taxa for Levant Island prior to the present study: *Alyxoria varia* (Pers.) Ertz & Tehler, *Anaptychia runcinata* (With.) J. R. Laundon, *Bacidia arceutina* (Ach.) Arnold, *Blastenia crenularia* (With.) Arup, Søchting & Frödén var. *crenularia*, *B. xerothermica* Vondrák, Arup & I. V. Frolov subsp. *xerothermica*, *Candelariella vitellina* (Hoffm.) Müll. Arg., *Cladonia cervicornis* (Ach.) Flot., *C. conista* (Nyl.) Robbins, *C. foliacea* (Huds.) Willd. subsp. *foliacea*, *C. foliacea* subsp. *endiviifolia* (Dicks.) Boistel,

*C. portentosa* (Dufour) Coem., *C. pyxidata* (L.) Hoffm., *C. rangiformis* Hoffm., *Collema subnigrescens* Degel., *Enchylium tenax* (Sw.) Gray var. *tenax*, *Glaucomaria rupicola* (L.) P. F. Cannon subsp. *rupicola*, *Gyalolechia fulgens* (Sw.) Söchting, Frödén & Arup, *Lecanora campestris* (Schaer.) Hue subsp. *campestris*, *L. gangaleoides* Nyl., *L. sulphurea* (Hoffm.) Ach., *Lepra amara* var. *flotowiana* (Flörke) Nimis, *Ochrolechia parella* (L.) Ach., *Parmotrema perlatum* (Huds.) M. Choisy, *P. pseudoreticulatum* (Tav.) Hale, *Physcia adscendens* H. Olivier, *P. clementei* (Turner) Lynge, *Physconia distorta* (With.) J. R. Laundon var. *distorta*, *Ramalina fastigiata* (Pers.) Ach., *R. pollinaria* (Westr.) Ach., *R. subfarinacea* (Nyl. ex Cromb.) Nyl., *Rinodina confragosa* (Ach.) Körb., *Roccella phycopsis* (Ach.) Ach., *Variospora flavescens* (Huds.) Arup, Frödén & Söchting, *Verrucaria nigrescens* Pers., *Xanthoparmelia conspersa* (Ehrh. ex Ach.) Hale and *X. stenophylla* (Ach.) Ahti & D. Hawksw.

In addition, several other works concerning the Mediterranean flora of the Var have extended our knowledge of the local lichen flora through the description of new species and lichen communities typical of the region, namely Abbassi Maaf and Roux (1984a, 1984b, 1987), Bouly de Lesdain (1907, 1909, 1924, 1925, 1956), Bricaud *et al.* (1991, 1992, 1993a, 1993b), Clauzade (1963, 1969a, 1969b), Clauzade and Roux (1977), and Roux and Bricaud (1991).

## **4 Material and methods**

### **4.1 Brief presentation and site survey**

For each station, the ecological characteristics (location, environment, substrate, local orientation, altitude) and the geographical coordinates (decimal degrees) were noted, in order to obtain a detailed inventory. Recording was carried out using the method of Roux (1990), namely identification with the naked eye and a magnifying glass of as many species as possible in the field, and sampling those not identified over a given surface area, usually a few square metres, in sufficient numbers of specimens (per substrate) at random from the surface area in question, which makes it possible, in the laboratory, to identify species that have gone unnoticed in the field. This method is sufficient, providing very satisfactory qualitative results and approaching a fairly good level of completeness for an inventory of lichens.

All the stations surveyed are compiled in **Appendix 1**.

### **4.2 Species determination**

For the determinations, we used a stereomicroscope (magnification from 8 to 56 times), a transmission microscope equipped with a camera (magnification from 100 to 1 500 times), as well as the chemical reagents usual in lichenology: K (20% aqueous potassium hydroxide solution), C (aqueous sodium hypochlorite

solution: commercially available concentrated solution diluted 2 times), N (50% aqueous nitric acid solution), I (iodo-iodide solution: lugol), P (paraphenylene diamine: freshly prepared alcoholic solution), but some species were subjected to chromatography (see Orange *et al.*, 2001), and some recently described taxa that are particularly difficult to confirm were sequenced. For the determinations, the following publications were employed:

Floristic: Clauzade and Roux (1985) and its supplements (1987 and 1989), Smith *et al.* (2009); Wirth *et al.* (2013), Italic (2023) (see Nimis and Martellos, 2020).

Nomenclature: Nimis (2016), Roux et coll. (2020).

5 Results

5.1 Overall results

A total of 38 stations were surveyed on Levant Island (**Appendix 1**); these were spread across the whole island. As there had been no previous surveys of the military territory, the stations visited were chosen in order to cover a range of environments that were varied enough to provide the best possible assessment of existing lichen biodiversity. The stations are categorized in terms of substrata (Table II). As the island is relatively large, it is clear that this inventory is not exhaustive (see distribution map Fig. 4), but the 38 stations are fairly representative of the various sectors of interest present on the site.

**Table II.** Distribution of the stations per substratum.

| Substratum     | Ecology type         | Number of stations | %          |
|----------------|----------------------|--------------------|------------|
| Siliceous rock | Calcifuge saxicolous | 23                 | 61         |
| Siliceous soil | Terricolous          | 2                  | 5          |
| Bark           | Corticolous          | 10                 | 26         |
| Dead wood      | Lignicolous          | 3                  | 8          |
| <b>Total</b>   |                      | <b>38</b>          | <b>100</b> |

The absence of limestone explains the presence of calcifuge lichens on weakly acidic rocks such as schists and micaschists. However, buildings and concrete walls were not investigated. Only a few terricolous lichens were observed. Only two surveys were carried out in environments where the dry conditions of the Mediterranean climate nevertheless allowed a few freshwater lichens to become established (LEV 06, on the edge of a dried-up adlittoral stream; LEV 17, on a shaded slope on the edge of a runway in a valley). Corticolous species were collected in dense maquis and valleys or in the undergrowth of oak-pine forests.

In terms of coastal vegetation (Table III), zonation (see Roux et coll. 2020) is as follows:

- Supralittoral zone (= hygrohaline stage).
- Adlittoral stage (= aerohaline stage) periodically subjected to sea spray, rather than waves, forming a transition with the terrestrial environment, and colonised by aerohaline grasslands and scrubland and chasmohalophilous communities.
- Proxilittoral (thermo-Mediterranean and meso-Mediterranean proxilittoral stages), developing not far from the coast and beyond the adlittoral inland and not subject to sea spray or haline aerosols.

A



B



**Figure 4:** Location of the study stations (with reference number) for eastern (A) and middle (B) parts of the island.

**Table III.** Zonation categories for coastal vegetation.

| Zone                                         | Characterisation                                                                                | Number of stations | %          |
|----------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------|------------|
| Supralittoral (= hygrohaline)                | Area regularly dampened by sea spray and waves, but submerged only during equinoxal high tides. | 3                  | 8          |
| Adlittoral (= aerohaline)                    | Periodically subjected to sea spray and making the transition to the terrestrial environment    | 15                 | 39         |
| Meso- and thermo-mediterranean proxilittoral | Terrestrial, beyond the adlittoral, not far from the coast, not subject to sea spray            | 20                 | 53         |
| <b>Total</b>                                 |                                                                                                 | <b>38</b>          | <b>100</b> |

## 5.2 Lichen vegetation

On the basis of known phytosociological data for south-eastern France, the 27 communities encountered can be attached to associations or communities already described as siliceous rock (17), epiphytic and corticolous (7), epiphytic and ignicolous (1) and terricolous (2). In terms of photic requirements, 14 of these communities are heliophilous, 9 are photophilous and 4 are sciaphilous. In all these types of environments, whether open or closed, fairly well-established lichen communities are to be found.

### 5.2.1 Saxicolous communities

All the saxicolous communities in the study area grow on siliceous substrates (gneiss, micaschists). There are no outcrops of limestone here, so all the communities surveyed are calcifuge. All the communities observed are classified according to their affinity to water in various forms (rain-fed, by run-off, substratum, atmospheric), to light (heliophilous, photophilous), to the nutrient enrichment by birds (nitrophilous, heminitrophilous, non-nitrophilous communities) and also, for the coastal fringe, from saline influences (halophilous, halotolerant communities).

#### 5.2.1.1 Very halophilic (marine) communities

These communities, essentially located in the supralittoral zone and all belonging to the *Lichinetea confinis* class, are favoured by regular immersion or exposure to sea spray. Among the sectors visited, several remarkable sites should be noted: the south-east coast, with its gentle slopes and wilderness which stretch from the Grand Cap to the vallon de l'Âne and the pointe du Pauvre Louis. These sites enabled us to carry out some fairly rich surveys in the

supralittoral and adlittoral zones exposed to sea spray. Two alliances are visible:

The *Verrucarion maura* alliance, which includes

- The association with *Hydropunctaria symbalana*, situated slightly above sea level, up to 30 cm above depending on wave exposure, wetted by the surf and often also by permanent spray. It forms black tar-like patches of varying size in rock crevices and cavities. In the study area, it is represented exclusively by *Hydropunctaria symbalana*: and no other accompanying species has been observed, neither *Collembopsidium* s.l. nor *Verrucaria halophila*, either on the exposed south-east coast or on the less sunny parts of the exposed coves to the east of Cap du Pauvre Louis. This Mediterranean association is distinct from those found on the Atlantic coast - the *Hydropunctarietum amphibiae* found in the upper mediolittoral and situated just a little below the *Hydropunctarietum maura* - which mainly host two other species: *H. amphibia* and *H. maura*.

The *Caloplacion marinae* alliance with dominant orange crustose lichens, not wetted by the permanent surf but mainly by sea spray. In the lower and middle supralittoral zone, we find the *Caloplacetum marinae* Klement 1955 (with *Flavoplaca marina*; the Atlantic species *Lecanora helicopsis* and *Myriolecis actophila* are absent), which is perhaps a Mediterranean variant. It is present in several places, although not very well developed in the sunny south-eastern parts, but better represented in the shadier cove of cap du Pauvre Louis. *Flavoplaca marina*, *Lecania atrynoides*, *Diplotomma glaucostrum*, *Diplotomma chlorophaeum*, *Myriolecis oyensis*, *Myriolecis salina* and *Variospora thallincola* are found here, the latter in the upper part.

#### 5.2.1.2 Hydrophilous and subhydrophilous communities

Although there are a few temporary streams, the fact that they dry up in summer makes the establishment of aquatic lichens difficult. However, surprisingly, in a few places (Rioufred Valley, Grand Avis Valley, mare de l'Âne Valley), it was possible to collect a few aquatic lichens from an association of *Hydropunctaria rheitrophila* impoverished with *H. rheitrophila*, and two significantly less hydrophilic transgressive species, *Verrucaria praetermissa* and *Collema ryssoleum* the latter along the edges. It seems that the particular conditions of shade and ambient humidity allow them to survive in drier periods, whereas in general the relatively long dry period (on average 3 months a year during periods of high temperature) is not conducive to their establishment.

- Subhydrophilous communities, subject to more or less prolonged run-off or seepage after rainfall, are rarely present, noted only a few times, and mainly belong to the *Peltulion euplocae* alliance, with the *Peltuletum euplocae* Wirth 1972, with *Peltula euploca*, along cracks in the sun, sometimes with *Lichinella stipatula*, *Toninia cinereovirens* and *Collema rysssoleum*.

- The ekeophilous communities, subject to brief seepage after rainfall and drying out rapidly, mainly concern the association of *Solenopsoretum vulturiensis* Ménard 1997, whose two characteristics, *Solenopsora vulturiensis* and *Catillaria chalybeia*, are particularly frequent in these environments, from the adittoral to the thermomediterranean belt, as well as along the inland slopes (the valley of Anse du Liserot, on a slightly damp slope).

- In places, patches of *Leprocaulon quisquiliare* and *Lepraria* sp. can also be found on small walls and damp slopes without seepage, particularly in shaded valleys at the edge of runways.

- Substratohygrophilous communities, present inland, very sciaphilous, on damp walls without seepage, could be observed through patches of *Porina chlorotica*. However, the more ombrophobous *Psilolechietum lucidae* was not observed.

#### 5.2.1.3 Astegophilous communities (wetted by rainfall but not subject to significant runoff afterwards)

These communities correspond to the class of *Rhizocarpetea geographici* Mattick 1951 em. Wirth 1972, comprising here, several associations, either of the heliophilous type, or of the non-heliophilous but photophilous type.

On the very sunny south-facing cliffs by the sea, we observed:

- *Xanthorietum resendei* Llimona 1976, a heliophilous, very thermophilous and nitrophilous association characterised by *Martinjahnsia resendei* (= *Xanthoria resendei*). *Xanthoria calcicola* and sometimes a few thalli of *Xanthoria parietina* are found on the tops of the rock heads, and *Diploicia subcanescens* is found on the walls as a transgressive. This association seems to exist, but we did not come across *M. resendei*, although it was present on the cap Lardier coast. Perhaps the environments we explored on those days were a little too exposed to the sea spray and we did not have enough time to explore other rocky heads.

On horizontal or slightly sloping surfaces that are in full sun but poor in nitrates:

- *Caloplaco nesodis*-*Aspicilietum intermutantis* Ménard 1997, largely dominated by crustose thalli, is very common here, with

*Aspiciliella intermutans* morphotype *intermutans*, *Aspicilia viridescens*, *Athallia necator* (= *Caloplaca inconnexa* var. *nesodes*) not present, and very often *Aspiciliella cupreoglaucula*, accompanied by the less nitrophilous species: *Acarospora umbilicata*, *Blastenia crenularia* var. *contigua*, *Diploschistes scruposus*, *D. euganeus*, *Kuettlingeria fuscoatroides*, *Lecanora campestris*, *L. gangaleoides*, *Lecidella asema* var. *elaeochromoides*.

- Stands dominated by large foliose lichen, *Xanthoparmelia mexicana* auct. Ital. (a species with salazinic acid but no norstictic acid, formerly confused with *X. tinctina*), which are fairly thermophilous. Previously, these stands were known as *Xanthoparmelieta tinctinae*. Chemical chromatographic analysis (TLC) of *Xanthoparmelia* specimens representative of the study area showed that they are in fact *X. mexicana*, a species closely related to but distinct from *X. tinctina*. Here, we also found *X. stenophylla* and *X. protomatrae* but not *X. sublaevis* (known from La Ciotat near Marseilles: Méric *et al.*, 2022), probably due to a lack of observations.

In the two previous stands, in addition to *Xanthoparmelia* with yellowish-green thallus (*X. mexicana*, *X. stenophylla* and *X. protomatrae*), there are numerous *Xanthoparmelia pulla* s.l. which can only be determined by chemical analysis. All the samples collected were analysed by chromatography, which confirmed the presence of *X. glabrans*, *X. luteonotata*, *X. delisei* and *X. verruculifera*.

These communities of large foliose lichens are very common on the rocky outcrops of the adlittoral zone, as well as those in the interior of the island.

On walls that are not sunny but well lit, we found non-heliophilous but photophilous and not very nitrophilous associations belonging to the suborder *Pertusarietalia leucosorae* Egea et Llimona 1987.

- The *Buellietum subdisciformis-sardiniensis* Ménard 1997, an association of crustose lichens on more or less vertical walls, very common along the coast, here devoid of *Buellia sardiniensis* (as at La Ciotat). The *Buellietum* often mixes with the *Pertusarietum gallicae* and with the *Leptra monogona* community; it varies from very photophilous to not very photophilous (on less well-lit walls). *Buellia leptoclinoides*, *B. tesserata* and *B. stellulata* are often found here.

- The *Pertusarietum gallicae-ramalinetosum breviusculae*, Ménard 1997, established on non-vertical rocky surfaces, is exclusively maritime (upper adlittoral stage), often facing the sea. It is home to *Pertusaria pluripuncta* (= *P. gallica*), *Ramalina breviuscula*, *Rinodina beccariana*, *R. santorinensis* (more common

than on the continental coast and a parasite of *Pertusaria* sp.), as well as *Protoparmelia montagnei* and its chemotype *aquilina*, *P. olivascens*, *Lecanora sulphurea*, *L. praepostera*, *Lecidella asema* (var. *asema* and var. *elaeochromoides*) and *Myriolecis liguriensis*.

- The community with *Lepra monogona* (*Pertusaria* s.l. white, K+ red), on very steep, not sunny but well-lit rock faces, where *Lepra monogona*, *Buellia tesserata*, *Rinodina alba*, *Lecanora gangaleoides* and *L. praepostera* grow side by side.

- The *Pertusarietum rupicolae* Wirth et Llimona 1975, which is clearly photophilous but not heliophilous or astegophilous, is less thermophilous than the previous ones. It is frequently found inland and throughout the mesomediterranean, on north-facing slopes that are not sunny but receive sufficient light, where *Pertusaria rupicola* grows here in the company of *Glaucomaria rupicola* subsp. *sulphurata*, *Lepra amara* var. *flotowiana*, *L. mammosa*, *Ochrolechia parella*, *Lecanora praepostera*, *L. sulphurea* and *Tephromela atra*.

#### 5.2.1.4 Stegophilous communities (under overhanging surfaces and not wetted by rain)

In the study area, these mainly stegophilous and non-heliophilous communities are located under overhangs and inverted rock faces, therefore completely sheltered from the rain, and are made up of aerohygrophilous lichens. They are fairly monotonous in the sector, with *Dirina fallax* and its sorediate morphotype (distinguished from *Dirina massiliensis* in recent years by its DNA and its calcifuge character) being the only characteristic species, making up the *Dirina fallax* association, the calcifuge vicariant of the calcicole *Dirinetum massiliensis*. These two lichen species are accompanied by *Roccella phycopsis*, which is indifferent to the nature of the rock, slightly more photophilous, more developed along the coast and more halotolerant, although it also exists in the proxilittoral area.

At cap du Pauvre Louis, in the lower overhanging walls, we observed the *Roccellographetum circumscriptae*, very rarely mentioned in the Mediterranean, with *D. fallax*, *Ingaderia sorediata* (= *Roccellographa circumscripta* morpho. *sorediata*) and *Roccella phycopsis*, an association that is more aerohygrophilous than the previous one, still not heliophilous, but typical of this station in the extreme east of the island (LEV 19).

#### 5.2.2 Terricolous and muscicolous communities

On the maquis soil, in undisturbed places, among the dry grasses and small stones on the ground, we find *Cladonietum foliaceae* Klement 1955, with *Cladonia foliacea* subsp. *foliacea*, *Cladonia furcata* morphotypes *furcata*, *palamaea* and *corymbosa*, *C. rangiformis* morphotype *rangiformis*, *C. cervicornis* and *C.*

*verticillata*. We did not observe *C. ciliata* f. *flavicans*. On the other hand, we did find a well-developed *Cladonia subturgida*, a species that is still poorly known and often not distinguished from *C. cervicornis*. The *Porpidietum crustulatae* Klement 1950, typical of microclimatically unstable pioneer stands with *Porpidia crustulata*, grows on the small siliceous stones on the ground and at the base of walls very close to the ground.

On slightly wetter soils, not exposed to the sun but sufficiently lit, on the edges of slopes, we find leprose crustose stands with *Lepraria* sp. and *Leprocaulon quisquiliare* and stands of *Cladonia humilis*.

### 5.2.3 Corticolous communities

Throughout the island, the scrub is fairly high and dense (mainly *Erica arborea* and *Arbutus unedo*) and the large trees are mainly represented by *Quercus ilex* and *Pinus halepensis*. However, given the size of the area, only few large old trees remain, probably survivors of former fires. Certain valleys, perpendicular to the coastline, benefit from regular maritime inlets and better protection against drought, allowing the establishment of aerohygrophilous lichen stands that are poorer elsewhere, as in the scrubland established on the hilltops.

All the communities mentioned below are essentially corticolous and occur mainly on deciduous trees, more rarely on coniferous trees. Some strictly lignicolous stands were observed in certain valleys well exposed to the sea.

#### 5.2.3.1 Heliophilous and photophilous communities

##### 5.2.3.1.1 Primary communities dominated by crustose lichens (pioneer communities)

- *Lecanoretum horizae* Barkmann 1958, a thermophilous and clearly heliophilous association, is found on the branches of deciduous trees (found here on *Populus alba*). In the study area, it is represented by an impoverished form with *Lecanora horiza*, *L. hybocarpa* and *Lecidella elaeochroma*, but we did not find *Blastenia xerothermica* subsp. *xerothermica* or *Catillaria nigroclavata*. This association is apparently not very visible on the island. We also observed *Caloplaca aegatica*, a transgressive of the *Opegraphetum ochrocinctae*.

- Concerning *Opegraphetum ochrocinctae* Boqueras and Gómez-Bolea 1987 corr. Boqueras 2000 (= *Opegraphetum ochrocheilae* Boqueras and Gómez-Bolea 1987). This association, well known in Port-Cros and Porquerolles in open environments (C. Roux, pers. Comm., unpublished), is characterized by *Alyxoria ochrocincta* (= *Opegrapha ochrocincta*), *O. celtidicola*, *Caloplaca*

*aegatica*, *Lecanora lividocinerea*. Bricaud and Roux (1991: 102, 105 and 106) did not study this association but mentioned these species on the island of Port-Cros as transgressive in the *Zamenhofietum coralloideae*. We found two of these species, *Caloplaca aegatica* and *Lecanora lividocinerea* (stations 14, 16 and 33), but the other two, *Alyxoria ochrocincta* and *O. celtidicola*, which are easily overlooked, probably exist on Levant Island. Further observations will be necessary to determine whether the typical *Opegraphetum ochrocinctae* exists on Levant Island.

As a result of the alteration of the bark and the closure of the environment, the two previous communities are progressively invaded by small foliose lichens, more particularly *Hyperphyscia adglutinata* (a species found as a companion in numerous corticolous, lignicolous and foliicolous lichen groups in the south of France, from the thermo-Mediterranean level to the mountain level, more rarely in the subalpine) and *Physcia adscendens*.

#### 5.2.3.1.2 Secondary stands dominated by foliose lichens

These stands of large foliose lichens generally appear as a result of the natural evolution of the plant cover and the gradual alteration of the rhytidomes. The environment changes from sunny to only well-lit, and atmospheric and substrate humidity becomes higher, favouring their establishment.

#### Nitrophilous or heminitrophilous communities

These mainly belong to the orders *Physcietalia adscendentis* (*Physcia adscendens*, *Xanthoria parietina*) and *Hypogymnietalia physodo-tubulosae* (*Parmotrema perlatum*, *Flavoparmelia soredians*).

- The *Physcietum adscendentis* Frey et Ochsner 1926, characterised by *Physcia adscendens*, *P. tenella* (*P. leptalea* was not found here), colonises small branches, while *Physconia enteroxantha*, *Xanthoria parietina*, establish themselves mainly on deciduous trunks.

#### Non-nitrophilous communities

- The *Flavoparmelietum caperatae* Felföldy 1941 nom. mut. replaces the previous group in forests where nitrate inputs are low. This association is mainly made up of large foliose lichens, *Flavoparmelia caperata*, *F. soredians*, *Punctelia subrudecta*, *Parmelia sulcata*, *Parmelia tiliacea*, *Parmotrema perlatum*, associated with the brown *Parmeliaceae*, *Melanohalea exasaperata*, the fruticose *Ramalina farinacea*, *Evernia prunastri* and the gelatinous *Collema furfuraceum*, which occurs in run-offs on weathered rhytidomes (the latter not found in the study area).

- Community with *Amandinea punctata* (different from the *Amandineetum punctatae* Barkman 1958), which is more heliophilous and xerophilous, develops at the base of certain trunks of *Quercus ilex* and *Pinus pinea*, and can replace *Flavoparmelietum caperatae* when the trunk becomes sunnier or drier on the vertical parts.

- *Parmotremetum crozalsiano-hypoleucini* Crespo 1979 nom. mut. is a typically thermo-Mediterranean association, photophilous and aerohygrophilous, only well-developed in certain valleys (Rioufred valley) or woodlands subject to maritime fogs, and more or less high scrubland with *Erica arborea*. *Parmotrema hypoleucinum*, *P. perlatum*, *P. reticulatum*, *Parmelina tiliacea*, *Flavoparmelia soledians*, *Usnea rubicunda* and *Chrysothrix candelaris* can be observed here. On the other hand, the characteristic species *Parmotrema crozalsianum* (known from Le Muy, Roquebrune rock) was only found once on *Juniperus phoenicea* in the Hameçon valley and *Usnea mutabilis* (known from Port-Cros) was not found there.

- In the slightly more open scrubland, the association with *Ramalina canariensis* and *R. pusilla* Abbassi Maaf 1987, which is more heliophilous and haloresistant, can be observed, with its two characteristic species, accompanied by *Pyrrhospora querneae* and *Lecanora lividocinerea*, as well as *Ramalina subgeniculata*, observed in the Rioufred valley (LEV 25).

#### 5.2.3.2 Sciaphilous communities

These communities appear when the previous ecological conditions evolve towards a more advanced forest stage: significant growth of phorophytes, reduced light in the undergrowth, more stable microclimatic conditions (lower thermal amplitude, higher hygrometry). As these species are often very discreet and difficult to spot in the field (hence the compulsory sampling), it is possible that some of them went unnoticed during our surveys. Further research could reveal other, richer stations.

Generally speaking, we regularly find species belonging to the order *Schismatommetalia decolorantis* (*Dendrographa decolorans*, *Bactrospora patellarioides*, *Pertusaria* sp.), which are less demanding in terms of atmospheric humidity.

##### 5.2.3.2.1 Astegophilous communities (i.e. wetted from rain)

On smooth or unaltered bark, the *Opegraphetum vulgatae-niveoatrae* Barkmann 1958 nom. mut. could be established and represented by small crustose species, but *Opegrapha vulgata* and *O. nivea* were not found and the community was not established. This may be due to a lack of surveys in the very closed *Quercus ilex* woodland.

On weathered bark (*Quercus ilex*), in sites with a certain forest continuity, the following communities are established:

- *Wayneetum stoechadianae* Abassi Maaf et Cl. Roux 1987, particularly sciaphilous, has developed here without its main characteristic species *Waynea stoechadiana*, but abundant *Coenogonium tavaresianum*, have been observed. *W. stoechadiana* is very probably present in the study area, but it may have been overlooked.

- The *Zamenhofietum coralloidea* Bricaud et Cl. Roux 1991 was observed only once at Étang du Haut in a pine forest of old, widely spaced pines with a well-developed and fertile *Zamenhofia coralloidea*, with *Enterographa crassa*, but without *Porina* or *Opegrapha*.

Very sciaphilous and more hygrophilous associations, such as *Acrocordietum gemmatae* Barkmann 1958, were not observed.

#### 5.2.3.2.2 Stegophilous communities

Stegophilous associations, largely protected from rain and run-off, such as *Phlyctidetum argenae* Ochsner 1928 (with *Phlyctis argena*, *P. agelaea*, *Ochrolechia* sp.) and other associations with sterile thalli, were not observed in the study area.

#### 5.2.4 Lignicolous communities

A few observations of standing dead wood of *Juniperus phoenicea* and of trunks piled up in the valley of the mare de l'Âne revealed a series of interesting species such as *Endohyalina kalbii* associated with *Rinodina nimisii* accompanied by *Athallia alnetorum*, the rarer *Rinodina pruinella* and more common species such as *Lecanora lividocinerea*, *L. confusa*, *Lecidella elaeochroma* var. *flavicans* and *Pyrrhospora quernea*.

### 5.3 Floristic interest

#### 5.3.1 Richness of the lichen flora

On the whole of Levant Island and on the basis of the 505 specimens collected, we recorded:

- 184 lichens,
- 1 Lichenicolous, non-lichenized fungus.

The list of species inventoried is given in **Appendix 2**. The distribution of species recorded by type of substratum and by vegetation stage is given in the following table (Table IV). As some corticolous species also can colonise rocks, and as some species are present in several vegetation stages at the same time, the totals per row or column are greater than the total number of taxa recorded.

**Table IV.** Distribution of species recorded by ecology and by zonation.

|                      | <b>Total lichens</b> | Supralittoral | Adlittoral | Meso- and thermo-Mediterranean proxylittoral |
|----------------------|----------------------|---------------|------------|----------------------------------------------|
| Corticolous          | <b>49</b>            | 0             | 3          | 49                                           |
| Lignicolous          | <b>20</b>            | 0             | 20         | 0                                            |
| Siliceous saxicolous | <b>128</b>           | 26            | 76         | 85                                           |
| Terricolous          | <b>12</b>            | 0             | 4          | 9                                            |

Only one taxon reaches the upper mediolittoral zone (= hydrohaline zone), *Hydropunctaria symbalana*, but it has been counted as supralittoral, as it is very often present in the lower supralittoral.

Without distinguishing between substrates, the number of lichens recorded per vegetation zone (several lichens may be common to two zones) is as follows:

- Supralittoral zone: 26 taxa,
- Adlittoral zone: 103 taxa,
- Thermo- and meso-Mediterranean proxylittoral zones: 143 taxa.

Surveys were carried out as far as possible in a variety of environments, both near and close to the coast, as can be seen from the distribution of stations on the map (Fig. 4).

### 5.3.2 Regional novelties

New regional discoveries are worth noting here. Mention should also be made of taxa that were previously reported in the Var and that had not been seen for more than 50 years (confirmation of old data).

#### **- Taxa previously mentioned, confirmed in the Var department: 3**

These are taxa mentioned only once in the old literature and listed as such in the Catalogue des lichens de France (Roux et coll., 2020) under label "83<sup>a</sup>", or taxa that have not been found in the region since the recent study, in the case of *Cladonia suburgida*.

1. *Cladonia suburgida* Samp.; (Pino-Bodas *et al.*, 2020: 9–18)
2. *Hydropunctaria rheitrophila* (Zschacke) C. Keller, Gueidan & Thüs; (de Crozals, 1924: 113)
3. *Lichinella stipatula* Nyl.; (de Crozals, 1923: 22).

**- Taxa new for the Var department: 11**

1. *Athallia alnetorum* (Giralt, Nimis & Poelt) Arup, Frödén & Søchting
2. *Bacidia sipmanii* Brand, Coppins, van den Boom & Sérus.
3. *Coniocarpon fallax* (Ach.) Grube
4. *Diploschistes scruposus* morpho. *violarius* (Schreb.) Norman
5. *Endohyalina ericina* var. *ericina* (Nyl.) Giralt, van den Boom & Elix
6. *Ingaderia soledata* (Sparrius, P. James & M. A. Allen) Ertz
7. *Lecania hutchinsiae* (Nyl.) A. L. Sm.
8. *Micarea micrococca* (Körb.) Gams ex Coppins
9. *Physcia mediterranea* Nimis
10. *Rinodina nimisii* Giralt & H. Mayrhofer
11. *Sphinctrina turbinata* (Th. Fr.) Th. Fr.

**5.4 Interesting or threatened species**

The following comments mainly concern certain uncommon species, species newly found in the geographical area or species of conservation interest (the following Red List categories are used: DD, data deficient; LC, least concern, NT, near threatened; VU, vulnerable; EN, endangered; CR, critically endangered).

***Acrocordia macrospora*** A. Massal. - Rare. An infrequently mentioned species, as it is often not very visible. Already mentioned in France in the Var, Hérault, Alpes-Maritimes and Brittany. This saxicolous species grows on basic to slightly calcareous silicate rock. It was collected here on the shady rocks of the small Rioufred Valley. It is characterised by its prominent, dimidiate perithecia with involucrellum descending onto a light brown thallus and its large ascospores (uniseptate ellipsoidal ascospores measuring  $26\text{--}33 \times 9\text{--}12.5 \mu\text{m}$ ). Meso-Mediterranean to hilly areas. EN.

***Alyxoria subelevata*** (Nyl.) Ertz & Tehler - Rare. Present in Brittany, Provence and Corsica. It was mentioned for the first time in the Var during the inventory of lichens of cap Lardier. Several records in Europe in the Mediterranean basin (Portugal, Spain, Greece, Italy), Great Britain and Ireland and the Cape Verde Islands. Saxicolous, on calcareous or non-calcareous rocks and mortar, more or less sciaphilous. Collected on Levant Island, on gneiss on a slope of the shaded path of Liserot. It is clearly distinguishable by its open and often slightly pruinose lirella. This species seems to easily pass unnoticed but it has already been observed several times at cap Lardier (Bertrand and Valance, 2023). Thermo-Mediterranean, lower meso-Mediterranean and hilly areas. VU.

***Anaptychia* aff. *Palmulata*** - Rare. This as yet not fully identified species has been collected several times in Corsica, in the Var (mont Fenouillet) and now on Levant Island (Rioufred cove, on branches of

*Quercus ilex*; chemin de la Douane on weathered gneiss). This species poses an identification problem, as it is morphologically intermediate between *A. runcinata* and *A. palmulata*. The thallus is lighter and smaller than *A. runcinata* and also resembles *A. palmulata*, but to date it has always been found sterile. Prosoplectenchymatous upper cortex with periclinal hyphae without crystallisation and no reaction to the usual reagents. Lower cortex prosoplectenchymatous. Lower surface whitish with simple to fasciculate and divided rhizines. The lobes are fairly narrow, 0.6–0.9 mm wide, and seem somewhat different from those of the true *A. palmulata* discovered by D. Masson in the Pyrénées-Atlantiques (pers. comm.). Its ecology is also intermediate between that of *A. runcinata* (saxicolous, exceptionally on the lower parts of trunks, from the coast to the mountains) and that of *A. palmulata* (mainly corticolous in a hyperhumid ombroclimate). The lack of truly discriminating characteristics makes it impossible to position this species with any certainty. DNA analysis on a complete collection of specimens would be necessary. Risk and threat assessment difficult due to data deficiency.

***Athallia alnetorum*** (Giralt, Nimis & Poelt) Arup, Frödén & Søbchting - Rare. But widely distributed, from the mesomediterranean to the subalpinestage. This species, which is morphologically similar to *Gyalolechia flavorubescens*, differs from it mainly in that its spores are smaller and due to its shorter and non-inspersed hymenium. This species was observed on the south coast of the Levant Island on a dead *Juniperus phoenicea* (LEV 03). It is characterised here by small apothecia 0.2–0.9 mm in diameter, sessile with a very narrow base, ascospores  $9.6\text{--}11.9 \times 4.7\text{--}6.0 \mu\text{m}$  and non-inspersed hymenium 50  $\mu\text{m}$  high. It is newly mentioned in the Var. VU.

***Bacidia sipmanii*** Coppins, van den Boom & Sérus. Extremely rare. This species, described recently in 2009, has so far only been found in Brittany in France. A calcifuge saxicolous species from the adlittoral zone. Reported from Great Britain and Ireland, the Canary Islands and Italy (Liguria). The specimens from the Levant Island correspond well to the description of the species, with slightly larger ascospores of  $32\text{--}50 \times 1.7\text{--}2.2 \mu\text{m}$  with 3–7 septa (versus  $26\text{--}40 \times 1.5\text{--}2.5 \mu\text{m}$  with 3–7 septa). Other characteristics are that the thallus is green-brown, thin, cracked and slightly rough, the apothecia 0.3–1 mm, dull brown, flat with a visible margin, to very convex and disappearing margin, the hymenium 70–90  $\mu\text{m}$  high with very coherent simple to slightly branched paraphyses, the epithecium light brown K–, the hypothecium colourless to light brown and filiform conidia  $20\text{--}30 \times 0.8 \mu\text{m}$ . Its ecology is similar to that of *B. scopulicola* and it has been observed on a subhumid gneiss slope near the shore of the Rioufred cove. CR.

***Bactrospora patellarioides* var. *convexa*** (B. de Lesd.) Egea & Torrente - A fairly common species, of which the var. *convexa* seems to be well established on the Mediterranean coast, since all the collections we have made in the Var (apart from the Levant Island) relate essentially to it. This variety is characterised by smaller, more convex apothecia, with a thinner rim and excipulum than the nominal variety. This species has been recorded until in the south of England in its var. *patellarioides*, but the consistency of the characters observed in the Var seems to us to merit the rank of variety given to this Mediterranean form by its authors. It is common on Levant Island, as on the Var coast, on trunks in thermo- and meso-Mediterranean forests. LC.

***Buellia abstracta*** (Nyl.) H. Olivier - Quite rare, but present here and there in a large part of France. This species, whose taxonomic definition is still being studied following confusion with a similar species, should be mentioned with caution, but for the moment it corresponds to the definition of Giralt and van den Boom (2011) and Giralt *et al.* (2011). Poorly known, it is still rarely mentioned, but it has been observed at two stations on Levant Island (LEV 06, LEV 08). Saxicolous, calcifugous, heliophilous. From adlittoral to mountain stage. NT.

***Caloplaca aegatica*** Giralt, Nimis & Poelt - A fairly rare species on the Mediterranean coast, found mainly in Corsica, the Var and Aude. Corticolous, on trunks and branches of *Quercus ilex*. Reported in Europe, mainly around the Mediterranean basin (Spain, France, Italy, Sardinia, Greece, Crimea, Israel). In the present study, it was collected at only two sites (LEV 14 and LEV 16) on wood (a dead trunk) and bark of *Populus alba* respectively, in two small valleys. Lower meso-Mediterranean and thermo-Mediterranean zone. Typically, Mediterranean taxon close to the sea. NT.

***Candelariella oleaginescens*** Rondon - A fairly rare and poorly known species on the Mediterranean and Atlantic coasts. It can be distinguished from *C. aurella*, mainly by its well-developed grey thallus and its maritime ecology (adlittoral zone). It was originally described as growing on limestone, dolomitic limestone and mortar around Marseilles. However, several related populations on the Var coast have been found on basic silicate rock, such as at cap Lardier and here on Levant Island (at Gour de Vidal, LEV 10), still in the adlittoral zone and always close to the coast. NT.

***Cladonia subturgida*** Samp. - Quite rare. This species, which exhibits great morphological polymorphism, was described on the basis of samples from Portugal by Sampaio (1918). The species was subsequently studied in depth by Pino-Bodas *et al.* (2012, 2020) in order to delimit existing neighbouring taxa. For this study, the authors

studied specimens collected in the Var and Alpes-Maritimes regions never before found and hitherto unmentioned by French lichenologists. The specimens, well-developed and highly characteristic, were found on the island's south coast, on the siliceous soil of the fairly exposed adlittoral (LEV 06). This species, which has long been confused with *C. cervicornis*, is probably under-recognised. Identification of secondary metabolites by TLC showed the presence of zeorin and fumarprotocetraric acid alone, so the specimen belongs to chemotype V. Its distribution is currently known to be circum-Mediterranean. DD.

***Coenogonium tavaresianum*** (Vězda) Lücking, Aptroot & Sipman – Very rare. Corticolous species (on weathered rhytidome of *Quercus ilex*, more rarely *Pinus* sp.), sciaphilous. Thermo-Mediterranean zone. Reported in Corsica, the Var and the Alpes-Maritimes. This is a typical species of old, long-mature thermomediterranean *Quercus ilex* forests. It has been observed at two stations on the island (LEV 09 and LEV 22), mainly on *Pinus halepensis* and abundantly on both occasions. In Europe, it has also been recorded in Spain, Italy and southern England. Given its very specific ecology, classified CR.

***Coniocarpon fallax*** (Ach.) Grube - Quite rare. This species, independent of *C. cinnabarinum*, the latter more common, differs mainly in the size of its slightly smaller ascospores (15–)17–20(–22) × (6–)7–9(–10) µm and (1–)3–4(–5) transverse septa versus (19–)23–28(–30) × (8–)10–11(–12) µm and (3–)4–5(–8) transverse septa. The specimen found on large *Quercus ilex* in the Jardin du Passeur, chemin de la Douane (LEV 31), is characterised by ascospores 18–23 × 7–8 µm with 2–4 transverse septa. Although fairly rare, this species appears to have a fairly wide distribution in France, except, so far, in the Mediterranean region. This is the first time it has been recorded in the Var. NT.

***Diploschistes euganeus*** (A. Massal.) J. Steiner - Not very rare. Reported in several parts of France. Also found in southern and central Europe, South Africa and Australia. Saxicolous, on basic silicate rocks, more rarely on tiles and bricks, calcifugous, fairly xerophilous, heliophilous. In the study area, it has only been found in one station (LEV 19). This species is difficult to distinguish from *D. actinostoma* in the field. However, having looked for it, as well as on the cap Lardier coast on the mainland, it doesn't seem to be very common, but it is present in the meso, supra-Mediterranean and Hill zones. NT.

***Diploschistes scruposus*** morpho. *interpediens* (Schreb.) Norman - Fairly common. This taxon is characterised by its octosporate asci and its calcifuge saxicolous habitat. We observed it

quite well developed at two stations on the island (LEV 26 and LEV 27), whereas on the coast of cap Lardier, only *D. scruposus* s.s. alone was found. This taxon is referred to here as a morphotype of *D. scruposus* (Roux et coll., 2020), although it differs from the nominal species in having octosporate asci with muriform ascospores ( $20\text{--}27 \times 8\text{--}10 \mu\text{m}$ ). It appears to be genetically different from *D. scruposus* s.s. according to Fernández-Brime *et al.* (2015), but considered as a synonym by Zhao *et al.* (2017). LC.

***Diploschistes scruposus*** morpho. ***violarius*** (Schreb.) Norman - Uncommon. This taxon, whose position is uncertain, is considered by Roux et coll. (2020) to be a morphotype of *D. scruposus*. It is characterised by its medulla reaction of C+ pink, K+ yellow and then rapidly turning dark purplish red, its ellipsoidal and fusiform ascospores, 4 per asci,  $23\text{--}32 \times 9\text{--}11 \mu\text{m}$ , a hymenium  $110 \mu\text{m}$  high and its ecology on highly altered gneiss on a slope at the edge of a shaded track (LEV 23). Recorded in several stations in the Alps, Massif Central, Hautes-Pyrénées and Corsica, but rarely mentioned in the meso-Mediterranean zone and for the first time in the Var. VU.

***Endohyalina ericina*** var. ***ericina*** (Nyl.) Giralt, van den Boom & Elix - Very rare. Very little recorded until recently, this species has been observed in Corsica, Gironde and the Landes on *Erica arborea* and *Pinus pinaster*. It was found here on *Pinus halepensis* (LEV 22) and is newly mentioned in the Var department. Adlittoral, thermo- and meso-Mediterranean zones. CR.

***Endohyalina kalbii*** (Giralt & Matzer) Giralt, van den Boom & Elix - Very rare. Found in Corsica, most recently on the coast of cap Lardier. It is also found in Europe in Spain, the Canary Islands, Greece and Italy. Corticolous, on trees and shrubs with rough rhytidomes on the coast (*Tamarix*, *Juniperus*, *Quercus*), here on *Juniperus phoenicea* in the company of *Rinodina nimisii*, heliophilous, halotolerant. Adlittoral zone, more rarely thermo-Mediterranean proxilittoral. CR.

***Gyalecta schisticola*** Werner - Rare. This species is mainly found in the southern part of France; elsewhere in Europe, it has been mentioned in Macaronesia and the Mediterranean (Italy). Previously recorded on the coast of cap Lardier in the adlittoral zone on exposed eroded granite by Bertrand and Valance (2023), it was observed here on Levant Island on altered gneiss on the chemin de la Douane (LEV 30), where it was very well developed. Also reported in the Bouches-du-Rhône département by Méric *et al.* (2022: 25). Saxicolous, on calcareous or non-calcareous rock, aero- and substrato-hygrophilous, not very heliophilous. Thermo-meso-Mediterranean and hilly areas. LC.

***Heterodermia obscurata*** (Nyl.) Trevis. - Uncommon. This species is found in several regions, but mainly in the west and south of France. It has also been recorded in Europe, in Great Britain, Spain, Portugal, Italy and the Alps from Switzerland to Austria. It has been found on the Levant Island in the adlittoral shaded valley of Rioufred, on branches of *Quercus ilex*. Meso-, supra-Mediterranean, hilly and montane zones. DD.

***Hydropunctaria rheitrophila*** (Zschacke) C. Keller, Gueidan & Thüs - Quite rare. However, this aquatic species is widespread throughout France, provided the ecological conditions (siliceous rocks, and a long- season watercourse) are met. It was observed here at the bottom of the Rioufred Valley in the company of *Verrucaria praetermissa*, on a shaded wall that had been submerged for a long time (LEV 24). This location is one of the few observed in the meso-Mediterranean area and deserves to be mentioned, as it is one of the only examples of this aquatic species present on the Hyères Islands. From the meso-Mediterranean to the Alpine zone. NT.

***Ingaderia sorediata*** (Sparrius, P. James & M. A. Allen) Ertz - Not very rare in Brittany, where it is mainly reported. This species has been recently separated from the form with apothecia *Roccellographa circumscripta*. The latter has been rarely recorded in the south (Alpes-Maritimes and Corsica), but none to date for its counterpart sorediate form. This is a very stegophilous, non-heliophilous, calcifuge saxicolous species that we only found under a damp, north-facing overhang below the Titan lighthouse (LEV 19) in the company of *Dirina fallax*. Very characteristic by its orange P+ reaction and its soralia. This species is probably little known in the south and therefore not much sought after, but could exist in other north-facing sea stations. Adlittoral zone. LC.

***Lecania cyrtellinoides*** (M. Choisy) Zahlbr. - Rare. This small corticolous species is often found not far from the coast, in the southern Mediterranean, Gironde and Brittany. Adlittoral and thermo-Mediterranean zones. It has been observed on the Levant Island in the Liserot Valley on a *Pinus halepensis* trunk (LEV 22). EN.

***Lecania hutchinsiae*** (Nyl.) A. L. Sm. - Rare. This is a species that often goes unnoticed on shaded siliceous rock faces. It has only been observed in France for about ten years. Mentioned to date in Brittany, Indre, Rhône, Provence and Corsica. Found on Levant Island in the Rioufred Valley, this is the first record from the Var department. Meso-mediterranean and hilly stage. VU.

***Lecanora lividocinerea*** Bagl. - Quite rare, except for the coast and the near Mediterranean coast where it is quite common. Only found on the Mediterranean coast, the Hyères islands and Corsica.

A typically Mediterranean species, also recorded in Spain, Morocco, Italy and Greece. Found on the Levant Island in the valley of the mare de l'Âne (on dead tree trunk wood) at the Étang du Haut (on a *Pinus halepensis* trunk). Corticolous, on trunks, branches and twigs of deciduous trees, on isolated or sparse trees or shrubs, especially in scrubland, heliophilous. Thermo-Mediterranean and lower meso-Mediterranean zone. NT.

***Lecanora rubrofusca* var. *monstruosa*** B. de Lesd. - rare. Only one station is known in France to date, the one mentioned in the inventory of cap Lardier. The new specimen found on an outcrop under runway n° 14 is well developed and corresponds well to the variety described by Bouly de Lesdain and to that of cap Lardier. The specimen newly found is described as follows: bright white thallus, areolate, with irregular, convex, thick areoles, more or less scattered or joined together; cortex K+ yellow, C-, KC-; apothecia 0.4–1.2 mm, lecanorine, sessile, with a thin thalline margin distinct in young apothecia but then excluded, with a brown disc, flat becoming convex; amphithecium without large agglomerated crystals, but with fine grey crystals; epithecium light brown without crystallisation; hymenium 75–80 µm high; ascospores simple, ellipsoidal, with 2 guttules, 12.5–15.0 × 5.5–6.5 µm. This second specimen, which is very similar with the one from cap Lardier, also displays the "exaggerated" characteristics (size of areoles and apothecia) of the more classic *Lecanora rubrofusca*, and seems to be consistent with it. Thermo-Mediterranean and lower meso-Mediterranean zones, not far from the coast. DD.

***Lecidella grisella*** Flörke - This common species is commonly considered by some authors to be a variety of *Lecidea fuscoatra*, or as an independent species by others. It is worth mentioning here, as the lichens at the two stations observed (with pink C+ medulla) are similar to those found at cap Lardier, all clearly with a diffuse thallus margin, not at all areolate, grey in colour, and corresponding to the same ecology of a slightly weathered gneiss slope at the edge of a runway (LEV 27). These observations are in line with those described by Aptroot and van Herk (2007) when specimens of *L. fuscoatra* were observed on rock faces or rock heads (LEV 29). For this reason, we declare these records to be independent species despite the lack of DNA data in one way as in the other. Meso-mediterranean to montane zone. LC.

***Myriolecis* cf. *salina*** (H. Magn.) Sliwa, Zhao Xin & Lumbsch - Quite rare. This calcifugous saxicolous coastal species is difficult to identify, as it is sometimes hard to distinguish from *Myriolecis oyensis*. Currently, in France, it is only found in Brittany. The specimens examined from Levant Island correspond to a form with a pink C+ thalline margin, with apothecia that rapidly become sessile,

and whose ecology is less exposed than that of *M. oyensis*. However, since the identity with the type of *M. salina* (from Sweden) and the populations of northern Europe is not proven by DNA analyses, the presence of *M. salina* on Levant Island and more generally in the Mediterranean region remains uncertain (as Nimis writes in Italic (2023) "The Italian records are somewhat dubious"). This is why we have provisionally classified these specimens as *M. cf. salina* rather than *M. liguriensis* (with a C– thalline margin and weakly crystallised) and *M. oyensis* (with mainly adnate apothecia and present strictly in the exposed supralittoral stage). Adlittoral zone. DD.

***Parmotrema crozalsianum*** (B. de Lesd. ex Harm.) D. Hawksw. - Very rare. This corticolous species is only known in France from a few stations on the Mediterranean coast. It has not yet been mentioned on the islands of Hyères. A single specimen was observed on a dead *Juniperus phoenicea* exposed on the south coast of the island (LEV 05). It fits closely the species description with its citrine yellow K+ and orange yellow P+ medulla, its underside black in the center and brown on the periphery, its marginal oval soralia and the absence of cilia on the periphery. However, this is only a very limited observation of this species, which seems to us to be rare on the island, whereas *P. hypoleucinum* is common there. As a result, the *Parmotremetum corzalsiano-hypoleucini* association is not fully represented on the island, whereas it is recorded as being complete on the Mediterranean shores of Spain. Thermo- and meso-Mediterranean stages close to the coast. CR.

***Parmotrema hypoleucinum*** (J. Steiner) Hale - Rare. In France, only in Hérault, Var and Corsica. Elsewhere in Europe on the Iberian Peninsula, Italy and Greece. Also, in the Canary Islands and widely present on the south-east coast of the United States and in California. This species was found in 9 stations visited on the island on various phorophytes, *Quercus ilex*, *Erica arborea*, *Pinus halepensis*, *Populus alba*, and can be abundant there. Upper thermo-Mediterranean and lower meso-Mediterranean levels, not far from the coast. EN.

***Physcia mediterranea*** Nimis - Rare. Until now, this calcifuge saxicolous species has only been mentioned on the coast of Corsica. Known from Greece to the Atlantic coast of the Iberian Peninsula, always on rocks close to the sea. Two stations on Levant Island (LEV 07 and LEV 24) have produced fine specimens. It is an esorediate *Physcia* close to *P. caesia*, with a yellow K+ medulla and white macules on the upper surface. Adlittoral zone. EN.

***Physconia petraea*** (Poelt) Vězda et Poelt - Rare. So far only recorded in the Vendée, Alpes-Maritimes, Corsica and recently in the Var (cap Lardier). Also known from Sardinia, Spain, Austria, Turkey

and Armenia. We found it in the Rioufred Cove (LEV 24), on a shaded outcrop in the valley, close to the sea. Saxicolous (on rocks and blocks of basic silicate rock, rarely calcareous), more rarely muscicolous or terricolous (soil on rocks), calcifuge. From adlittoral to montane zones. EN.

***Porina curnowii*** A. L. Sm. - Very rare. This species of *Porina* has only been recorded in France near the coast, in the Channel, Brittany, Hérault and the Var (Bricaud *et al.*, 1991: 148). It is also known from the south of Ireland and England, as well as Sardinia, and appears to be a Mediterranean-Atlantic species. It was found on Levant Island, in the Calanque de la Carbonière, on the north coast, under a rocky overhang (LEV 20). The specimen is characterised by a greenish-brown thallus, 0.2–0.4 mm perithecia, hemispherical with involucrellum with a reddish inner part and acicular ascospores 7-septate,  $33\text{--}43 \times 3.2\text{--}4.5 \mu\text{m}$ . Thermo-Mediterranean to hilly zones. CR.

***Protoparmelia olivascens*** (Nyl.) Llimona - Rare, but can be easily confused with *Protoparmelia montagnei*, from which it can be distinguished by spot tests (K+ medulla slowly turning an intense wine-red). This species has only been recorded in France in the southern Mediterranean and Corsica. Also found in Spain and Greece. Probably under-reported in the Mediterranean basin. On the south coast of Levant Island (LEV 02 and LEV 13), always in the adlittoral (descending very low) where it is sometimes abundant. Saxicolous, on rocks, boulders and stones of silicate rock, calcifuge, heliophilous, thermophilous. Upper thermo-Mediterranean, meso- and supra-Mediterranean zones. NT.

***Ramalina subgeniculata*** Nyl. - Very rare. Known in France only in Corsica, the Var and the Hérault. This species has a thallus in small tufts 2–3 cm high with roughly cylindrical and more or less hollow strips with a few perforations, esorediate, with subterminal apothecia extended by a lateral spur, with uniseptate, fusiform ascospores  $12\text{--}14 \times 3.8\text{--}5.0 \mu\text{m}$ . It was first identified (Bertrand and Valance, 2023) as *R. subpusilla* on the basis of its specific chemistry (TLC and HPLC), with salazinic acid alone and without divaricatic or norstictic acid, according to Krog and Østhaugen (1980) and Groner and La Greca (1997). However, DNA analysis (ITS) showed that it was different from these and fell well within the clade of the *R. subgeniculata* group. However, it would appear to be a divaricatic acid-free chemotype of *R. subgeniculata*. It was observed here, in the Rioufred Cove (LEV 25) on *Pinus halepensis* and *Quercus ilex* in the company of *R. pusilla*. Thermo-Mediterranean and meso-Mediterranean zones. CR.

***Rinodina dalmatica*** Zahlbr. - Extremely rare. Found in France only in the southern Mediterranean, in the Hérault and the Var (Le Fenouillet: Valance and Valance, 2021: 8, 54). Known from Spain, Portugal and Croatia. It was found on the Levant Island, quite abundant on the trunk of a large *Pinus halepensis*, at Grand Avis (LEV 33). It is characterised by its entirely blastidiate-soradiate thallus, containing pannarin and traces of norpannarin (confirmed by HPLC-MS) and by *Pachysporaria*-type ascospores, here  $13\text{--}20 \times 7\text{--}10 \mu\text{m}$  with a young, polygonal lumen. Thermo-meso-Mediterranean stages. CR.

***Rinodina nimisii*** Giralt & H. Mayrhofer - Very rare. Known so far in France only from Corsica on coastal shrubs and also in Spain, Sardinia and Greece. This species, which is not very conspicuous but is present, either on the bark of shrubs or on dead wood exposed at coastal sea entrances, has been found on the south coast of Levant Island (LEV 03 and LEV 14) on *Juniperus phoenicea*. It is regularly associated with *Endohyalina kalbii*, and both are sometimes difficult to distinguish visually. These specimens of *R. nimisii* therefore represent the first records from the Var. Adlittoral and thermo-Mediterranean zones. CR.

***Rinodina pruinella*** Bagl. - Quite rare. A small, discreet species, known in France in the southern Mediterranean and sub-Mediterranean regions and the Var (Le Cœur, 1992: 21), but not yet mentioned in the Hyères Islands. Also found in Spain, Italy, Sicily and Morocco. It has been found on Levant Island, on dead wood from exposed tree trunks, on the south coast (LEV 14). The specimens are characterised by a yellow K+, P+ orange areolate thallus, 0.4–1.0 mm lecanorine apothecia with a tapering thalline margin, a brown, flat to convex, slightly pruinose disc and *Dirinaria*-type ascospores,  $17\text{--}20 \times 9.5\text{--}11.0 \mu\text{m}$ . Thermo-Mediterranean and meso-Mediterranean zones. VU.

***Rinodina santorinensis*** var. ***santorinensis*** J. Steiner - Rare. Found in France only in the Alpes-Maritimes, Var and Corsica. Otherwise known from the Canary Islands, Portugal, Spain, Sardinia and Greece. Can easily be confused with *Rinodina beccariana*, but differs in secondary metabolites and parasitism. We have found it several times in the rocky adlittoral of the south coast (LEV 02, LEV 11 and LEV 13) where it seems to be less rare than on the coast of the Saint-Tropez Peninsula where we have rarely encountered it. Saxicolous, on walls or steeply sloping surfaces of silicate rock, calcifuge, usually a parasite of other lichens (various crustose species). Lower meso-Mediterranean and thermo-Mediterranean zones. EN.

***Usnochroma carphinea*** (Fr.) Søchting, Arup & Frödén - Rare. In France, only in the Mediterranean region and Corsica. Elsewhere, also recorded in Macaronesia, the Iberian Peninsula, Italy and Greece. On Levant Island it was found in a single station on land (LEV 07), on a rocky outcrop in the middle of the maquis. This taxon is not normally rare on siliceous places in the Var, but here it is probably one of the heliophilous saxicolous species affected by the advance of the maquis. Saxicolous, on sunny walls or on stones on the ground of very coherent silicate rock, calcifuge, very xerophilous, heliophilous, thermophilous. Thermo- and meso-Mediterranean zones. VU.

***Xanthoparmelia glabrans*** (Nyl.) O. Blanco, A. Crespo, Elix, D. Hawksw. & Lumbsch - Very rare. In France, only recorded in the Pyrénées-Orientales, Var (cap Lardier) and Vaucluse. Also found in Spain, Macaronesia, Italy and Greece. Specimens of brown *Xanthoparmelia* from Levant Island have been analyzed by TLC, enabling us to differentiate between species and infraspecific taxa, which under ordinary circumstances would all have been classified as *Xanthoparmelia pulla* s. l. Morphologically difficult to distinguish from *X. pulla*, *X. glabrans* can be distinguished by its chemical composition - it contains alectoronic and collatolic acids, which are unique in these brown *Xanthoparmelia*. Saxicolous, calcifugous, heliophilous. From meso-Mediterranean to montane belt. Risk and threat assessment difficult due to lack of data on its distribution.

***Zamenhofia coralloidea*** (P. James) Clauzade & Cl. Roux - Quite uncommon. Known in France only from the Armorican Massif and the Var (Hyères Islands) where it has been extensively studied by Roux and Bricaud (1991). Also found in Great Britain, Ireland, Spain and Italy. It has been observed on Levant Island in its characteristic form with numerous apothecia (ascospores fusiform, 9–11 septate, halonate,  $43\text{--}54 \times 8\text{--}10 \mu\text{m}$ ) at two sites (LEV 16 and LEV 33) on *Cupressus macrocarpa* bark and *Pinus halepensis* bark respectively. This is a characteristic of the sciaphilous and slightly stegophilous association of *Zamenhofietum coralloideae*, accompanied by *Enterographa crassa*, but where the association can also be almost monospecific. Thermo- and meso-Mediterranean stages. LC.

## 6 Conclusion

### 6.1 Sociological interest

A relatively large number of communities (28 in the study area) were identified. Several well-developed coastal communities were found, both calcifugous saxicolous on the seashore, and corticolous in the maquis and mature woodland preserved in the small sheltered valleys (Rioufred, Grand Avis, Liserot, Courcousson). This reflects

favourable ecological conditions in many areas. The best growths of slow-dynamic corticolous species have been found in these valleys. In the more open parts of the maquis on the crests and open slopes, it seems that drought is slowing down the establishment and development of the corticolous lichen flora, as mature woodland is lacking and the number of species is low. This could probably be due to the various fires that have swept across the island (the historic fire of October 1866, and the large-scale fires that affected the south-eastern part of the island in 1926 and in September 1990), which have resulted in a depletion of mature woodland.

In other respects, the island effect can manifest itself at several levels.

On the south-east coast, the shrubs are colonised by corticolous or lignicolous species not seen on the mainland coast of cap Lardier, for example *Rinodina nimisii*, *Endohyalina kalbii*, *Rinodina pruinella*, *Parmotrema hypoleucinum* and *P. crozalsianum*. These colonisations are very probably due to conditions of atmospheric humidity, whereas a pronounced drought would prevent these from developing. Similarly, adlittoral saxicolous species are well developed several metres inland from the coast, probably due to exposure to the prevailing damp winds from the east.

Certain valleys, such as Rioufred or Grand Avis, maintain a humidity level that appears to be permanent and allows the establishment of thermo-Mediterranean species.

However, further investigations would probably lead to other discoveries, particularly in very closed environments favourable to certain corticolous species that are evidence of more mature forest continuity. In this respect, the expected species *Waynea steochadiana* (present on Porquerolles and Port-Cros, even inland at Roquebrune-sur-Argens) was not observed, although it is likely present on the island.

## **6.2 The importance of lichens for the island's management plan**

A study of the lichen flora of Levant Island does not, *a priori*, reveal any problems disrupting the lichen ecosystems. Work and development are limited in relation to the total surface area, and there is very little use of the paths and natural environments.

However, the risk of fire persists in all cases and would have consequences for the degradation of the lichen flora, as it would for the Mediterranean coast as a whole. Fire is one of the most important factors in the impoverishment of the environment or the disappearance of species and lichen communities, as the following evolutionary dynamics must be taken into account.

The evolution of Mediterranean woodlands goes through various preliminary stages, during which very sun-loving communities successively establish themselves when the vegetation is not very dense, then photophilous but not sun-loving when the canopy thickens, and finally more sciaphilous species specific to denser and very shaded environments. At the same time, the increase in humidity and the decrease in thermal differences, as well as the ageing of the rhytidome of phorophytes, play a very important role in the appearance of a range of aerohygrophilous species and species with slower dynamics than those of the more photophilous species. In this way, the large foliose species of the illuminated undergrowth disappear in favour of a group of small, discreet species which are ultimately indicative of a woodland with a certain maturity resulting from a forest continuity generally established after several decades without disturbance (small temperature differences, phorophytes with altered bark favourable to a few small substratohygrophilous species). These conditions do not exist in low or even developing scrub, even several years after a fire, when the phanerogamic vegetation appears to be well established. This seems to be the case on the island for several areas of dense scrubland.

## **7 Outlook**

Fire protection measures must be maintained, as a fire leaves an imprint on the lichen flora that goes well beyond the regeneration of the first phanerogamic layers.

Due to the regulated military nature of the area, the problems of over-frequentation and urban development, due to pressure from property development, do not seem to have had any impact on the lichen flora. In many places, the island remains very wild with little access. Its natural evolution can only remain desirable, so that fully mature forests can develop more uniformly across the island.

As a result of the classification of this island territory as a remarkable natural area, with its particular Mediterranean climatic conditions and the fact that almost the entire island is a military camp with strictly regulated access, and therefore relatively protected, the island can be considered an interesting area for learning about Mediterranean lichen biodiversity. Further surveys could be envisaged to complete this initial lichenological inventory and provide a basis for long-term monitoring.

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### Appendix 1. List of collecting localities on Levant Island

- LEV 01: 04/04/2022; Levant Island, Grand Cap, a little north; adlittoral rocks with strong supralittoral influence; very compact and coherent siliceous rock ("Roches de fer"); south-east; alt. 11 m; E 06.472012° / N 43.019059°.
- LEV 02: 04/04/2022; Levant Island, Grand Cap, a little north; various rocky outcrops above ground (1 m), micaschist and "Roches de fer"; south-east; alt. 15 m; E 06.471605° / N 43.018957°.
- LEV 03: 04/04/2022; Levant Island, Grand Cap, a little to the north; low adlittoral shrub vegetation, exposed to the sea winds; trunk and branches of dead *Juniperus phoenicea*; south-east; alt. 15 m; E 06.471605° / N 43.018957°.
- LEV 04: 04/04/2022; Levant Island, Grand Cap, "hameçon" Valley, a little to the north; bare adlittoral zone; non-calcareous schists on the ground, erected in blades; north-east; alt. 11 m; E 06.472588° / N 43.020982°.
- LEV 05: 04/04/2022; Levant Island, Grand Cap, "hameçon" valley to the north; isolated shrubs in the wet valley; trunk and dead branches of a *Juniperus phoenicea*; east; alt. 15 m; E 06.472374° / N 43.021112°.
- LEV 06: 04/04/2022; Levant Island, Grand Cap, valley of the "hameçon", to the north, bare ground on the edge of a dry stream; siliceous, sandy soil; east; alt. 22 m; E 06.471953° / N 43.020977°.
- LEV 07: 04/04/2022; Levant Island, north of the Grand Cap, under runway n°14, north of the "Vaisseau"; large rocky outcrop on the ground and rocky bar; garnet micaschists with large quartzite pebbles; east; alt. 64 m; E 06.472740° / N 43.027771°.
- LEV 08: 04/04/2022; Levant Island, military port of Grand Avis; coastal rocks, western flank of the calanque; non-calcareous fine schists; north-east; alt. 6 m; E 06.452928° / N 43.026542°.
- LEV 09: 05/04/2022; Levant Island, Grand Avis military base; light pine forest in the middle of the base; trunk of *Pinus halepensis*; north; alt. 60 m; east; E 06.459760° / N 43.024032°.
- LEV 10: 05/04/2022; Levant Island, Gour de Vidal (under runway n°14); supralittoral crags and adlittoral limit; seaward and very exposed laminated schists; south-east; alt. 5 m; E 06.480411° / N 43.031577°.
- LEV 11: 05/04/2022; Levant Island, Gour de Vidal (under runway n°14); rocky outcrops of the adlittoral; seaward erect schists and more humid opposite face; south-east; alt. 10 m; E 06.480115° / N 43.031597°.
- LEV 12: 05/04/2022; Levant Island, Vallon de la mare de l'Ane (under runway n°14); mediolittoral rock, beaten; quartzite; south-east; alt. 0.5 m; E 06.481587° / N 43.034452°.
- LEV 13: 05/04/2022; Levant Island, vallon de la mare de l'Ane (under runway n°14); bottom of the vallon; adlittoral, large rocky outcrops; hard schist; south-east; alt. 6 m; E 06.480972° / N 43.034342°.
- LEV 14: 05/04/2022; Levant Island, vallon de la mare de l'Ane (under runway n°14); pile of dead trunks at the bottom of the vallon; lignicolous, dead trunks; south-east; alt. 6 m; E 06.480890° / N 43.034354°.
- LEV 15: 05/04/2022; Levant Island, vallon de la mare de l'Ane (under runway n°14); rocks crossed by a dry stream; hard micaceous schists; south-east; alt. 9 m; E 06.480680° / N 43.034340°.
- LEV 16: 05/04/2022; Levant Island, Chemin des Moines, east of Courcousson; trees on edge of track; *Cupressus macrocarpa*, *Eucalyptus amygdalina*, *Populus alba*; south-east; alt. 66 m; E 06.476620° / N 43.040950°.
- LEV 17: 05/04/2022; Levant Island, Chemin des Moines, east of Courcousson; shaded earthy slope beside runway; quartzite and siliceous earth; south-east; alt. 65 m; E 06.476600° / N 43.040020°.
- LEV 18: 05/04/2022; Levant Island, military port of Grand Avis; small humid valley on the western flank of the cove; schists and sands; north; alt. 5 m; E 06.452937° / N 43.025784°.

- LEV 19: 06/04/2022; Levant Island, le Titan, cove west of cap du Pauvre Louis; sea rocks at the foot of a large steep cliff; gneiss; north; alt. 4 m; E 06.508870° / N 43.047240°.
- LEV 20: 06/04/2022; Levant Island, Calanque de la Carbonière, halfway up the cove; rocky outcrop at the end of the road; gneiss, micaschist; north; alt. 27 m; E 06.496200° / N 43.049170°.
- LEV 21: 06/04/2022; Levant Island, Calanque de la Carbonière, halfway up the cove; dense shrub thicket at the end of the road; *Myrtus communis*, *Erica arborea*; north; alt. 25 m; E 06.496190° / N 43.049124°.
- LEV 22: 06/04/2022; Levant Island, track leading down to the Anse du Liserot; dense scrub with trees, trees along the track; trunk of *Pinus halepensis*; north; alt. 40 m; E 06.496150° / N 43.049130°.
- LEV 23: 06/04/2022; Levant Island, track leading down to the Liserot Cove; damp shaded slope at the edge of the track with seeps; weathered gneiss; south; alt. 28 m; E 06.494680° / N 43.046800°.
- LEV 24: 06/04/2022; Levant Island, Calanque de Rioufred; rocky outcrops and shaded bed of a temporary stream in the valley; gneiss; south; alt. 4 m; E 05.451680° / N 43.018170°.
- LEV 25: 06/04/2022; Levant Island, Calanque de Rioufred; shaded valley with stream running over rocky outcrops; trunks and branches of *Quercus ilex*, *Pinus halepensis*; south; alt. 6 m; E 06.451680° / N 43.018170°.
- LEV 26: 06/04/2022; Levant Island, Calanque de Rioufred; rocky outcrops and slope bordering the access track to the cove ('calanque'); weathered gneiss; south-west; alt. 39 m; E 06.451850° / N 43.019070°.
- LEV 27: 07/04/2022; Levant Island, vallon du Grand Avis, on the edge of the stream; low rocky outcrops, a little damp in an open area; gneiss, micaschist; north-west; alt. 16 m; E 06.454690° / N 43.024780°.
- LEV 28: 07/04/2022; Levant Island, Vallon du Grand Avis, creek bed; rocky creek bed, just at the edge of the permanent flow; gneiss, micaschist; north; alt. 15 m; E 06.454630° / N 43.024730°.
- LEV 29: 07/04/2022; Levant Island, chemin de la Douane; former quarry on edge of track; iron-rich gneiss; north; alt. 38 m; E 06.453649° / N 43.024564°.
- LEV 30: 07/04/2022; Levant Island, chemin de la Douane, jardin du Passeur; small rocky outcrop on edge of track, shaded; weathered gneiss; north; alt. 38 m; E 06.453694° / N 43.024661°.
- LEV 31: 07/04/2022; Levant Island, chemin de la Douane, jardin du Passeur; wood of large trees and sparse scrub bordering the track; trunks of large *Quercus ilex*; north; alt. 38 m; E 06.453510° / N 43.024672°.
- LEV 32: 07/04/2022; Levant Island, Calanque de la Paille, western point of the cove; spur strongly exposed to sea spray, supralittoral; micaschists; north; alt. 5 m; E 06.464554° / N 43.039883°.
- LEV 33: 07/04/2022; Levant Island, Grand Avis, étang du Haut; light pine forest on the edge of the pond; *Pinus halepensis* trunks; variable; al. 70 m; E 06.462810° / N 43.026685°.
- LEV 34: 10/05/2021; Levant Island, chemin de la Douane; edge of runway; embankment, wood along edge; north; alt. 38 m; E 06.453694° / N 43.024851°.
- LEV 35: 11/05/2021; Levant Island, runway n°14; roadside embankment; earth, rock; south-east; alt. 65 m; E 06.470313° / N 43.025822°.
- LEV 36: 11/05/2021; Levant Island, Anse de Liserot; light pine forest by the sea; *Pinus halepensis*; West; alt. 2 m; E 06.489711° / N 43.042824°.
- LEV 37: 11/05/2021; Levant Island, Pointe du Titan; stairs leading down to the lighthouse cove; gneiss; north; 35; E 06.509560° / N 43.046713°.
- LEV 38: 11/05/2021; Levant Island, Sémaphore du Titan, edge of firing range; shrubs (2-3 m high) on edge of small meadow; various shrubs; north-east; alt. 90 m; E 06.504517° / N 43.048328°.

## Appendix 2. List of species inventoried

In the full list below, each species name is followed by the numbers of the stations where it has been observed and then, depending on the case, by an abbreviation indicating whether it is a new record (N) or the confirmation of a single older record (CF), specifying the geographical scale of the new record: France (F), Var (83). Here the indicated presence of species refers to the 3<sup>rd</sup> edition of the Catalogue des lichens de France (Roux et coll., 2020, 2021, 2022, 2023). For example, CF83 means confirmed in the department n° 83 (Var), as it was only mentioned there once and N83 means newly reported in the Var department.

Other abbreviations used and borrowed from the Catalogue des lichens de France (Roux et coll., 2020): **chemo.** chemotype; **eco.** ecotype; **morpho.** morphotype; **phyco.** phycotype.

1. *Acarospora privigna* (Ach.) A. Schneid.; 26
2. *Acarospora subfuscescens* (Nyl.) H. Magn.; 08
3. *Acarospora subrufula* (Nyl.) H. Olivier; 06
4. *Acarospora umbilicata* Bagl.; 27, 29
5. *Acrocordia macrospora* A. Massal.; 24
6. *Alyxoria subelevata* (Nyl.) Ertz & Tehler; 23
7. *Alyxoria varia* (Pers.) Ertz & Tehler; 16
8. *Amandinea pelidna* (Ach.) Friday & L. Arcadia; 24
9. *Amandinea punctata* (Hoffm.) Coppins & Scheid.; 38
10. *Anaptychia* aff. *palmulata*; 25, 30
11. *Anaptychia runcinata* (With.) J. R. Laundon; 02, 27
12. *Aspicilia viridescens* (A. Massal.) Hue; 15, 26, 28
13. *Aspiciliella cupreoglauca* (B. de Lesd.) Zakeri, Divakar & Otte; 26, 27, 29
14. *Aspiciliella intermutans* (Nyl.) M. Choisy; 07, 24
15. *Athallia alnetorum* (Giralt, Nimis & Poelt) Arup, Frödén & Søchting; 03; **N83**
16. *Bacidia rubella* (Hoffm.) A. Massal.; 16, 31
17. *Bacidia sipmanii* Brand, Coppins, van den Boom & Sérus.; 26; **N83**
18. *Bactrospora patellarioides* var. *convexa* (B. de Lesd.) Egea & Torrente; 09, 16, 22, 31, 33
19. *Blastenia crenularia* var. *crenularia* (With.) Arup, Søchting & Frödén; 01
20. *Blastenia crenularia* var. *contigua* (A. Massal.) Cl. Roux; 19
21. *Buellia abstracta* (Nyl.) H. Olivier; 06, 08
22. *Buellia disciformis* f. *disciformis* (Fr.) Mudd; 34
23. *Buellia dispersa* A. Massal.; 10
24. *Buellia leptoclinoides* (Nyl.) J. Steiner; 02, 11, 13, 20
25. *Buellia stellulata* (Taylor) Mudd; 01
26. *Buellia subdisciformis* (Leight.) Vain.; 15, 26, 29
27. *Buellia tesserata* Körb.; 02, 07, 11, 13
28. *Caloplaca aegatica* Giralt, Nimis & Poelt; 14, 16
29. *Candelariella oleaginescens* Rondon; 10
30. *Candelariella vitellina* (Hoffm.) Müll. Arg.; 07, 08, 27, 29, 37
31. *Catillaria chalybeia* (Borrer) A. Massal.; 01, 02, 04, 10, 11, 13, 18, 19, 23, 26, 27, 28, 32
32. *Chrysothrix candelaris* (L.) J. R. Laundon; 16, 25, 33, 34
33. *Cladonia cervicornis* (Ach.) Flot.; 06, 18, 34
34. *Cladonia fimbriata* (L.) Fr.; 34
35. *Cladonia firma* (Nyl.) Nyl.; 34
36. *Cladonia foliacea* subsp. *endiviifolia* (Dicks.) Boistel; 34
37. *Cladonia foliacea* subsp. *foliaceae* (Huds.) Willd.; 06, 18, 27
38. *Cladonia furcata* subsp. *furcata* morpho. *corymbosa*; 26
39. *Cladonia furcata* subsp. *furcata* morpho. *furcata*; 34, 37
40. *Cladonia furcata* subsp. *furcata* morpho. *palamea*; 34
41. *Cladonia humilis* (With.) J. R. Laundon; 18, 23

42. *Cladonia rangiformis* morpho. *rangiformis*; 06, 18, 27
43. *Cladonia subturgida* Samp.; 06; **CF83**
44. *Cladonia verticillata* (Hoffm.) Schaer.; 34
45. *Cliostomum griffithii* (Sm.) Coppins; 38
46. *Coenogonium luteum* (Dicks.) Kalb & Lücking; 16
47. *Coenogonium pineti* (Schrad. ex Ach.) Lücking & Lumbsch; 25
48. *Coenogonium tavaresianum* (Vězda) Lücking, Aptroot & Sipman; 09, 22
49. *Collema rysssoleum* (Tuck.) A. Schneid.; 07, 24, 27
50. *Coniocarpon fallax* (Ach.) Grube; 31; **N83**
51. *Dendrographa decolorans* (Turner & Borrer ex Sm.) Ertz & Tehler; 09, 16, 21, 22, 25, 31, 33
52. *Diploicia canescens* (Dicks.) A. Massal.; 38
53. *Diploicia subcanescens* (Werner) Haffelner & Poelt; 01, 02, 04, 10, 13, 37
54. *Diploschistes actinostoma* (Pers. ex Ach.) Zahlbr.; 27
55. *Diploschistes euganeus* (A. Massal.) J. Steiner; 19
56. *Diploschistes scruposus* morpho. *interpediens* (Schreb.) Norman; 26, 27
57. *Diploschistes scruposus* morpho. *violarius* (Schreb.) Norman; 23; **N83**
58. *Diplotomma chlorophaeum* (Hepp ex Leight.) Szatala; 01, 19
59. *Diplotomma glaucoatrum* (Nyl.) Cl. Roux; 10, 19
60. *Dirina fallax* De Not.; 02, 13, 19
61. *Endohyalina ericina* var. *ericina* (Nyl.) Giralte, van den Boom & Elix; 22; **N83**
62. *Endohyalina kalbii* (Giralte & Matzer) Giralte, van den Boom & Elix; 03, 05
63. *Enterographa crassa* (DC.) Fée; 25, 31
64. *Evernia prunastri* (L.) Ach.; 33
65. *Flavoparmelia caperata* (L.) Hale; 25, 33, 34, 38
66. *Flavoparmelia soredians* (Nyl.) Hale; 05, 14, 16, 21, 22, 25, 33
67. *Flavoplaca flavocitrina* (Nyl.) Arup, Frödén & Søchting; 08
68. *Flavoplaca limonia* (Nimis & Poelt) Arup, Frödén & Søchting; 19
69. *Flavoplaca marina* (Wedd.) Arup, Frödén & Søchting; 01, 02, 10, 13, 15, 19, 32, 37
70. *Flavoplaca maritima* (B. de Lesd.) Arup, Frödén & Søchting; 08, 18, 24, 28
71. *Glaucumaria rupicola* subsp. *rupicola* (L.) P. F. Cannon; 27
72. *Glaucumaria rupicola* subsp. *sulphurata* (Ach.) Cl. Roux; 27
73. *Gyalecta schisticola* Werner; 30
74. *Heterodermia obscurata* (Nyl.) Trévis.; 25
75. *Hydropunctaria rheitrophila* (Zschacke) C. Keller, Gueidan & Thüs; 24; **CF83**
76. *Hydropunctaria symbalana* (Nyl.) Cl. Roux; 12, 19
77. *Hyperphyscia adglutinata* (Flörke) H. Mayrhofer & Poelt; 25
78. *Ingaderia sorediata* (Sparrius, P. James & M. A. Allen) Ertz; 19; **N83**
79. *Kuettlingeria fuscoatroides* (J. Steiner) I. V. Frolov, Vondrák & Arup; 08, 18, 28
80. *Lecania atrynoides* M. Knowles; 02, 06, 08, 10, 11, 13, 18, 19, 32, 37
81. *Lecania cyrtellinoides* (M. Choisy) Zahlbr.; 22
82. *Lecania hutchinsiae* (Nyl.) A. L. Sm.; 24; **N83**
83. *Lecanora campestris* subsp. *campestris* (Schaer.) Hue; 08, 17, 18, 19, 23, 27, 28
84. *Lecanora confusa* Almb.; 05
85. *Lecanora expallens* Ach.; 38
86. *Lecanora gangaleoides* Nyl.; 26, 29
87. *Lecanora horiza* (Ach.) Linds; 16
88. *Lecanora hybocarpa* (Tuck.) Brodo; 09, 22, 25, 33, 38
89. *Lecanora lividocinerea* Bagl.; 14, 33
90. *Lecanora praepostera* Nyl.; 02, 13, 24, 27
91. *Lecanora rubrofusca* var. *monstruosa* B. de Lesd.; 07
92. *Lecanora sulphurea* (Hoffm.) Ach.; 01, 02, 11, 13, 18, 20

93. *Lecanora symmicta* (Ach.) Ach.; 38
94. *Lecidea fuscoatra* (L.) Ach.; 29
95. *Lecidea grisella* Flörke; 27
96. *Lecidella asema* var. *asema* (Nyl.) Knoph & Hertel; 27
97. *Lecidella asema* var. *elaeochromoides* (Nyl.) Nimis & Tretiach; 01, 02, 07, 10, 11, 13, 15, 18, 19, 20, 26, 27
98. *Lecidella carpathica* Körb.; 27
99. *Lecidella elaeochroma* var. *flavicans* (Ach.) M. Choisy; 03, 14
100. *Lepra amara* var. *amara* (Ach.) Hafellner; 25
101. *Lepra amara* var. *flotowiana* (Flörke) Nimis; 24
102. *Lepra mammosa* (Harm.) Hafellner; 27
103. *Lepra monogona* (Nyl.) Hafellner; 24, 27
104. *Leprocaulon quisquiliare* (Leers) M. Choisy; 17, 23, 34, 35
105. *Lichinella stipatula* Nyl.; 07, 24; **CF83**
106. *Melanohalea exasperata* (De Not.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch; 34
107. *Micarea micrococca* (Körb.) Gams ex Coppins; 22; **N83**
108. *Myriolecis bandolensis* (B. de Lesd.) M. Bertrand, Cl. Roux & Nimis; 19
109. *Myriolecis liguriensis* (B. de Lesd.) Cl. Roux; 04, 08, 18, 19, 27, 37
110. *Myriolecis oyensis* (M. Bertrand & Cl. Roux) M. Bertrand & Cl. Roux; 01, 15, 37
111. *Myriolecis* cf. *salina* (H. Magn.) Sliwa, Zhao Xin & Lumbsch; 10, 11, 13, 20, 32
112. *Ochrolechia parella* s.l. eco. Saxicole (L.) A. Massal.; 01, 02, 07, 13, 17, 18, 20, 23, 26, 27, 29
113. *Ochrolechia parella* s.l. eco. Corticole (L.) A. Massal.; 05
114. *Opegrapha conferta* Anzi; 19
115. *Parmelia omphalodes* (L.) Ach.; 18
116. *Parmelia saxatilis* s.l. (L.) Ach.; 29
117. *Parmelia sulcata* Taylor; 14
118. *Parmelina tiliacea* s. l. (Hoffm.) Hale; 26, 34
119. *Parmotrema crozalsianum* (B. de Lesd. ex Harm) D. Hawksw.; 05
120. *Parmotrema hypoleucinum* (J. Steiner) Hale; 05, 09, 16, 22, 25, 33, 34, 36, 38
121. *Parmotrema perlatum* (Huds.) M. Choisy; 09, 16, 25, 29, 34, 38
122. *Parmotrema reticulatum* (Taylor) M. Choisy; 25
123. *Peltula euploca* (Ach.) Poelt; 07
124. *Pertusaria pluripuncta* Nyl.; 01, 02, 11, 13, 18, 19, 20, 26, 27, 37
125. *Pertusaria pseudocoralina* (Lilj.) Arnold; 29
126. *Pertusaria rupicola* (Sommerf.) Harm.; 29
127. *Physcia adscendens* H. Olivier; 02, 05, 09, 10, 13, 16, 18, 20, 21, 22, 25
128. *Physcia acaesia* var. *caesia* (Hoffm.) Fürnr.; 29
129. *Physcia dubia* morpho. *dubia* (Hoffm.) Lettau; 22, 23
130. *Physcia mediterranea* Nimis; 07, 24; **N83**
131. *Physcia tenella* (Scop.) DC.; 02, 05, 13, 20
132. *Physconia aenteroxantha* (Nyl.) Poelt; 25
133. *Physconia petraea* (Poelt) Vězda & Poelt; 24
134. *Porina chlorotica* (Ach.) Müll. Arg.; 20, 24
135. *Porina curnowii* A. L. Sm.; 20
136. *Porpidia cinereoatra* subsp. *cinereoatra* (Ach.) Hertel & Knoph; 26, 29
137. *Porpidia crustulata* (Ach.) Hertel & Knoph; 17, 18, 26, 27, 29, 35
138. *Porpidia platycarpoides* (Bagl.) Hertel; 18
139. *Protoparmelia montagnei* chémo. *aquilina* (Fr.) Poelt & Nimis; 02
140. *Protoparmelia montagnei* chémo. *montagnei* (Fr.) Poelt & Nimis; 07, 13, 27
141. *Protoparmelia olivascens* (Nyl.) Llimona; 02, 13
142. *Punctelia borrieri* (Sm.) Krog; 16
143. *Punctelia subrudecta* (Nyl.) Krog; 25, 34

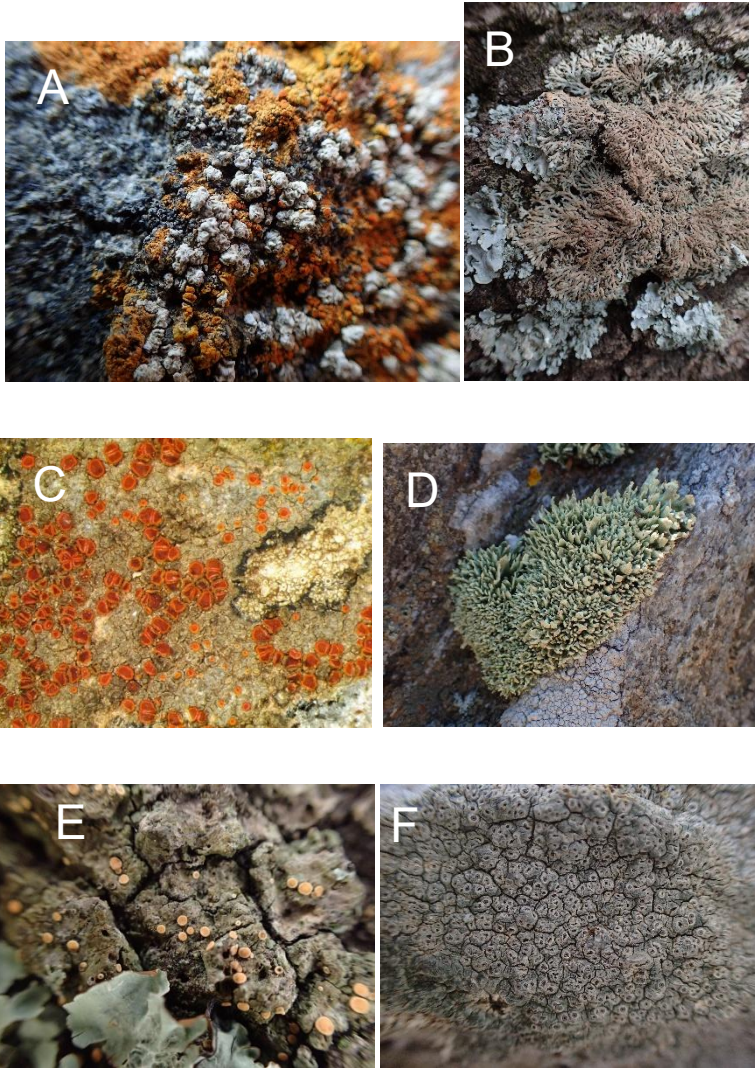
144. *Pyrrhospora quernei* (Dicks.) Körb.; 05, 09, 14, 16, 21, 22, 33, 34, 36, 38
145. *Ramalina breviscula* Nyl.; 01, 02, 07, 13, 19, 20, 27, 29
146. *Ramalina canariensis* J. Steiner; 05, 14, 16, 20, 21, 33, 36, 38
147. *Ramalina pusilla* Le Prévost; 14, 16, 25, 34, 38
148. *Ramalina requienii* (De Not.) Jatta; 06, 13
149. *Ramalina siliquosa* (Huds.) A. L. Sm.; 18
150. *Ramalina subfarinacea* s.l. (L.) Ach.; 07, 29
151. *Ramalina subgeniculata* Nyl.; 25
152. *Rhizocarpon richardii* subsp. *constrictum* (Malme) Cl. Roux; 29
153. *Rinodina alba* Metzler ex Arnold; 07, 24
154. *Rinodina beccariana* var. *beccariana* Bagl.; 01, 02, 07, 13, 18, 19, 20, 24
155. *Rinodina gennarii* Bagl.; 08, 27, 32
156. *Rinodina dalmatica* Zahlbr.; 33
157. *Rinodina nimisii* Giralt & H. Mayrhofer; 03, 14; **N83**
158. *Rinodina occulta* (Körb.) Sheard; 26
159. *Rinodina pruinella* Bagl.; 14
160. *Rinodina santorinensis* var. *santorinensis* J. Steiner; 02, 11, 13
161. *Roccellap hycopsis* (Ach.) Ach.; 02, 13, 18, 19, 20, 25, 37
162. *Sanguineodiscus aractus* (Fr.) I. V. Frolov & Vondrák; 01, 10, 13
163. *Solenopsora holophaea* (Mont.) Samp.; 18, 20, 23, 27
164. *Solenopsora vulturiensis* A. Massal.; 18, 20, 23, 24, 26, 27
165. *Tephromela atra* (Huds.) Haffelner; 01, 02, 07, 13, 18, 19, 20, 26
166. *Toninia cinereovirens* (Schaer.) A. Massal.; 24
167. *Usnea rubicunda* Stirt.; 33
168. *Usnochroma carphinea* (Fr.) Søchting, Arup & Frödén; 07
169. *Variospora thallincola* (Wedd.) Arup, Frödén & Søchting; 01, 08, 10, 15, 19
170. *Verrucaria fusconigrescens* Nyl.; 19
171. *Verrucaria praetermissa* (Trevis.) Anzi; 24
172. *Xanthocarpia* cf. *crenulatella* (Nyl.) Frödén, Arup & Søchting; 27
173. *Xanthoparmelia conspersa* (Ehrh. Ex Ach.) Hale; 27
174. *Xanthoparmelia delisei* (Duby) O. Blanco, A. Crespo, Elix, D. Hawksw. & Lumbsch; 27
175. *Xanthoparmelia glabrans* (Nyl.) O. Blanco, A. Crespo, Elix, D. Hawksw. & Lumbsch; 24
176. *Xanthoparmelia luteonotata* (J. Steiner) O. Blanco, A. Crespo, Elix, D. Hawksw. & Lumbsch; 07, 15, 26
177. *Xanthoparmelia mexicana* auct. ital. [non Gyeln.] Hale; 07, 24, 26
178. *Xanthoparmelia protomatrae* (Gyeln.) Hale; 24
179. *Xanthoparmelia stenophylla* (Ach.) Ahti & D. Hawksw.; 07, 27
180. *Xanthoparmelia verruculifera* (Nyl.) O. Blanco, A. Crespo, Elix, D. Hawksw. & Lumbsch; 27, 29
181. *Xanthoria calcicola* Oxner; 01, 02, 03, 07, 10, 11, 13, 15, 18, 19, 20, 27, 32, 37
182. *Xanthoria parietina* (L.) Th. Fr.; 05, 21, 24, 34, 38
183. *Zamenhofia coralloidea* (P. James) Clauzade & Cl. Roux; 16, 33

#### **Lichenicolous, non-lichenised fungus**

Lichenicolous fungi were not surveyed, although one remarkable species was observed as a parasite on *Ochrolechia parella*.

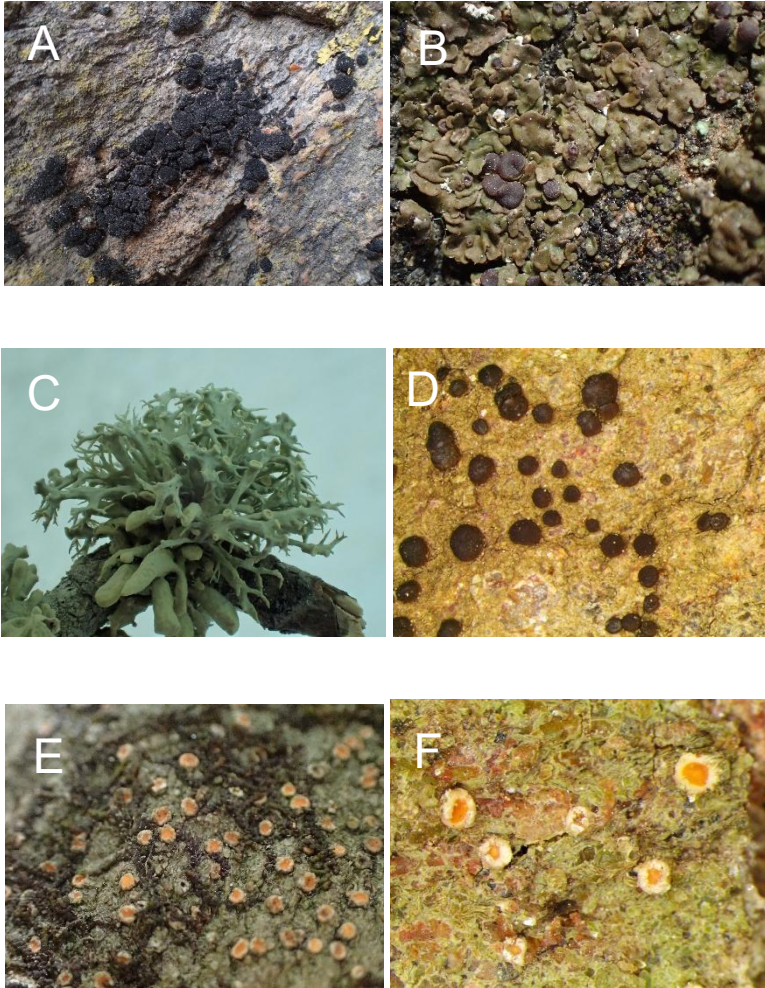
*Sphinctrina turbinata* (Th. Fr.) Th.Fr.; 18; **N83**

Some lichens from Levant Island (I)



**Figure 5.** **A.** *Myriolecis oyensis* (Grand Cap). **B.** *Anaptychia* aff. *palmulata* (Rioufred). **C.** *Kuettlingeria fuscoatroides* (vallon du Grand Avis). **D.** *Ramalina breviscula* (vallon de l'Âne). **E.** *Coenogonium pineti* (Rioufred). **F.** *Diploschistes euganeus* (cap du Pauvre Louis). Photos M. Bertrand.

Some lichens from Levant Island(II)



**Figure 6.** **A.** *Lichinella stipatula* (Rioufred ). **B.** *Solenopsora holophaea* (calanque de la Carbonière). **C.** *Ramalina subgeniculata* (Rioufred). **D.** *Bacidia sipmanii* (Rioufred). **E & F.** *Gyalecta schisticola* (chemin de la Douane). Photos M. Bertrand.