Article

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The genus *Solenopsora* (Lichenized Ascomycetes, *Leprocaulaceae*) in Italy

Abstract

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This paper includes a dichotomous key, descriptions and predictive distributional maps for all of the 9 infrageneric taxa of the lichen genus *Solenopsora* (*Leprocaulaceae*) known to occur in Italy. The genus includes obligatory saxicolous lichens with the main centre of diversity in the Mediterranean, Macaronesian, and Madrean biogeographical regions. All taxa have their optima below the montane belt. Most of them have a distinctly Thyrrenian-Mediterranen distribution pattern in Italy, being most frequent in areas with a mild, suboceanic climate.

Key words: Biogeography, dichotomous key, flora, lichens, Southern Europe.

Introduction

After the completion of a new checklist of the lichens of Italy (Nimis 2016), and its incorporation into ITALIC, the online information system on the lichens of Italy (Nimis & Martellos 2002; Martellos 2012), work has started on the preparation of a computer-aided lichen flora of the country, containing keys and descriptions (Nimis & Martellos 2020). A first comprehensive key, including all species known from Northern Italy (2.240 infrageneric taxa) has been already published online for testing (Nimis 2021). Separate, nationwide dichotomous keys to given families and/or genera are also being produced, which will be eventually integrated into a complete national key.

This paper is dedicated to the genus *Solenopsora* in Italy. It includes a key, descriptions and predictive distributional maps for all taxa known to occur in the country. The genus, for a long time listed under the *Catillariaceae*, was recently found to belong into the *Leprocaulaceae* (Miadlikowska & al. 2014, Fačkovcová & al. 2020). It mainly occurs in temperate and subtropical regions, the centre of diversity being in the Mediterranean, Macaronesian, and Madrean biogeographical regions (Fačkovcová & al. 2020). European species were treated by Guttová & al. (2014; see also Fačkovcová & al. 2019), who recognised 9 infrageneric taxa, all of which do occur in Italy (see Nimis 2016; Guttová & al. 2019).

Data and Methods

The key, which is also available online in an illustrated, interactive version, was produced using FRIDA (FRiendly IDentificAtion, see Martellos 2010), a software package for producing digital identification keys, developed since 2003 at the Department of Life Sciences of the University of Trieste. Contrary to most available software for the creation of identification tools, FRIDA is mainly focused on the optimization of classical dichotomous keys, although it also includes the possibility of adding a multi-entry query interface. FRIDA allows to store and organise characters and their states, names of taxa, descriptions, digital images, and textual notes into a unified system. These resources are used for generating digital identification keys, which can be edited, refined, enriched by further content, and published online, or used through an app for mobile devices (Martellos & Nimis 2015; Nimis & Martellos 2020). To allow collaborative efforts in the development of identification keys, FRIDA is based on a double-level architecture, which permits several authors to contribute to a common project, while maintaining a high degree of independence (Martellos 2010).

The distribution of species in the administrative regions of Italy is based on the data provided by Nimis (2016), integrated with data from Fačkovcová & al. (2019; 2020), and Guttová & al. (2019). Commonness/rarity of species was assessed on the basis of the number of literature citations for the different administrative regions of Italy (from Nimis 1993, 2016), and from the number of herbarium samples revised by Guttová & al. (2019).

The predictive distribution maps are based on the presence/absence in the administrative regions of Italy, and on commonness-rarity values (see Nimis & al. 2018) in 9 ecoregions (see Nimis 2016; Martellos & al. 2020), delimited on the basis of several thematic maps (altitude, precipitation, urbanization, etc.), also taking into account the difference between the Tyrrhenian (humid) and Adriatic (dry) part of the Italian Peninsula, which is relevant in influencing lichen distribution in Italy (Nimis & Tretiach 1995, 2004; Nimis 2016). The maps show the probability of finding a species in a given climatic area, and point to further exploration in some regions (when a species was never recorded from a region, that region remains blank). The actual distribution of species is likely to be narrower than that depicted in the maps, because these do not take into account the occurrence of the main types of rocks on which *Solenopsora*-species grow (calcareous, siliceous, and ultrabasic rocks).

Results

The species

Solenopsora A. Massal.
Framm. Lichenogr.: 20, 1855.

Thallus crustose or squamulose, sometimes placodioid, the upper surface corticate, with a trebouxioid photobiont. Apothecia lecanorine, the thalline margin sometimes becoming excluded. Asci 8-spored, clavate, *Catillaria*-type (but sometimes with a small

ocular chamber). Ascospores (0-)1-septate, hyaline, without a thick epispore. Conidia simple, bacilliform. Medulla with orcinol and β-orcinol depsidones, triterpenes and different unidentified substances. Type species: *S. requienii* A. Massal. (= *S. holophaea*).

Solenopsora candicans (Dicks.) J. Steiner

Österr. bot. Z., 65: 288, 1915. Basionym: *Lichen candicans* Dicks., Fasc. Plant. Crypt. Brit., 3: 15, 1793.

Synonyms: *Caloplaca candicans* (Dicks.) Flagey; *Diphratora candicans* (Dicks.) Jatta; *Lecania candicans* (Dicks.) Stizenb.; *Lecanora candicans* (Dicks.) Schaer.; *Placodium candicans* (Dicks.) Duby; *Placodium epigaeum* (Ach.) Gray; *Placolecania candicans* (Dicks.) Zahlbr.; *Ricasolia candicans* (Dicks.) A. Massal.

Description: Thallus crustose-placodioid, epilithic, forming orbicular to irregular, strongly white-pruinose, 2-5 cm wide rosettes. Lobes mostly flattened, contiguous, radiating, 0.4-0.8(-1.4) mm wide, chalky white, sometimes glaucous-white at margins. Cortex colourless, with abundant crystals not soluble in K; medulla white, with a few crystals only. Apothecia frequent, subsessile, 0.8-2 mm across, with a flat, dark brown to black, usually slightly pruinose disc and a thin, white-pruinose, finally sometimes excluded thalline margin. Epithecium brownish; hymenium colourless, 50-70 µm high, K/I+ blue; paraphyses simple, not markedly capitate; hypothecium colourless, 110-140 µm high. Ascospores 1-septate, narrowly ellipsoid to almost acicular, sometimes slightly curved, (10-)12-17(-20) × 2.5-5 µm. Spot tests: thallus K-, C-, KC-, P-, UV+ greenish grey; medulla P+ orange-red. Chemistry: medulla with pannarin and zeorin (both major).

Note: a Mediterranean-Atlantic, to mild-temperate species found on calcareous rocks, most often on horizontal faces. Widespread throughout Italy (Fig. 1a), with optimum below the montane belt; more heliophilous in northern than in southern Italy, where it often occurs in sheltered situations.

Solenopsora cesatii (A. Massal.) Zahlbr.

Österr. bot. Z., 68: 303, 1919. Basionym: *Ricasolia cesatii* A. Massal., Mem. Lichenogr.: 47, 1853.

Synonyms: *Berengeria cesatii* (A. Massal.) Trevis.; *Diphratora cesatii* (A. Massal.) Jatta; *Lecania cesatii* (A. Massal.) Bagl.; *Placolecania cesatii* (A. Massal.) Zahlbr.; *Solenopsora carpatica* Pišút & Vězda

Description: Thallus crustose-placodioid, epilithic, blue-grey to grey when dry, bright green when wet, often white-pruinose in marginal parts, forming either single rosettes (up to 2 cm across) or concentric radiating circles or arcs (up to 15 cm across), squamulose-lobulate in central parts, irregularly lobed at margins. Lobes 0.4-0.8 mm wide, flat to usually slightly convex, undulate, folded and crisped, with round, entire margins. Apothecia sessile, 0.5-1.5(-3) mm across, with a dark brown to black, sometimes pruinose disc and a persistent thalline margin. Epithecium brownish; hymenium colourless, K/I+ blue, 40-60 µm high; paraphyses simple, coherent; hypothecium colourless, 100-110 µm high. Ascospores (0-)1-septate, narrowly ellipsoid, (7-)8-11 × 2.5-4 µm. Spot tests: thallus C-, K-, KC-, P-; medulla P+ orange-red. Chemistry: medulla with pannarin and zeorin (both major), plus minor unidentified substances.

Note: a lichen with optimum in the submediterranean belt, found in fissures of calcareous boulders in rather sheltered situations. Widespread throughout Italy (to be looked for in Umbria), but most frequent outside the Tyrrhenian ecoregion (Fig. 1b).

Solenopsora grisea (Bagl.) Kotlov

Nov. Sist. Niz. Rast., 37: 251, 2004. Basionym: *Ricasolia cesatii* var. *grisea* Bagl., Comm. Soc. Critt. Ital., 1, 3: 121, 1862.

Synonyms: *Solenopsora bagliettoana* Tav. ined.

Description: Thallus crustose-placodioid, epilithic, forming continuous, irregular patches (up to 8-10 cm across), the central parts glaucous grey-green, the marginal lobes up to 1 mm wide, white-pruinose at margins. Central part of thallus with raised lobules producing blastidia or breaking into soralia-like structures. Apothecia infrequent, up to 1.5 mm across, with an initially flat, then strongly convex, brown, pruinose or epruinose disc, and a crenulate, but often finally excluded thalline margin. Epithecium brownish; hymenium colourless, 60-70 µm high, K/I+ blue; paraphyses simple, coherent; hypothecium colourless, 80-100 µm high. Ascospores (0-)1-septate, narrowly ellipsoid, (10-)14-18 × 2.5-4 µm. Spot tests: thallus and medulla C-, K-, KC-, P-. Chemistry: medulla with terpenoids and unidentified substances, rarely with atranorin.

Note: on calcareous rocks in open to sheltered situations. Most probably widespread throughout Italy (to be looked for in several regions), with optimum below the montane belt in the Tyrrhenian part of the country (Fig.1c). For further details see Guttová & al. (2014).

Solenopsora holophaea (Mont.) Samp.

Broteria, ser. bot., 19: 26, 1921. Basionym: *Parmelia holophaea* Mont., in Webb & Berthelot, Hist. des Iles Canaries, 3, 2, 4, 51: 113, 1840.

Synonyms: *Lecania holophaea* (Mont.) A. L. Sm.; *Lecania requienii* (A. Massal.) Zahlbr.; *Lecanora holophaea* (Mont.) Nyl.; *Massalongia requienii* (A. Massal.) Jatta; *Pannaria holophaea* (Mont.) B. de Lesd.; *Solenopsora requienii* A. Massal.; *Thalloidima holophaeum* (Mont.) Arnold

Description: Thallus squamulose, olive-green to olive-brown, epruinose, rather glossy. Squamules 1-3 mm wide, rounded, concave to flat, contiguous or imbricate, with entire to crenulate or flexuose, raised margins; lower surface somewhat paler, attached by sparse, mostly centrally located, pale rhizines. Upper cortex of anticlinally oriented, gelatinized hyphae; medulla white. Apothecia 0.5-1.5 mm across, sessile to shortly stipitate, with a dark brown to blackish, flat disc, and a smooth, finally sometimes excluded thalline margin. Epithecium reddish brown; hymenium colourless or pale reddish brown, 50-60 µm high, I+ blue; paraphyses coherent, swollen at apices; hypothecium colourless or pale brown, 130-140 µm high. Ascospores 1-septate, ellipsoid-elongate to slightly fusiform, 11-18(-24) × 4-5(-6) µm. Spot tests: thallus and medulla K-, C-, KC-, P-, UV-. Chemistry: terpenoids, unidentified substances.

Note: a Mediterranean-Atlantic lichen found in sheltered crevices of basic siliceous rocks and on soil, especially along the coast; rare, and exclusively Tyrrhenian in Italy, to be looked for in Latium (Fig. 1d).

Solenopsora liparina (Nyl.) Zahlbr.

Öst. bot. Z., 68: 304, 1919. Basionym: *Lecanora liparina* Nyl., Flora, 59: 305, 1876.

Synonyms: *Ricasolia cesatii* var. *olivacea* Bagl.; *Ricasolia liparina* (Nyl.) Flagey; *Solenopsora cesatii* f. *liparina* (Nyl.) Clauzade & Cl. Roux

Description: Thallus crustose-placodioid, epilithic, forming up to 2.5 cm wide, orbicular rosettes, the central parts sometimes falling off, leaving semicircular arcs of lobes. Lobes 0.3-0.6 mm wide, flat to slightly convex, olivaceous grey or grey-green, with rounded, white-pruinose ends. Apothecia sessile, to 1 mm across, with a brown, bluish-white-pruinose disc, and a smooth to scabrid, persistent to finally excluded thalline margin. Epithecium brown, granular, the granules not dissolving in K; hymenium colourless, 60-70 µm high; paraphyses coherent, swollen at apices; hypothecium colourless, 80-90 µm high. Ascospores 1-septate, hyaline, straight or slightly curved, 13-16× 3-4 µm. Spot tests: thallus K-, C-, KC-, P-, UV-; medulla P+ orange-red. Chemistry: medulla with pannarin and zeorin (both major).

Note: on inclined surfaces of ultrabasic rocks (e.g. serpentine), often in fissures, in shaded situations also on vertical faces, mostly in the Mediterranean belt; so far recorded from Liguria and Tuscany (Fig. 1e).

Solenopsora marina (Zahlbr.) Zahlbr.

Cat. Lich. Univ., 5: 756, 1828. Basionym: *Placolecania marina* Zahlbr., Österr. Bot. Z., 57: 396, 1907.

Description: Thallus squamulose, pale green to glaucous green, up to 0.4 mm thick, forming rosettes or irregular patches up to 5-6 cm in diam. Outer squamules elongate, loosely attached by sparse rhizines, flexuose, folded, with white-pruinose margins; central parts of thallus crustose-areolate. Upper cortex paraplectenchymatous 40-50 µm thick; medulla white. Apothecia sessile, up to 0.5(-1) mm across, with a brownish, initially flat, finally strongly convex disc, and a thin, often white-pruinose, finally excluded thalline margin. Proper exciple of radially arranged hyphae; epithecium brownish; hymenium colourless, 60-90 µm high; paraphyses filiform, conglutinated, mostly simple; hypothecium colourless, 90-100 µm high. Ascospores 1-septate, hyaline, narrowly ellipsoid to fusiform, 9-16 × 3-3.5 µm. Pycnidia black, immersed. Conidia hyaline, simple, bacilliform, 3.5-4,5 × 0.5-1 µm. Spot tests: medulla K- C- , KC-, P-. Chemistry: different terpenoids and unidentified substances.

Note: on calcareous substrata, mostly in rock fissures and in humid and shaded situations in the Mediterranean belt; so far reported only from Tuscany and Basilicata (Fig. 1f), also known from e. g. the Dalmatian coasts, Turkey, Eastern Mediterranean (Jordan), and from the Ukraine (Guttová & al. 2019).

Solenopsora olivacea (Fr.) H. Kilias subsp. ***olivacea***

Herzogia, 5: 399, 1981. Basionym: *Biatora olivacea* Dufour ex Fr., Syst. Orb. Veget., 1: 285, 1825.

Synonyms: *Biatorina michelettiana* A. Massal.; *Biatorina olivacea* (Fr.) Anzi; *Catillaria olivacea* (Fr.) Zahlbr.; *Lecanora olivacea* (Fr.) Nyl.; *Placodiella olivacea* (Fr.) Szatala; *Ricasolia olivacea* (Fr.) Bagl.; *Toninia olivacea* (Fr.) Clauzade

Description: Thallus crustose, epilithic, brown-green to olive-green, epruinose, forming irregular, sometimes confluent, up to 10 cm wide patches, the central part often warted-areolate, the marginal part often lobulate, the lobes usually short and flat, sometimes not well developed. Apothecia sessile, 0.3-0.5(-0.8) mm across, with a pale to dark brown, flat to finally convex disc and a thin, poorly visible and often finally excluded thalline margin. Epithecium

colourless to pale brown; hymenium colourless, 35-40 µm high: paraphyses coherent, simple, clavate; hypothecium colourless, 50-90 µm high. Ascospores 1-septate, narrowly ellipsoid with rounded ends, (10-)12.16×2.5-4 µm. Pycnidia immersed in the thallus. Conidia bacilliform, 3.5-4.5×0.5-0.9 µm. Spot tests: thallus K-, C-, KC-, P-; medulla P+ orange-red. Chemistry: medulla with pannarin and zeorin (both major).

Note: a Mediterranean species found on calcareous rocks, especially in open woodlands, with optimum below the montane belt in the Tyrrhenian part of the country (Fig. 1g).

Solenopsora olivacea subsp. ***olbiensis*** (Nyl.) Clauzade & Cl. Roux

in Roux, Bull. Soc. Bot. Centre-Ouest, n. sér. 13: 226, 1982. Basionym: *Lecanora olbiensis* Nyl., Flora, 59: 306, 1876.

Synonyms: *Catillaria olivacea* var. *soredifera* Zahlbr.; *Toninia olivacea* var. *olbiensis* (Nyl.) Clauzade

Description: Thallus crustose, episubstratic, sorediate, green, brown-green, epruinose, forming irregular, sometimes confluent, up to 10 cm wide patches, the central part often warted-areolate, the marginal part often lobulate, with short, sometimes not well-developed lobes. Soralia laminal, round, excavate, pale green, turning yellowish in the herbarium. Apothecia usually absent. Spot tests: thallus K-, C-, KC-, P-; medulla P+ orange-red. Chemistry: medulla with pannarin and zeorin (both major).

Note: on calcareous rocks, often associated with the typical subspecies, but rarer, and bound to more humid and shaded situations, with optimum below the montane belt in the Tyrrhenian part of the country (Fig. 1h).

Solenopsora vulturiensis A. Massal.

Lotos, 6: 75, 1856.

Synonyms: *Lecania holophaea* var. *glaucospora* (Nyl.) A.L. Sm.; *Lecania leucospeirea* (Nyl.) A.L. Sm.; *Lecanora holophaea* var. *glaucospora* Nyl.; *Lecanora leucospeirea* Nyl.; *Lecanora subdisparata* Nyl.; *Solenopsora leucospeirea* (Nyl.) Zahlbr.; *Solenopsora subdisparata* (Nyl.) Samp.; *Thalloidima leucospeireum* (Nyl.) Arnold

Description: Thallus crustose-subsquamulose, epilithic, pale grey to olive-grey, sorediate-blastidiate, consisting of single, crowded or scattered, rarely radiating, 0.2-0.5 mm wide, squamule-like lobules with white-pruinose margins, forming irregular patches; central lobules raised and subcoralloid (1-3 mm high) when producing blastidia, apically breaking into soralia-like structures; peripheral lobules adpressed and the whole finally appearing as a subleprose crust. Apothecia rare, 0.3-0.6 mm across, with an epruinose to faintly pruinose, pinkish brown to finally brown-black, flat to convex disc, and a crenulate, finally often excluded thalline margin. Epithecium brown or reddish brown; hymenium colourless, 50-60 µm high; paraphyses mostly simple, 1.5-2 µm thick, the apical cells 4-5 µm wide, often with an internal brown cap; hypothecium colourless to orange-brown, 80-110 µm high. Ascospores at first 1-celled, later 1-septate, hyaline, ellipsoid, 9-11(-14) × 4-5(-6) µm. Spot tests: thallus K+ faintly yellow, C-, KC+ faintly yellow, P- or P+ yellow-orange, UV-. Chemistry: terpenoids, unidentified substances, occasionally atranorin in low quantities,

Note: a Mediterranean-Atlantic lichen found on basic siliceous substrata, including brick walls, in open to most often sheltered situations; so far reported only from Tyrrhenian Italy (Fig. 1i).

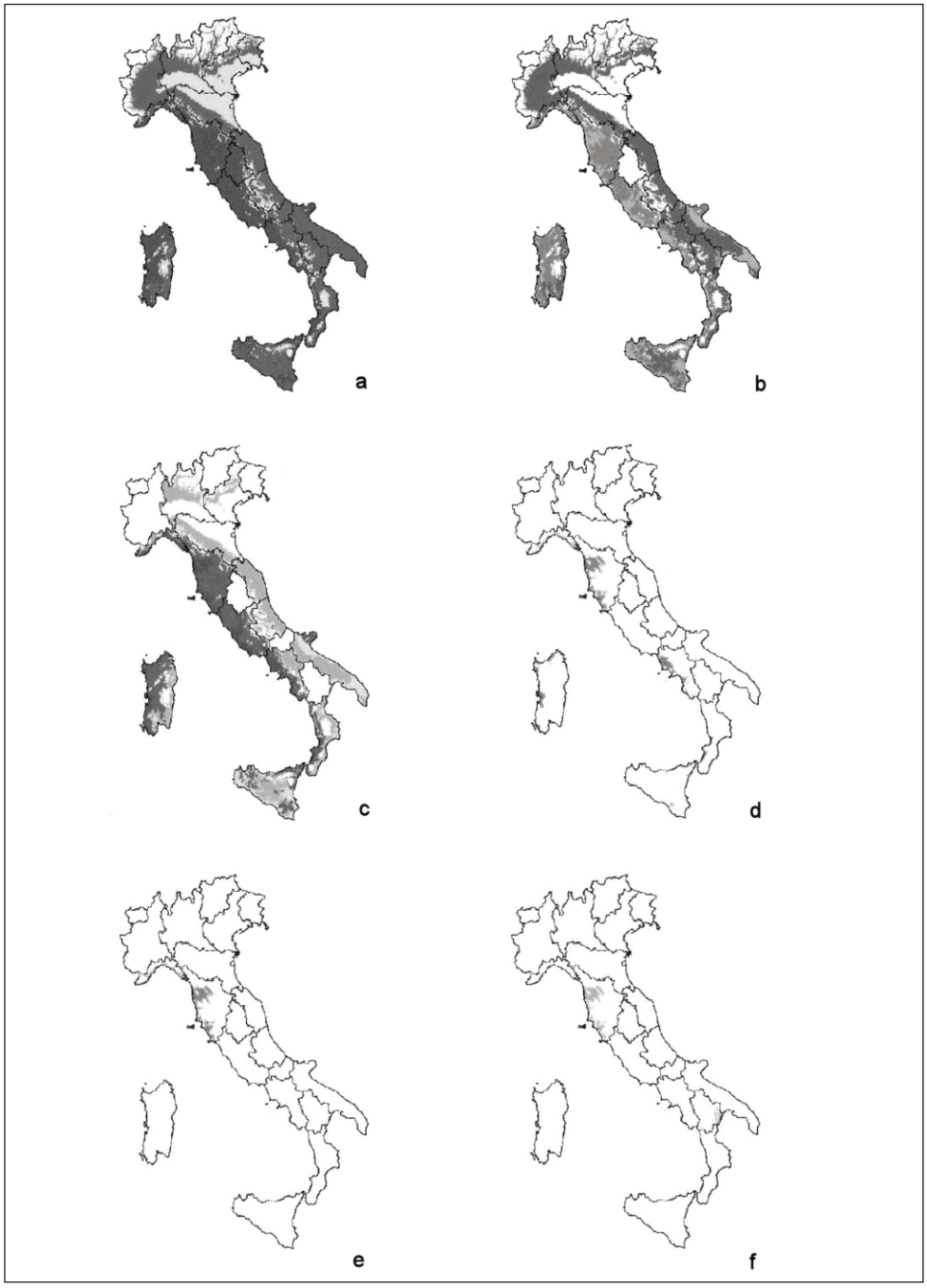

Fig. 1. Predictive distribution maps of the infrageneric taxa of *Solenopsora* occurring in Italy: a) *S. candicans*, b) *S. cesatii*, c) *S. grisea*, d) *S. holophaea*, e) *S. liparina*, f) *S. marina*.

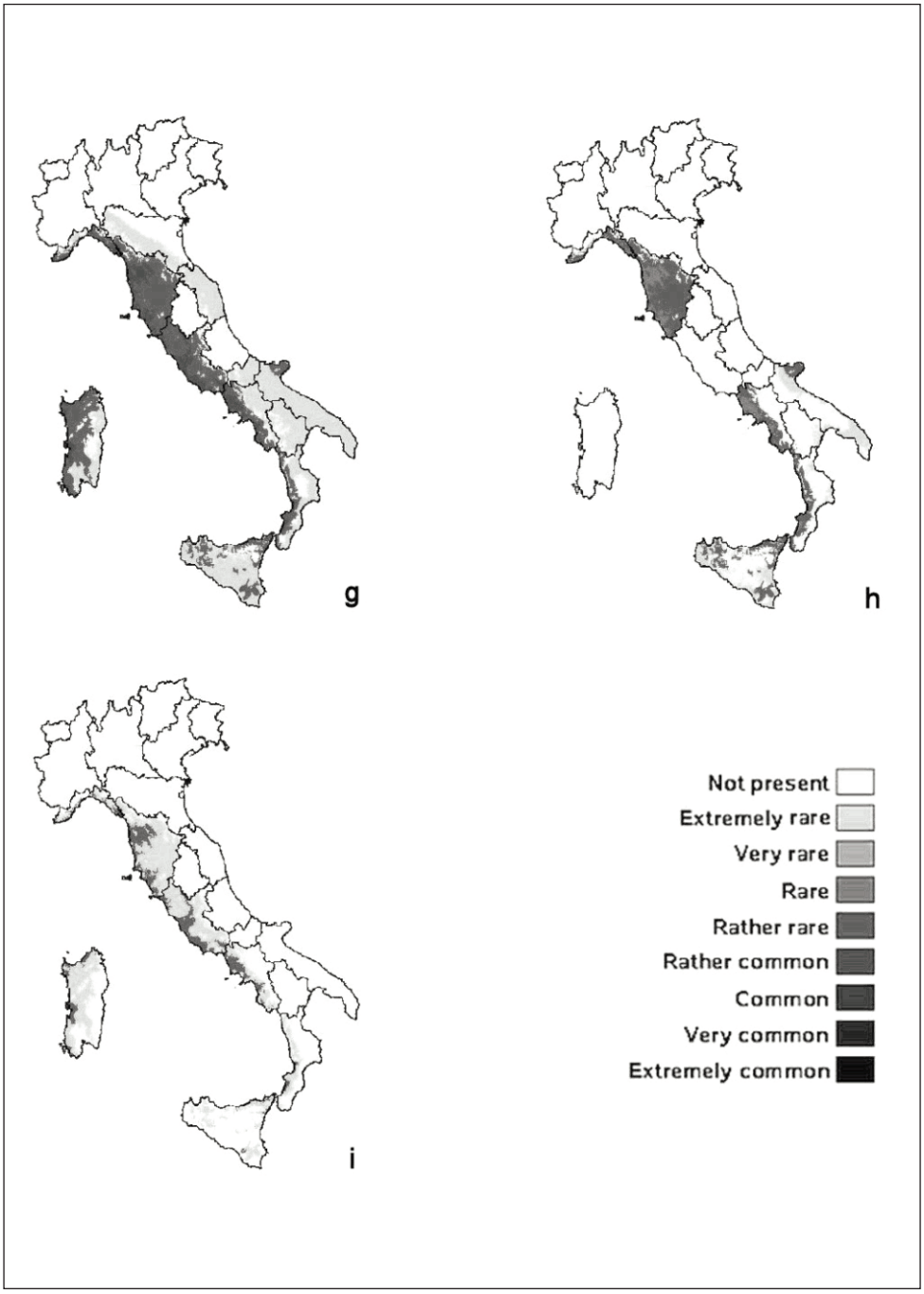

Fig. 1. (Continuation). Predictive distribution maps of the infrageneric taxa of *Solenopsora* occurring in Italy: g) *S. olivacea* subsp. *olivacea*, h) *S. olivacea* subsp. *olbiensis*, i) *S. vulturiensis*.

Dichotomous key

1. Soredia or blastidia present. Apothecia rare ***2***
1. Soredia or blastidia absent. Apothecia usually abundant ***4***
2. On siliceous substrata, central lobules raised and subcoralloid (1-3 mm high) when producing blastidia, apically breaking into soralia-like structures; peripheral lobules adpressed ..... ***S. vulturiensis***
2. On calcareous substrata. Thallus different ***3***
3. Thallus indistinctly placodioid, epruinose. In humid, sheltered situations ***S. olivacea* subsp. *olbiensis***
3. Thallus distinctly placodioid, the margin of lobes white-pruinose. In both open/sunny and sheltered situations .....***S. grisea***
4. Thallus squamulose to subfoliose, greenish or brown ***5***
4. Thallus crustose-placodioid, white to grey, rarely greenish- brown ***6***
5. Squamules pale greenish to glaucous green, not glossy, white-pruinose at margins. Upper cortex paraplectenchymatous. Apothecia pale/medium brown, sessile, with a finally convex disc. On calcareous substrata in humid-sheltered situations ***S. marina***
5. Squamules red-brown to greenish brown, glossy, epruinose, with rounded, entire margins. Upper cortex of anticlinally oriented, gelatinized hyphae. Apothecia dark red-brown to blackish, with a flat disc. On basic siliceous substrata in open situations ***S. holophaea***
6. On ultrabasic rocks (e.g. serpentine) ..... ***S. liparina***
6. On calcareous rocks *7*
7. Thallus not placodioid, brown-green to olive-green, epruinose ***S. olivacea* subsp. *olivacea***
7. Thallus placodioid, white to pale grey, at least in part white-pruinose ***8***
8. Thallus blue-grey, white-pruinose only in marginal parts, forming either single rosettes (up to 2 cm across) or concentric radiating circles or arcs (up to 15 cm across), with undulate, folded-crisped lobes. Mostly in sheltered situations ..... ***S. cesatii***
8. Thallus entirely white-pruinose, chalk-white, forming single rosettes (up to 5 cm across), with flattened, closely adpressed, isotomically branched lobes. In both exposed and sheltered situations ..... ***S. candicans***

Discussion

All of the 9 infrageneric taxa of *Solenopsora* known to occur in Europe are present in Italy. All of them are saxicolous, one being specialized on ultrabasic rocks such as serpentine (*S. liparina*), two growing on siliceous rocks (*S. holophaea*, *S. vulturiensis*), the others on calcareous rocks. Their relative commonness/rarity was assessed from the total number of literature references (from Nimis 1993, 2016), and of Italian herbarium samples revised by Guttová & al. (2019). Out of a total of 339 citations and 236 herbarium samples, the species can be ranked, in order of decreasing commonness, as follows (number of citations/number of TSB samples): *S. candicans* (118/73), *S. cesatii* (68/40), *S. olivacea* subsp.

olivacea (51/33), *S. grisea* (33/33), *S. holophaea* (29/17), *S. vulturiensis* (20/18), *S. olivacea* subsp. *olbiensis* (13/11), *S. liparina* (4/10), *S. marina* (3/1). The most commonly collected/recorded species are those which are not restricted to the eu-Mediterranean belt, the rarer species are strictly Mediterranean and often coastal, or, as in the case of *S. liparina*, restricted to a rather rare type of rocks (ultrabasic siliceous rocks). The species of *Solenopsora* have a remarkable similarity in their climatic requirements, with more specific requirements in terms of microclimate. All of them have the optima below the montane belt; only *S. candicans*, *S. cesatii* and *S. grisea* occasionally occur above 1.000 m. Furthermore, 75% of the total number of citations, and 73% of herbarium samples are from administrative regions facing the Thyrrenian sea, the majority of species being most frequent in Thyrrenian Italy, an ecoregion characterized by a milder, more suboceanic climate than the one prevalent in northern Italy and along the Adriatic side of the Peninsula at comparable altitudes (the most relevant exception being *S. cesatii*, which is most frequent outside Tyrrhenian Italy). This agrees well with the model based on climatic and geological data developed by Guttová & al. (2019), suggesting that the occurrence of *Solenopsora*-taxa seems to be mainly governed by low variability in diurnal temperature and tolerance to dryness, with precipitation in the range of 0–20 mm in the driest month and a minimum temperature of >5 °C in the coldest month. The predictive distribution maps of Fig.1 also highlight exploration bias, as most of the taxa are undercollected. Further sampling will contribute to a better knowledge of the geographic as well as climatic areas occupied by these taxa in Italy.

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References

Fačkovcová, Z., Lőkös, L., Farkas, E. & Guttová, A. 2019: New Records of Species of the Lichen Genus *Solenopsora* A. Massal. in the Balkan Peninsula and Adjacent Islands. – Herzogia **32:** 101-110. https://doi.org/10.13158/heia.32.1.2019.101

—, Slovák, M., Vďačný, P., Melichárková, A., Zozomová-Lihová, J. & Guttová, A. 2020: Spatio-temporal formation of the genetic diversity in the Mediterranean dwelling lichen during the Neogene and Quaternary epochs. – Molec Phylog. Evol. **44**. https://doi.org/10.1016/j.ympev.2019.106704

Guttová, A., Sosomová-Lihová, J., Timdal, E., Kučera, J., Slovák, M., Piknová, K. & Paoli, L. 2014: First insights into genetic diversity and relationships of European taxa of *Solenopsora* (*Catillariaceae*, Ascomycota) with implications for their delimitation. – Bot. J. Linn. Soc. **176:** 203-223. https://doi.org/10.1111/boj.12200

—, Fačkovcová, Z., Martellos, S., Paoli, L., Munzi, S., Pittao, E. & Ongaro, S. 2019: Ecological specialization of lichen congeners with a strong link to Mediterranean-type climate: a case study of the genus *Solenopsora* in the Apennine Peninsula. – Lichenologist **51:** 75-88. https://doi.org/10.1017/s0024282918000543

Martellos, S. 2010: Multi-authored interactive identification keys: The FRIDA (Friendly IDentificAtion) package. – Taxon **59:** 922-929. https://doi.org/10.1002/tax.593020

— 2012: From a textual checklist to an information system: The case study of ITALIC, the Information System on Italian Lichens. – Pl. Biosyst. **146:** 764-770. https://doi.org/10.1080/11263504.2012.740088
— & Nimis, P. L. 2015: From Local Checklists to Online Identification Portals: A Case Study on Vascular Plants. – plosOne **103:** 1-18.
—, d'Agostino, M., Chiarucci, A., Nimis, P. L., & Nascimbene, J. 2020: Lichen distribution patterns in the ecoregions of Italy. – Diversity **12:** 1-21. https://doi.org/10.3390/d12080294
Miadlikowska, J., Kauff, F., Högnabba, F., Oliver, J. C., Molnár, K., Fraker, E., Gaya, E., Hafellner, J., Hofstetter, V., Gueidan, C., Otálora, M. A. G., Hodkinson, B., Kukwa, M., Lücking, R., Björk, C., Sipman, H. J. M., Burgaz, A. R., Thell, A., Passo, A., Myllys, L., Goward, T., Fernández-Brime, S., Hestmark, G., Lendemer, J., Lumbsch, H. T., Schmull, M., Schoch, C. L. Sérusiaux, E., Maddison, D. R., Arnold, A. E., Lutzoni, F., Stenroos, S. 2014: A multigene phylogenetic synthesis for the class Lecanoromycetes (Ascomycota): 1307 fungi representing 1139 infrageneric taxa, 317 genera and 66 families. – Mol. Phylogenet. Evol. **79:** 132-168. https://doi.org/10.1016/j.ympev.2014.04.003
Nimis, P. L. 1993: The Lichens of Italy. An Annotated Catalogue. – Mus. Reg. Sci. Nat. Torino, Monogr. XII, 897 pp.
— 2016: The Lichens of Italy. A Second Annotated Catalogue. – Trieste.
— 2021: The lichens of Northern Italy. An interactive guide. – Continuously updated online at: http://italic.units.it/flora/index.php?procedure=ext_key_home&key_id=241 [Last accessed 23/3/2021].
— & Martellos, S. 2002: ITALIC, the information system on Italian lichens. – Bibl. Lichenol. **82:** 271-823.
— & — 2020: Towards a digital key to the lichens of Italy. – Symbiosis **82:** 149-155.
— & Tretiach, M. 1995: The lichens of Italy. A phytoclimatic outline. – Crypt. Bot. **5:** 199-208.
— & — 2004: Delimiting Tyrrhenian Italy: A lichen foray in the SW of the peninsula. – Bibl. Lichenol. **88:** 456-478.
—, Martellos, S., Spitale, D. & Nascimbene, J. 2018: Exploring patterns of commonness and rarity in lichens: a case study from Italy (Southern Europe). – Lichenologist **50:** 385-396. https://doi.org/10.1017/s0024282917000731

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