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Dedicated to Clifford M. Wetmore,
University of Minnesota, U.S.A.
To him I owe my appreciation
of lichen taxonomy.

A REVISION OF THE *LECANORA DISPERSA* COMPLEX IN NORTH AMERICA

LUCYNA ŚLIWA

Abstract. The *Lecanora dispersa* group in North America is revised based on about 1900 specimens from 25 herbaria. The following 19 species are recognized in the study area: *Lecanora agardhiana* Ach., *L. albescens* (Hoffm.) Flörke, *L.* cf. *andrewii* B. de Lesd., *L. crenulata* Hook., *L. dispersa* (Pers.) Sommerf., *L. flowersiana* H. Magn., *L. fugiens* Nyl., *L. hagenii* (Ach.) Ach., *L. invadens* H. Magn., *L. juniperina* Śliwa, *L. percrenata* H. Magn., *L. perpruinosa* Fröberg, *L. persimilis* (Th. Fr.) Nyl., *L. salina* H. Magn., *L. sambuci* (Pers.) Nyl., *L. semipallida* H. Magn., *L. torrida* Vain., *L. wetmorei* Śliwa, and *L. zosterae* (Ach.) Nyl. The morphology, anatomy, lichen products, and ecology of the species are discussed. Based on the combinations of morphological, anatomical and chemical characters, four distinctive subgroups of species are identified: *L. dispersa* s.str. gr., *L. semipallida* gr., *L. crenulata* gr., and *L. hagenii* gr. A key for the identification of the species is provided, and all species are illustrated. The North American species have varied distribution patterns, which are illustrated on maps. The taxa differ also in frequency: common species including *L. dispersa*, *L. semipallida* and *L. hagenii*; frequent species but with limited distributional ranges such as *L. flowersiana*, *L. wetmorei*, and *L. zosterae*; relatively rare species including *L. albescens*, and *L. fugiens*; and taxa known only from a single locality, such as *L. agardhiana*, *L. perpruinosa*, and *L. salina*. Seven of the species are reported for the first time from the continent: *L. agardhiana*, *L.* cf. *andrewii*, *L. fugiens*, *L. invadens*, *L. percrenata*, *L. perpruinosa*, and *L. semipallida*. Nomenclatural and taxonomic clarifications include the typification of *L. crenulata*, *L. persimilis*, and *L. sambuci*, and the synonymy of *L. turbinata* Poelt & Leuckert with *L. zosterae* var. *beringii*. Two new combinations are made: *L. zosterae* var. *beringii* (Nyl.) Śliwa *comb. nov.* (= *L. beringii*) and *L. zosterae* var. *palanderi* (Vain.) Śliwa *comb. nov.* (= *L. palanderi*). Moreover, *Lecanora elenkinii* Mereschk., *L. flotoviana* Spreng., *L. thallophila* H. Magn., and *L. utahensis* H. Magn., which at first were considered members of the group, were excluded from the study as they proved not to be related.

Key words: *Ascomycota*, *Lecanorales*, lichens, taxonomy, nomenclature, key, distribution, new records, Canada, Mexico, United States

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INTRODUCTION

The *Lecanora dispersa* complex is characterized by thalli that are generally immersed in rock (endolithic) or bark (endophloedal) but are superficial in rare cases, apothecia with a mostly white thalline margin, and either with xanthones or lichen products not being detectable. The group is considered to be the most difficult for taxonomic study in the large genus *Lecanora* (Laundon 2003).

The present treatment was initiated as a revision of the North American collections of the group in an effort to assess the species diversity of these lichens on that continent. Previously, only a few members of the complex had been reported from the U.S.A. and Canada. Fink (1935) reported three species from the U.S.A., *L. dispersa*, *L. hagenii*, and *L. sambuci*, whereas in the sixth checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada (Esslinger & Egan 1995) ten species were listed: *L. albescens*, *L. beringii*, *L. crenulata*, *L. dispersa*, *L. hagenii*, *L. persimilis*, *L. salina*, *L. sambuci*, *L. torrida*, and *L. zosterae*.

During the course of this study, it became clear that a thorough examination of the taxonomy and nomenclature of the entire group was necessary, and as a result many discoveries and novel observations were made.

The group proved extremely difficult for study as many characters considered diagnostic in previous studies of other *Lecanora* groups were found to be highly variable, particularly with respect to ecological conditions. The species exhibit considerable intraspecific variability. On the other hand, the differences between species are subtle or difficult to observe if one is not familiar with the taxa. Therefore, a particular effort was made to assess the characters of greatest taxonomic value. As a result, the following features were taken into particular consideration in this revision: thallus and apothecia morphology, apothecial anatomy, pycnidia and conidia, lichen products, ecology, and distribution.

Nevertheless, many problems remain to be resolved in the *L. dispersa* complex in North America, and much is yet to be learnt about the complex in other continents. This revision is intended as a contribution to the ongoing struggle with the taxonomy of this common yet so difficult species complex.

PREVIOUS INVESTIGATIONS

TAXONOMY

The first attempt towards the modern taxonomy of the complex was that of Poelt *et al*. (1995), which concerning saxicolous species of the eastern Alps. These authors circumscribed and illustrated a number of species based on combinations of anatomical and chemical characters. They also provided a useful key to aid species identification and recognized 11 species in the region: *L. agardhiana*, *L. albescens*, *L. crenulata*, *L. dispersa*, *L. flotoviana*, *L. perpruinosa*, *L.* '*roridula*', *L. torrida*, *L. turbinata*, *L. xanthostoma*, and *L. eurycarpa* (unrelated to the group). Poelt *et al*. (1995) brought the knowledge of the complex up to date, and their treatment served as an excellent basis for discussing the North American species. Those authors, however, did not refer to type or original

collections, and none of the names adopted were typified in the work.

Fröberg (1997) studied the species on rocks in southern Sweden, and accepted six species: *L. albescens*, *L. crenulata*, *L. dispersa*, *L. flotoviana*, *L. perpruinosa*, and *L. xanthostoma*. He validated the name *L. xanthostma*, and discussed his new species *L. perpruinosa* proposed earlier (Fröberg 1989) in more detail. However, with respect to other names he did not study the original material. Consequently, despite the progress he made in the understanding of species concepts in the group, the usage of certain names, for instance *L. flotoviana*, remained ambiguous. Moreover, both Poelt *et al*. (1995) and Fröberg (1997) pointed out some particular problems, as with the circumscription of *L. hagenii*. Additionally, there were some differences in species concepts between the two treatments, such as in the delimitation of *L. dispersa*, which have caused some further confusion.

A neglected member of the complex, *L. zosterae*, was resurrected and lectotypified in a publication on the typification of *L. subfusca*, its varieties, and some related taxa published before 1850 by Brodo and Vitikainen (1984). This species has since been more precisely circumscribed by Laundon (2003), who examined the status of the species in the British Isles. Laundon briefly discussed the whole *L. dispersa* group in this paper, and lectotypifed *L. umbrina* which he suggested should be taken up for the species previously known as *L. hagenii*.

Other observations on the *L. dispersa* complex are included in national or local biogeographical and other studies. Such observations and remarks are often a valuable source of information on members of the complex and their delimitation (e.g., Roux 1976; Clauzade & Roux 1985; Degelius 1986; Hawksworth & Dalby 1992; Nimis 1993; Nimis & Bolognini 1993; Wirth 1995; Thomson 1997; Brodo *et al*. 2001; Sérusiaux *et al*. 2003; Ryan *et al*. 2004).

Here it is worth mentioning J. Motyka's volumes devoted to the Lecanoraceae family (Motyka 1995, 1996) and supplemented by the atlas of nomenclature types in LBL-L (Motyka-Zgłobicka & Zgłobicki 2002). They were produced posthumously and have been ruled not to be used as a source of validly published names under the *Code* (Lumbsch *et al*. 1999), but the treatment may serve as a source of information on the location of some original collections as well as detailed descriptions of particular species.

In 2001–2002, I conducted research on North American collections of the complex, which were continued in 2004–2006. During this study, it became clear that a thorough examination of the taxonomy and nomenclature of all representatives of the complex was necessary. Since the majority of available names within the group of taxa are based on European collections, it was also necessary, in most cases, for material from both continents to be compared. A particular effort was made to trace available original collections to ensure that names were correctly applied; this led to some interesting discoveries.

The most significant was a reappraisal of the application and taxonomic status of two important but so far poorly understood members of the complex: *L. flotoviana* and *L. xanthostoma*. As a consequence, it was found that the true *L. flotoviana* did not belong to the *L. dispersa* complex at all, from studies of the original material discovered in GOET; *L. semipallida* was shown to be the correct name for the common, widespread member of the *L. dispersa* group to which the name *L. flotoviana* had been misapplied. Further, the recently named *L. xanthostoma* proved to be conspecific with *L. semipallida* and was reduced to synonymy with it (Śliwa 2007).

It was also critical to fix the application of the epithets of the oldest names in the complex, *L. dispersa*. and *L. albescens* (Śliwa 2006), and in addition the name *L. hagenii* was saved for usage in its current sense by conservation of the epithet with a conserved type (Śliwa & Hawskworth 2006). Specimens distributed in exsiccates were preferentially selected for typifications in these works, as that means that isotype reference material was thus made available for consultation in many institutions throughout the world.

In the course of the study, two previously unknown corticolous species of the group were

discovered, *L. juniperina* and *L. wetmorei*, and these have been formally described elsewhere (Ryan *et al*. 2004). Further results from the revision of the *L. dispersa* group in North America are presented here.

CHEMOTAXONOMY

The extracellular chemical products of species of the *Lecanora dispersa* complex have interested a few lichenologists. Pioneering chemical studies on the complex were performed by Leuckert *et al*. (1990), who examined the products of both intact thalli and pure cultures of the fungal partner. They reported production of two depsidones, pannarin and dechloropannarin, by cultures of made from single ascospores of a specimen named as *L. dispersa* which also produced a xanthone pigment as the major secondary compound. Leuckert *et al*. (1990) analysed further samples with 'the *L. dispersa* s.l. morphology' and found and characterised two chemotypes containing (1) 2,7-dichlorolichexanthone (major product), traces of cf. 2,7-dichloro-3-*O*-methylnorlichexanthone, and pannarin as an accessory of variable proportion; and (2) vinetorin (major product), chlorovinetorin, and two accessory compounds. Elix and Crook (1992), in a paper devoted to the co-occurrence of chloroxanthones in various combinations in lichens, provided a detailed list of the xanthone components of a number of species, including *L. beringii*, *L. populicola*, and *L. salina*.

Poelt *et al*. (1995) noted extensive correlations between the morphology and anatomy and the lichen products of particular members of the complex, and recognized several different chemical groups: '0', lichen substances not detected (*L. agardhiana*, *L. crenulata*, *L. perpruinosa*, *L.* '*roridula*', and *L. turbinata*); '1', vinetorin, with aotearon (*L. flotoviana*, and *L. xanthostoma*); '2', 7-chlor-3-*O*-methylnorlichexanthone, with 4,7-dichloro-3-*O*-methylnorlichexanthone (*L. flotoviana*); and '3', 2,7-dichlorolichexanthone, with ±2,7-dichloro-3-*O*-methylnorlichexanthone and ±pannarin (*L. albescens*, *L. dispersa*, and *L. torrida*). Fröberg (1997), in his treatment, distinguished ten different lichen products in *L. dispersa*, most of which remained unidentified, although it is worth mentioning he indicated eight different chemotypes within his concept of *L. flotoviana*.

MOLECULAR SYSTEMATICS

To date there are no scientific papers devoted to resolving all relationships in the *L. dispersa* complex by molecular phylogenetic methods. Judging from abstracts of symposium presentations by Guzow and Węgrzyn (1997) and Schultz *et al*. (2004), there have been some first attempts towards ascertaining phylogenetic relationships.

According to Arup and Grube (1998) the complex forms a moderately supported group with clades of lobate and usnic acid-containing *Lecanora* species (see also Grube *et al*. 2004). An interesting insight into the phylogeny of the genus is provided by Grube and Blaha (2003).

A search in the GenBank indicated that several sequences of a few members of the *L. dispersa* complex are available, obtained mostly as an effect of some broader-scope mycological/lichenological studies (Gargas & Taylor 1995; Gargas *et al*. 1995; Haugen *et al*. 2004; Arup *et al*. 2007).

MATERIAL AND METHODS

The geographical area of this study includes the continental United States of America and Canada as well as the northernmost part of Mexico. This area is referred to as North America throughout this text.

The study is based on collections named as members of the *L. dispersa* complex in the following North American herbaria: ASU, CANL, COLO, FH, NY, MICH, MIN, MSC, OMA, OSC, US, WIS, and herb. Spribille. Additionally, a considerable number of *Lecanora* names of unknown taxonomic position were investigated and their diagnoses checked for any indication they may belong to the group. As a result, types and historical materials of most of the 32 taxa mentioned in this work were located and examined, along with other reference material from many major European herbaria: B, BM, GOET, GZU, H, KRAM, L, LD, LE, M, S, UPS. In total, about 1900 specimens were examined morphologically, and most of them chemically. TLC analyses were made on representative specimens of all accepted taxa.

For light microscopy, free-hand sections were made with a razor blade and mounted in water. Tissue measurements were made in water, and ascospore measure-

ments in 25% KOH (K). Measurements are rounded to the nearest 0.5 microns, with normal extremes in parenthesis. The structure and coherency of paraphyses were also studied in K, which facilitates their separation. Granulation of tissues was observed in polarized light (pol); pol+ meaning the granules are bright in polarized light, and pol– that they are not prominent. The solubility of granules and/or crystals was tested with 25% KOH (K) and 65% nitric acid (N); these last two reagent tests were always carried out on separate cross sections.

Chemical examination included colour reactions, response to ultraviolet light (UV) and thin-layer chromatography (TLC). Spot test reactions of thalli, apothecial margins and discs were made with KOH [20–30% aqueous solution] (K), sodium hypochlorite [commercial laundry bleach] (C) and paraphenylenediamine [solution in 95% ethyl alcohol] (PD). The TLC analyses was performed in solvent system A and/or C (methods followed Orange *et al*. 2001).

Scanning electron microscopy (SEM) was applied to study the surface of the apothecial disc and to recognize features of pruina. For SEM examination, apothecia direct from herbarium specimens were affixed to an aluminium stub with double-sided transparent tape. The specimens were not critical-point dried or fixed in any other way. The stubs were sputter-coated with carbon using a CRESSINGTON sputter-coater, and viewed with a Hitachi S-4700 scanning electron microscope at 20.0 kv. Additionally, an elemental analysis of apothecial margins and discs was performed using the NORAN Vantage energy dispersive spectrometer (EDS) microanalysis system.

The terminology used in the descriptions basically follows Brodo (1984) and Purvis *et al*. (1992). Abbreviations of authors' names follow Brummitt and Powell (1992). To make specimen citations more uniform, some label data were supplemented with county information (where lacking) based on the *Citation World Atlas* (Hammond Incorporated 1984). Biogeographical terminology used throughout the text is based on Brodo *et al.* (2001).

The research was performed in the lichen laboratory and herbarium of the J. F. Bell Museum of Natural History, University of Minnesota (St Paul, U.S.A.; MIN) during the academic year 2001/02, and continued in the Laboratory of Lichenology at the W. Szafer Institute of Botany, Polish Academy of Sciences (Kraków, Poland) in 2004–2006. The SEM studies were made in the Laboratory of Field Emission Scanning Electron Microscopy and Microanalysis in the Institute of Geological Sciences, Jagiellonian University (Kraków, Poland) in 2006.

Results

Characterization of the group

Thallus morphology

In most species of the *Lecanora dispersa* group, the thallus is not visible or inconspicuous since it is entirely or partly developed within the substratum. However, there are also species with a clearly visible, crustose, superficial thallus (sometimes also evanescent). The habit of the thalli varies from indistinct, to membranaceous, through thin, crustose and ecorticate, to distinct, relatively thick, and corticate with various structures. No species have soredia or isidia.

The variations in thallus structure include a continuous, smooth or granulose to areolate-rimose crust (e.g., *L. juniperina*, *L. perpruinosa*); discontinuous and composed of more or less convex granules or areoles, clearly dispersed or aggregated (e.g., *L. fugiens*, *L. salina*); and rarely distinct rosettes (e.g., *L. albescens*). Depending on the structure of the thallus, the margin is indefinite or definite (i.e., hardly or clearly distinguishable), continuous, sometimes slightly crenulate, or indistinctly lobate. The thallus is often best-developed close to the base of apothecia or may be confined to the region under apothecia and then rarely wider than the apothecia under which they occur (e.g., *L. salina*, *L. torrida*, *L. zosterae* var. *beringii*).

A prothallus was not observed in any species except *L. fugiens*, where white dendroid hyphae arise on the edges of thallus areoles.

Thallus colour does not vary a great deal, being some shade of whitish grey to yellowish or greenish grey. The colour may also be more striking in some species, however: for example, chalk white (e.g., *L. torrida*), ash-grey (e.g., *L. perpruinosa*), or beige to yellowish brown (e.g., *L. fugiens*). A diffuse bluish pigment occurs in some species (e.g., *L. hagenii*, *L. invadens*), and in others the surface is slightly to moderately pruinose (e.g., *L. albescens*).

Apothecial morphology

All species in the *Lecanora dispersa* group have well-developed lecanorine apothecia, with the exception of *L. agardhiana*, which may also

produce lecideine apothecia (*L. agardhiana* subsp. *sapaudica* var. *lecidella* (Poelt) Leuckert & Poelt; Poelt *et al*. 1995) and *L. persimilis*, in which the apothecia are often biatorine. Apothecial size is generally 0.3–1.2 mm diam., but the apothecia of some species do not exceed 0.6 mm (e.g., *L. sambuci*) or 0.8 mm (e.g., *L. fugiens*), and those of *L. albescens*, *L. semipallida*, *L. zosterae* and *L. wetmorei* commonly reach 1.4 mm; moreover *L. zosterae* can reach 3.5 mm diam. The apothecia may occur singly, in which case they are often evenly distributed or clustered in groups. *Lecanora fugiens* has, for instance, apothecia arising singly on a discrete, single areole of the thallus, whereas those of *L. zosterae* var. *berhingii* or *L. persimilis* often arise in groups of 2–3. In most taxa the apothecia are sessile, but in some the apothecia are adnate or immersed either in the substratum or thallus areoles. The fruit bodies of *L. agardhiana* are whole or partly immersed into the substratum, while those of *L. torrida* are clustered in groups of 2–3 and widely sessile or immersed in single areoles of the thallus. In some species the apothecia are distinctly constricted at the base, as in *L. zosterae* var. *berhingii*, in which they are raised on a short stipe, and *L. zosterae* var. *zosterae* with peltate apothecia which are apparently adnate but actually narrowly attached at the base and constricted. Several species have apothecia, some of which are constricted and some of which are sessile (e.g., *L. albescens*, *L. semipallida*).

The discs of the apothecia of most species are more or less flat (Fig. 1), but may also be concave and cup-like. They are generally regular in outline, but may became flexuose (Fig. 2), especially when crowded.

Apothecial margins, that is exciples, are predominantly persistent and usually prominent and thick. In some species the margin becomes level with the disc, thin, and very rarely almost excluded as the species matures. Sometimes, when the thalline exciple is excluded, a dark parathecial ring becomes evident (e.g., *L. torrida*). In *L. zosterae* the margin may occasionally become raised above the disc and involuted. In some specimens of several species, a heavily flexuose margin is observed, while others have an even margin (e.g., *L. semipallida*). The texture of the margin varies from predominantly smooth to rough (e.g., *L. flowersiana*) or rarely to wax-like (e.g., *L. salina*). The margins are most often white or whitish (e.g., *L. dispersa*, *L. flowersiana*, *L. hagenii*) or concolorous with the thallus (e.g., *L. albescens*, *L. salina*), or more occasionally concolorous or almost so with the disc (e.g., *L. persimilis*, some morphs of *L. dispersa*). The margin may be epruinose or slightly to moderately white pruinose. In many species the margins are uniform, but they may also be differentiated, that is concolorous with the thallus below (close to the base of the apothecia) and whitish, sometimes also apparently pruinose at the top (e.g., *L. zosterae*). In some species a bluish pigment appears on the uppermost part of the margin and they become darkened (e.g., *L. semipallida*, *L. torrida*, occasionally *L. dispersa*).

Margin morphology, and especially its crenulation, is often used to distinguish and/or characterize some species in the *L. dispersa* group. Although this character is very variable in some species, it may well define some others. To use it as a diagnostic character, however, some terminological clarification is necessary, as the term 'crenulate' is used in different ways by different authors. Here, the following distinctions are used: (i) margin entire (= continuous, Figs 3 & 4), e.g., *L. wetmorei*, *L. zosterae*, sometimes also *L. semipallida*; (ii) margin cracked (= discontinuous, fissured, Figs 5 & 6), e.g., *L. flowersiana*, *L. percrenata*; (iii) margin crenate (= undulate, with rounded marginal segments, Figs 7 & 8), e.g., *L. crenulata*, *L. juniperina*, *L. semipal-*

→

Figs 1–8. Apothecia of *Lecanora dispersa* complex members by scanning electron microscopy (SEM): 1 – flat apothecium of *L. invadens* H. Magn. (*Śliwa 1819*, KRAM); 2 – flexuose apothecium of *L. zosterae* (Ach.) Nyl. (*Scotter s.n*., CANL); 3 – apothecial margin entire, even with disc in *L. semipallida* H. Magn. (*Wetmore 13052*, KRAM); 4 – apothecial margin entire, prominent in *L. semipallida* H. Magn. (*Wetmore 13052*, KRAM); 5 – cracked apothecial margin of *L. flowersiana* H. Magn. (*Wetmore 80349*, MIN); 6 – cracked apothecial margin of *L. percrenata* H. Magn. (*Wetmore 44341*, MIN); 7 – crenate apothecial margin of *L. crenulata* Hook. (*Wetmore 14385*, KRAM); 8 – crenate apothecial margin of *L. zosterae* (Ach.) Nyl. (*Nash 41287*, ASU).


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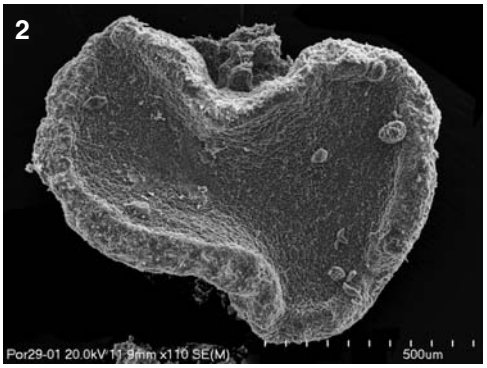
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500um


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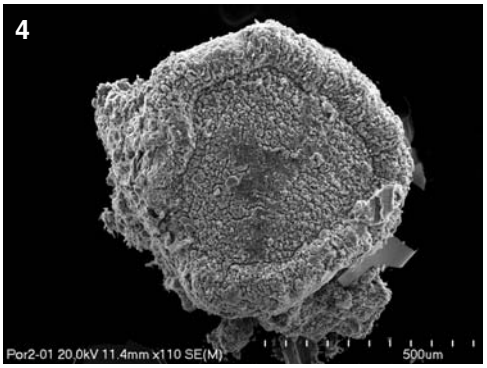
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5
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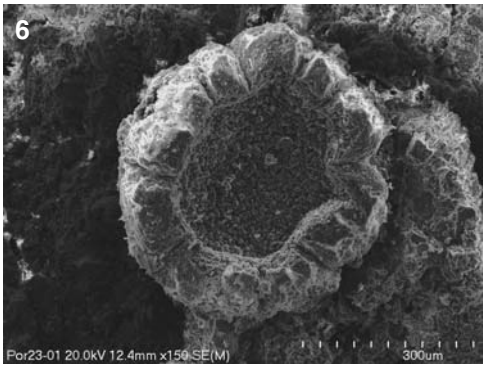
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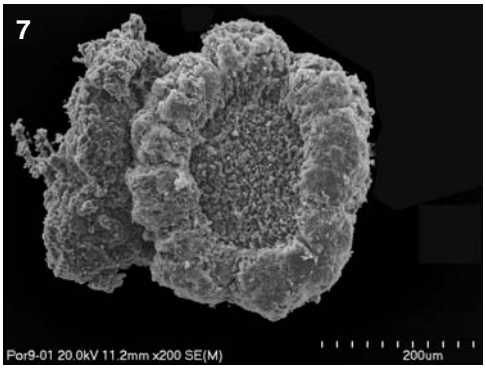
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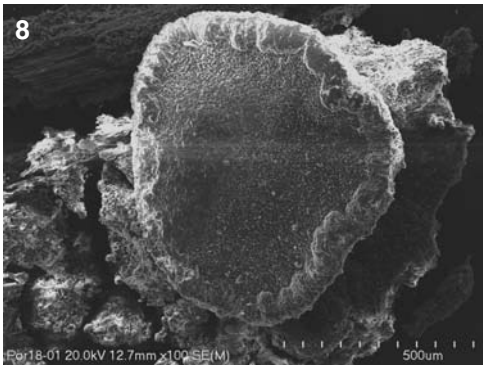
200um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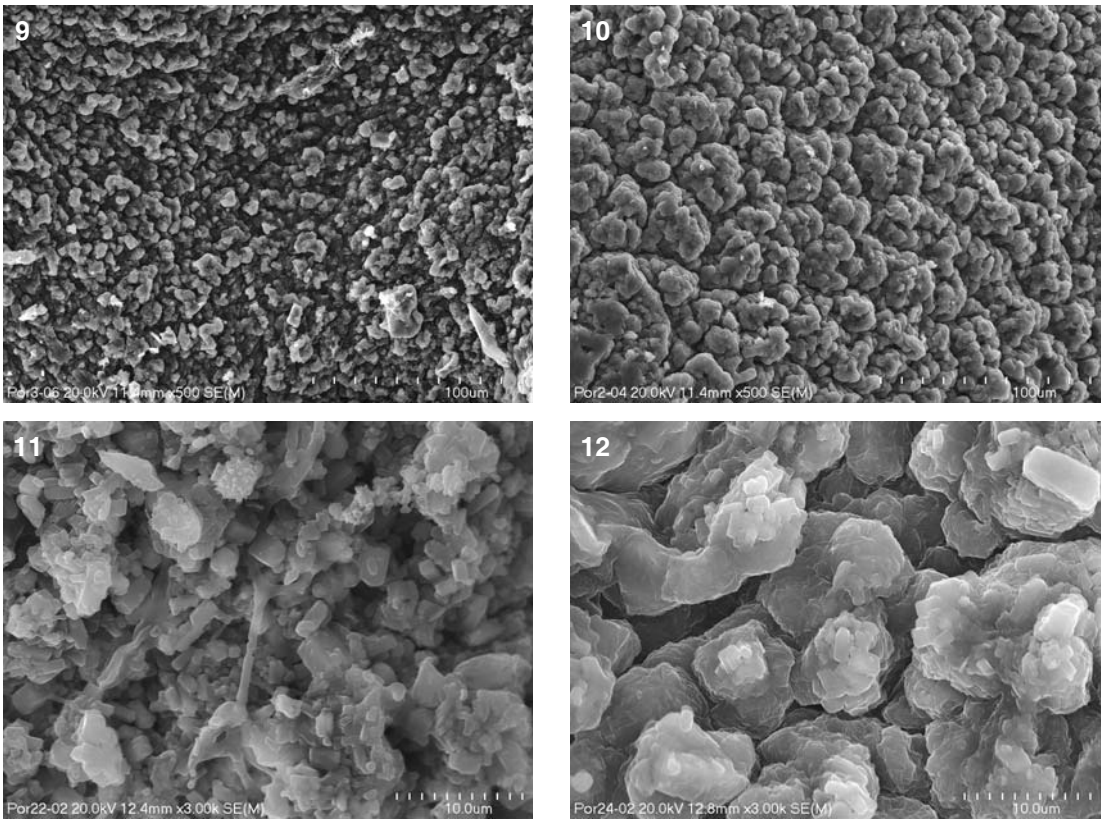
500um



Figs 9–12. Apothecial discs by scanning electron microscopy (SEM): 9 – fine granular surface of apothecial disc of *Lecanora dispersa* (Pers.) Sommerf. (*Śliwa 1510*, KRAM); 10 – coarse granular surface of apothecial disc of *L. semipallida* H. Magn. (*Wetmore 13052*, KRAM); 11 – crystals on surface of apothecial disc of *L. hagenii* (Ach.) Ach. (*Wetmore 13751*, MIN); 12 – crystals on surface of apothecial disc of *L. flowersiana* H. Magn. (*Wetmore 80349*, MIN).

lida, sometimes also *L. zosterae*; and (iv) margin incised (= dentate, with sharp marginal segments), e.g., *L. hagenii* (especially young apothecia).

The discs are predominantly plane, smooth, and without umbos, but may also be concave, and in a few species, convex. However, in *L. agardhiana* some specimens were found to be umbonate (i.e. with a sterile column in the centre of the apothecial disc). The colour of the discs varies from yellowish to pale brown, brown, reddish brown or blackish, but can also be pale greenish yellow, or yellow-orange (e.g., *L. semipallida*), orange or maroon (e.g., *L. hagenii*), chocolate brown (e.g., *L. flowersiana*), or lead-coloured (e.g., some morphs of *L. juniperina*). When infected by lichenicolous fungi, the disc may become dark brown or black in colour. Exposure to intense insolation also influences the colour of the disc, which can become darkened or blackish. The discs are bare or slightly, moderately, or heavily pruinose (scabrose to almost frosted). Pruina are characteristically present in some species and absent in others, but this feature may perhaps also be modified by habitat conditions. When abundant, the pruina may impart a somewhat plumbeous or bluish appearance of the disc (e.g., *L. invadens*, *L. perpruinosa*, *L. wetmorei*). The pruina of the apothecial discs was studied by SEM. These investigations showed, the pruinosity in most species was caused by non-crystalline, fine granular (Fig. 9) or coarse granular (Fig. 10) material. Crystalline material was observed on the disc surface of only a few species (e.g., *L. hagenii*, *L. flowersiana*) (Figs 11 & 12).

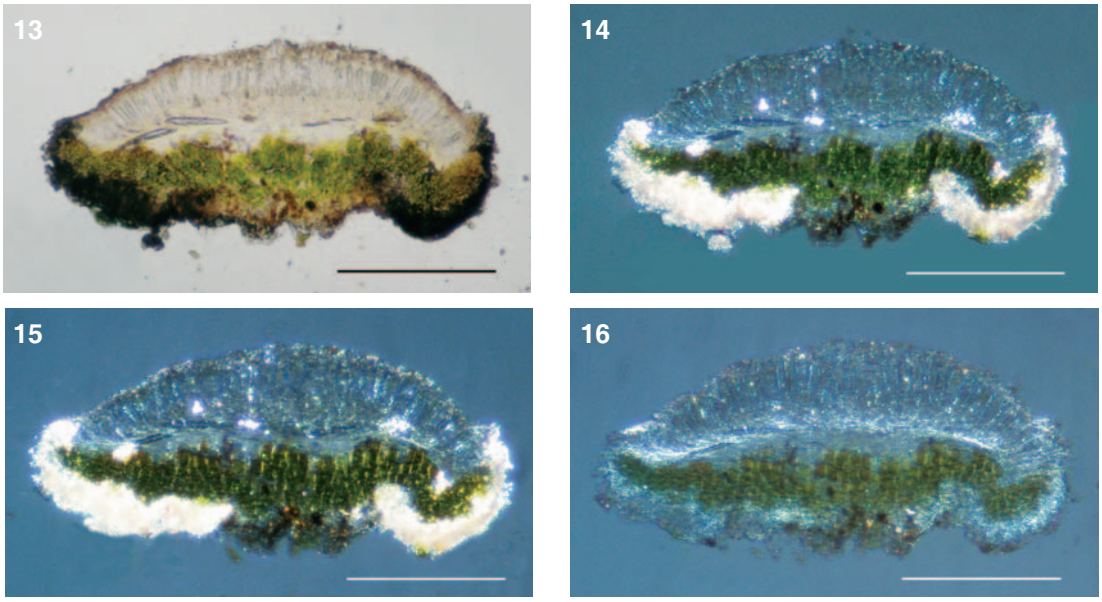
Apothecial anatomy

An amphithecium, that is, a thalline exciple, is always present, contains trebouxioid algae, and is rather thick, averaging mostly 100–200(–270) μm in height at the base of the apothecia. In a few species (e.g., *L. agardhiana*) the amphithecium may be reduced or is considerably thinner and rarely exceeds ±60 μm. The amphithecium is always corticate and the algae more or less densely fill the area below the cortex. The algal layer is most often continuous below the hypothecium, but may also be frequently discontinuous in some species (e.g., *L. dispersa*, *L. torrida*). In several species the algae tend to be clustered into groups and may also be sometimes restricted to the apothecial base (e.g., *L. agardhiana*, *L. persimilis*).

The amphithecial cortex varies from indistinctly to well delimited; however, some variation was also observed between different specimens of a single species. The cortex is characteristically thickened at the base in some species, but more or less uniform in thickness in others. The structure of the cortex is various and somewhat depends on the species, and may be composed of (i) adglutinated hyphae (sometimes apparently cellular), gelatinous, e.g., *L. dispersa*; (ii) paraplectenchyma (lumina of cells distinct, irregular), not gelatinous, e.g., *L. perpruinosa*; (iii) prosoplectenchyma (interwoven, ±regularly arranged hyphae), gelatinous, e.g., *L. semipallida*; or (iv) amorphous (cell walls and lumina indistinct), gelatinous, e.g., *L. flowersiana*, *L. zosterae*. Sometimes the structure of the cortex is hard to be define due to the presence of especially dense cortical granules. The majority of species of the *L. dispersa* group have the cortex more or less densely obscured by cortical granules, which are especially prominent in polarized light (pol+) and indicate the same solubility features; they are insoluble in K and slowly soluble in N. The abundance of the granules seems related to substratum properties. Species occurring in calcium-rich habitats have the cortex filled with the granules, which may also spread into the area below the cortex. An example of infraspecific variation in the abundance of cortical granules is *L. dispersa*, which has very abundant cortical granules when growing on calcareous rock, but much less abundant to almost absent granules in specimens originating from bark or wood. In a few species cortical granules are sparse (often located mostly in the top of the margin) or lacking (e.g., *L. hagenii*, *L. persimilis*, *L. zosterae*). In several species of the group, additional K-soluble granules occur in the amphithecial cortex (e.g., *L. salina*). In the species of the *L. dispersa* group s.str., the cortical area is also inspersed with very fine granules (the same kind as in the epithecium), which are insoluble in K and insoluble in N. These granules are best observed after application of the reagents and the disappearance of the soluble granules.

A parathecium, that is, a true exciple, is indistinct in the majority of species, but may also be well-delimited and up to 30 μm wide. A distinct parathecium, which may be narrow or wide, characteristically overlaps the amphithecium in *L. agardhiana* and *L. torrida*. A distinct prosoplectenchymatous parathecium is seen in a few species, especially *L. crenulata* and *L. semipallida*.

An epithecium (i.e., an epihymenium), the uppermost part of the hymenium and including the granules between and directly above the paraphyses, is usually coloured or rarely hyaline. It tends to be pale in some species and dark in some others, although it is probably modified by habitat conditions, especially insolation. The colour of the epithecium is most often shades of yellow or brown (e.g., *L. dispersa*, *L. hagenii*, *L. semipallida*) but may also be reddish (e.g., *L. floweriana*, *L. zosterae*) or shades of olive, green, bluish green or blackish (e.g., *L. invadens*, *L. percrenata*). The colour disappears, remains unchanged, or becomes more intense with K. It may be unchanged, turning more intense, or pink to purple in N (often part of the hymenium below also turning pink). In a few species the epithecium is deeply pigmented, and the pigment extends through up to a third of the upper hymenium (e.g., *L. flowersiana*, *L. percrenata*). The granulation of the epithecium is an important character within the *L. dispersa* complex, and its features can be used to diagnose and to distinguish species and/or species groups. Four basic types of epithecial stuctures occur in the group: (i) granular (pol+), granules superficial



Figs 13–16. Cross section of apothecium of *Lecanora dispersa* (Pers.) Sommerf. (*Wetmore 15510*, KRAM): 13 – apothecial anatomy in regular light; 14 – granulation of apothecial tissues in polarized light, with prominent cortical and epithecial granules which are inspersed through the whole hymenium; 15 – section of apothecium in polarized light after application of K (epithecial granules prominent); 16 – section of apothecium in polarized light after application of N (epithecial granules prominent; the same kind of granules visible in other parts of apothecium). Scale bars = 200 μm.

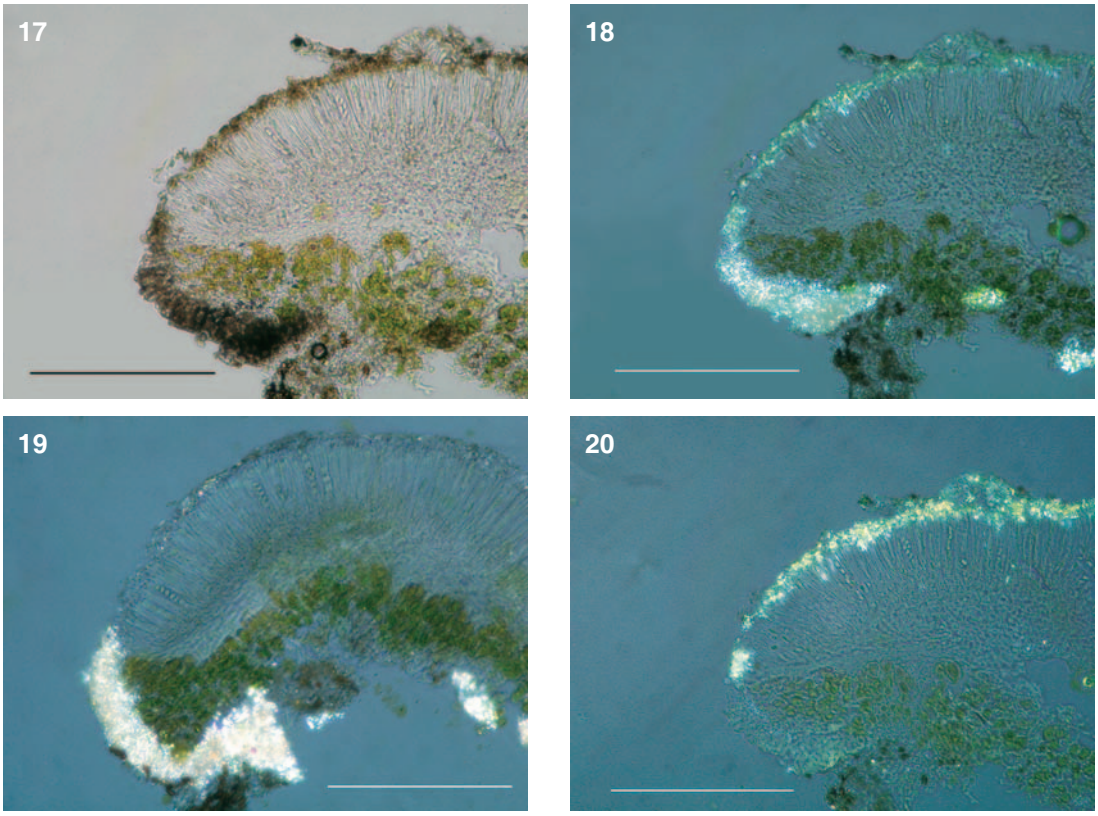
and between paraphyses tips, or also inspersed in the whole hymenium, fine, insoluble in K and insoluble in N (in some specimens the granules may partly be soluble but most remain prominent in K and prominent in N), Figs 13–16, e.g., *L. dispersa*, *L. albescens*, *L. juniperina*; (ii) granular (pol+), granules superficial and between the paraphyses tips, coarse, soluble in K and insoluble in N, Figs 17–20, e.g., *L. semipallida*, *L. fugiens*, *L. invadens*; (iii) indistinctly granular (pol±), rarely not at all granular, granules superficial, coarse, insoluble in K and soluble in N (those epithecial granules have identical features as the epipsamma usually has, see below), Figs 21–24, e.g., *L. hagenii*, *L. sambuci*; (iv) not at all granular but usually distinctly pigmented (epipsamma sometimes insoluble in N), Figs 25–26, e.g., *L. flowersiana*, *L. percrenata*.

A different situation exists in the epithecium of *L. torrida*, which is often not at all granular but shows shades of brown, or shades of olive, green or bluish (becoming more intensely green with K and turning pink or red in N). Although the epithecium itself is not at all granular, fine granules (pol+) may be interspersed through the whole hymenium and are insoluble in K and insoluble in N, as in *L. dispersa*. *Lecanora wetmorei* has a granular epithecium (pol±), with granules insoluble in K and soluble in N. In some specimens, however, additional coarse granules are present in or above the epithecium (pol+) which are soluble in K but insoluble in N. *Lecanora zosterae* usually has an epithecium that is not at all granular, but it may very rarely be granular (pol+) with granules soluble in K but insoluble in N.

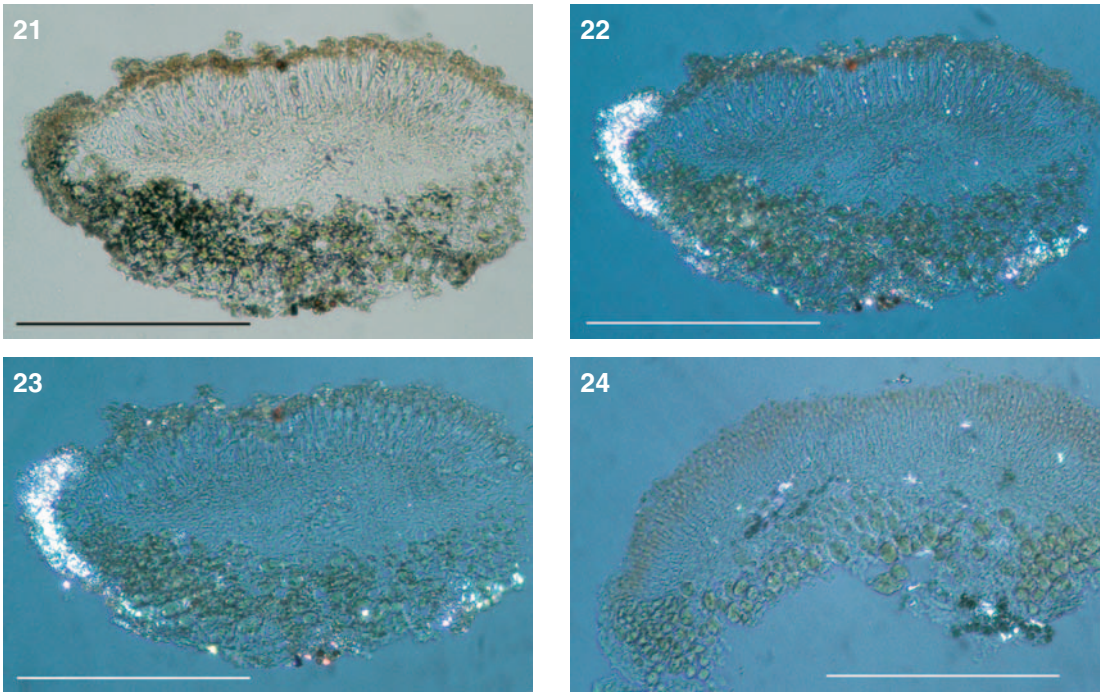
An epipsamma is defined here as the most superficial part of the epithecium, that is, present above the tips of the paraphyses. It may be ± granular (usually pol±, rarely pol+) with an undifferentiated structure. The epipsamma is generally insoluble in K and soluble in N, although in a few species it was occasionally N-insoluble, e.g., *L. flowersiana*, *L. percrenata*. It is always present in some species but is entirely lacking in some others. The presence of an epipsamma may be correlated with the pruinosity of the apothecial disc.

The hymenium is hyaline in the majority of species, and only in a few is the hymenium yellowish. The height of the hymenium is (30–)45–70(–90) µm. A subhymenium is indistinct in most species, but may also be more or less distinct and averages 15–20(–30) µm in height, hyaline or not transparent (and then usually ± granular). The hypothecium is hyaline or almost so, or rarely yellowish, and varies between 20–50 µm and 100–120 µm in height. The hypothecium is composed of adglutinated hyphae which form a pseudoparenchyma or prosoplectenchyma. It is most often clear and without granules, but in a few species it is darkened by granules (pol–) and/or oil droplets, e.g., *L. flowersiana*, *L. percrenata*.

The width of the paraphyses varies between species. They may be slender (averaging less than 2 µm wide) or thick (averaging more than 2 µm wide). In some species the paraphyses are somewhat branched throughout, with few anastomoses, not expanded apically, and coherent in K (e.g., *L. dispersa*, *L. juniperina*, *L. salina*). Most often, however, they are simple or sparsely branched (frequently only in the uppermost part), not or slightly to moderately expanded apically (rarely capitate) and ± free in K (e.g., *L. hagenii*, *L. invadens*, *L. semipallida*). The tips of the paraphyses may be pigmented or not. The pigment is rarely sharply delimited as a cap (e.g., *L. torrida*). Unusual paraphyses occur in *L. perpruinosa* which are submoniliform, that is, appearing as chains of swollen cells. *Lecanora flowersiana* and *L. percrenata* have thick and adglutinated paraphyses which are distinctly septate with extraordinarily



Figs 17–20. Cross section of apothecium of *Lecanora semipallida* H. Magn. (*Wetmore 13052*, KRAM): 17 – apothecial anatomy in regular light; 18 – granulation of apothecial tissues in polarized light, with prominent cortical and epithecial granules; 19 – section of apothecium in polarized light after application of K (epithecial granules dissolved); 20 – section of apothecium in polarized light after application of N (epithecial granules prominent). Scale bars = 200 µm.

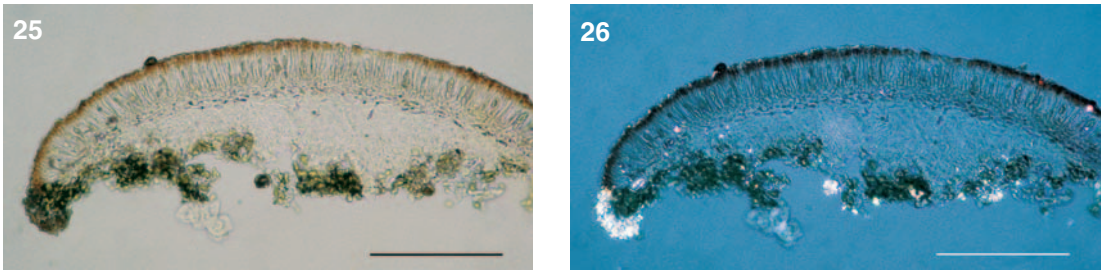


Figs 21–24. Cross section of apothecium of *Lecanora hagenii* (Ach.) Ach. (*Wetmore 13751*, MIN): 21 – apothecial anatomy in regular light; 22 – granulation of apothecial tissues in polarized light, with prominent cortical granules; 23 – section of apothecium in polarized light after application of K (epithecium unchanged); 24 – section of apothecium in polarized light after application of N (epithecial granules dissolved). Scale bars = 200 μm.

enlarged apical cells; they are apparently submoniliform as well.

The asci are clavate or broadly clavate, with the thickened ascus tips staining blue in iodine (K/I), and with a distinct projection from below (*Lecanora*-type). The asci are eight-spored in the majority of species. The only species with multispored asci is *L. sambuci*, which has (12–)16 or more spores per ascus. Specimens with four-spored asci occur occasionally in *L. persimilis* and *L. semipallida*.

The ascospores are always hyaline, non-septate and ellipsoid. Although the shape of spores is rather variable in most species, in some they seem broadly ellipsoid (Fig. 27) or more distinctly narrowly ellipsoid (Fig. 28). To provide more objec-



Figs 25–26. Cross section of apothecium of *Lecanora flowersiana* H. Magn. (*Trana 4495*, MIN): 25 – apothecial anatomy in regular light; 26 – granulation of apothecial tissues in polarized light, with prominent cortical granules. Scale bars = 200 μm.

Fig. 27. Broadly ellipsoid to ellipsoid spores of *Lecanora invadens* H. Magn. by SEM – mean spore length to width ratio = 1.7 (*Śliwa 1819*, KRAM).

tive spore shape descriptions the following scale is used here: (i) broadly ellipsoid – mean spore length to width ratio (Q) averaging 1.2–1.8; (ii) ellipsoid – mean spore length to width ratio (Q) averaging 1.9–2.3; and (iii) narrowly ellipsoid – mean spore length to width ratio (Q) averaging 2.4–3.5. Additionally, for the length and width of spores between their minimum and maximum values recorded, the arithmetic mean of all observations is given in squared parentheses. In several species, extreme values (recorded once and never repeated) are also indicated. Unusual in the group are the narrowly ellipsoid (sometimes apparently fusiform) spores of *L. percrenata*, and the broadly ellipsoid (sometimes apparently subglobose) spores of *L. semipallida*.

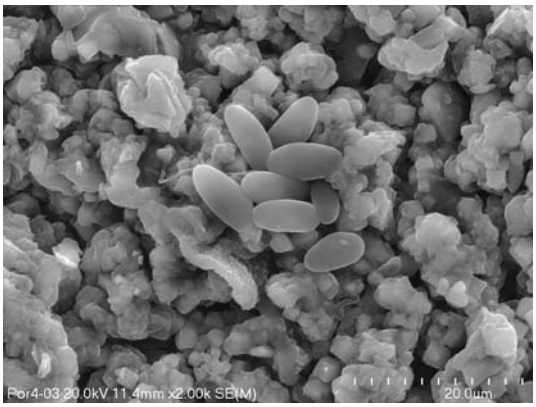


Fig. 28. Ellipsoid to narrowly ellipsoid spores of *Lecanora hagenii* (Ach.) Ach. by SEM – mean spore length to width ratio = 2.3 (*Śliwa 1507*, KRAM).

Pycnidia and conidia

Pycnidia were seen in a few specimens of two species, *L. percrenata* and *L. semipallida*. They are black, not abundant, and inconspicuous since buried in locally thickened parts of the thallus. Conidia are falcate, consistently filiform and characteristically curved. They are about 16–19 µm long and ±1 µm thick in *L. percrenata*, and 10–17(–18) µm long and ±1 µm thick in *L. semipallida*. Pycnidia may occur more frequently and been overlooked in the species complex.

Chemistry

LICHEN PRODUCTS. Although several members of the group do not produce any characterstic lichen compounds (e.g., *L. hagenii* and related species), the chemistry plays an important role in the identification of certain taxa. Examples include *L. dispersa* (refers predominantly to its chemical race with pannarin), *L. semipallida* (which consistently contains vinetorin), and *L. salina* (gyrophoric acid present). In these cases, the segregation is made on the grounds of morphological and anatomical characters, and is supported by the chemical data. The identification of other species within the group by chemical features, however, has serious restrictions. This is due to the need for sophisticated protocols for chromatographic studies of xanthones, the main constituents of many species, and severe limitations as to their determination on the basis of such characters. Consequently, lichexanthones are difficult to use in identification keys, and in this treatment attention was paid to identification of the xanthones most frequently detected and able to be recognized with available standards, 2,7-dichlorlichexanthone and vinetorin (5-chloro-3-*O*-methylnorlichexanthone). Detailed chemical characterizations of most species can be found in published reports discussed above (see 'Previous investigations' section).

REAGENT AND UV-TESTS. The most common patterns of chemical reagent tests in the complex are consistently negative responses to spot tests and also to UV light (10 species). The apothecial

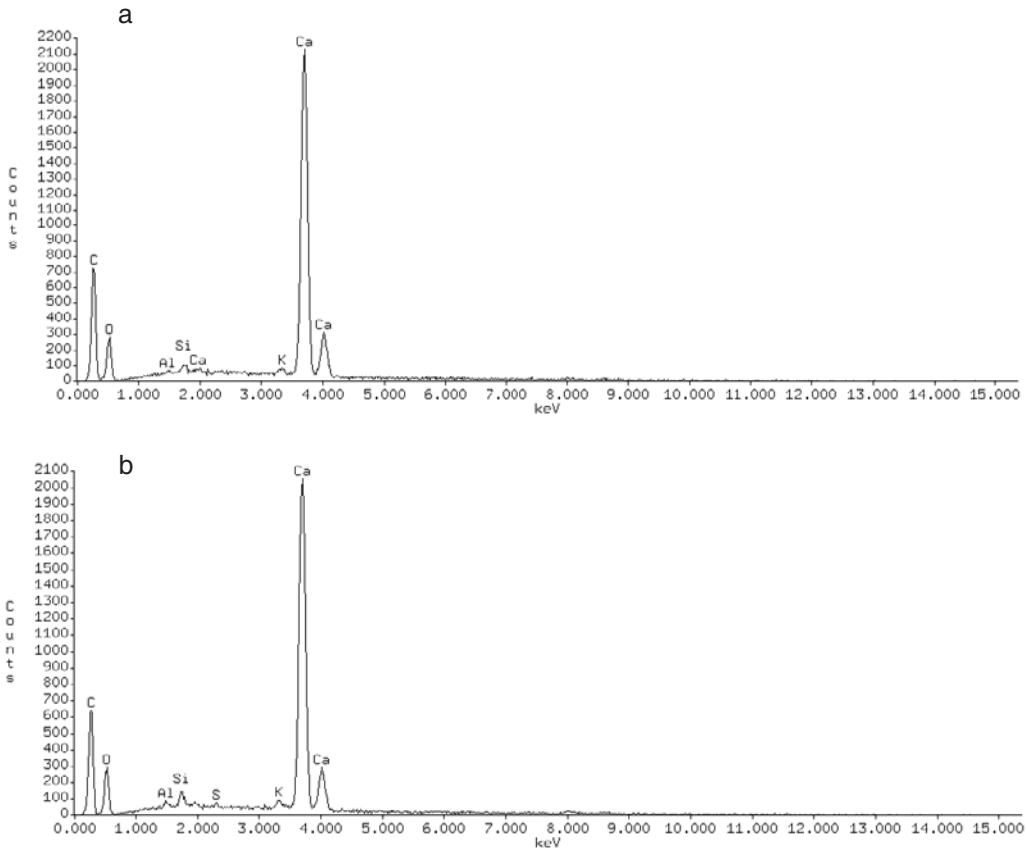


Fig. 29. Element content and element ratios in apothecial disc (a) and margin (b) of *Lecanora wetmorei* Śliwa. (*Flowers 613*, KRAM).

margin and sometimes also the disc of species producing pannarin may give a PD-positive orange reaction (e.g., *L. albescens*, *L. fugiens*, *L. dispersa*, *L. torrida*). The reaction may be more or less distinct in different parts of the same specimen. The species containing xanthones usually give positive, yellow or weakly orange reactions with C, and sometimes also with K; they usually are also UV-positive (e.g., *L. fugiens*, *L. semipallida*). The presence of gyrophoric acid in *L. salina* is manifested by a C+ pink reaction.

ELEMENT CONTENT. When undertaking SEM examinations of the morphology of the apothecia, the element content of apothecial disc and margin was also analyzed. This study revealed differences between species in the element composition of particular parts of the apothecia. There are species that have the same element content and more or less the same element ratios in both the disc and margin, e.g., *L. wetmorei* (Fig. 29). In some other species, however, the ratio of particular elements varies between the disc and margin, e.g., *L. semipallida* (Fig. 30). The preliminary data obtained are interesting, and further study may yield more information on variation in this aspect of the *L. dispersa* complex, and especially on the location of particular chemical constituents.

Ecology

The members of the complex are generally regarded as occupying primarily calcareous substrata, and the majority of taxa do occur directly on calcareous rocks, often on limestone, and also on concrete and mortar. Several of the saxicolous

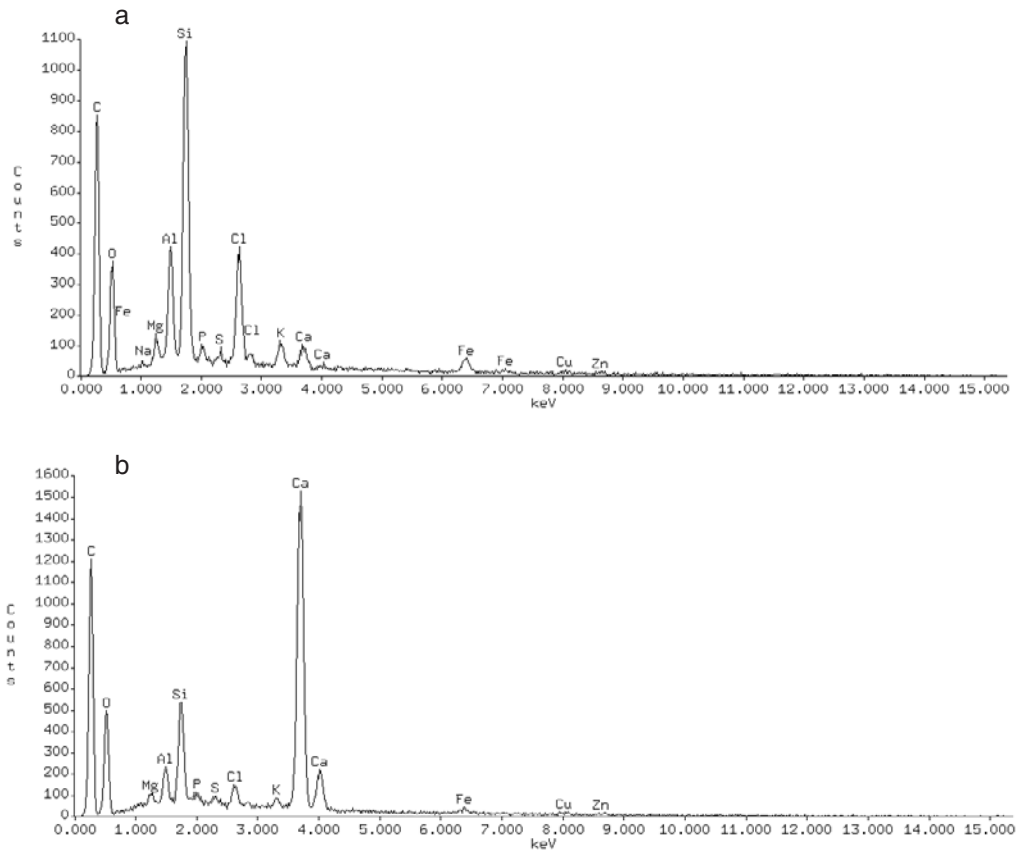


Fig. 30. Element content and element ratios in apothecial disc (a) and margin (b) of *Lecanora semipallida* H. Magn. (*Wetmore 13052*, KRAM).

species grow exclusively on calcareous rocks: *L. agardhiana*, *L. crenulata*, *L. perpruinosa*, and *L. torrida*. Others, although tending to favour calcium-containing substrata, may also inhabit weakly or non-calcareous rocks (e.g., *L. dispersa*, *L. flowersiana*). Siliceous rock is occupied by such species as *L. andrewii*, *L. fugiens*, and *L. salina*.

The corticolous members of the complex are *L. hagenii*, *L. juniperina*, *L. persimilis*, *L. sambuci*, and *L. wetmorei*. They inhabit a wide range of tree species but frequently occur also on wood. Some of them are collected mostly on the trunks of trees, but others (e.g., *L. persimilis*, *L. sambuci*) are collected mainly on branches and twigs.

Many species of the complex are less substratum-specific than previously considered. The most spectacular examples are *L. dispersa* and *L. hagenii*. The usually saxicolous *L. dispersa* may occur on tree bark or wood (especially in urban environments) and the predominantly corticolous *L. hagenii* may also occur on calcareous rock, concrete and mortar. The two species frequently accompany each other, especially on constructed substrata such as fences, walls, and tombstones. Some species may rather occasionally be collected on other than typical substrata, for example *L. semipallida* on calcareous rock (limestone, calcium-rich sandstone) and concrete, and may rarely be found on other substrata such as bark or wood. *Lecanora percrenata* grows primarily on calcium-containing rocks (sandstone, caliche, limestone) but may also occur on volcanic ash or on wood.

The least selective species in substratum choice in the whole complex is *L. dispersa*, which occurs

on a wide range of substrata including calcareous and siliceous rocks, concrete and mortar, dusty bark, wood, and many manufactured substrata including asbestos-cement, metal, leather, and rubber. It may also grow commensally on other lichens, as *L. semipallida* often does. Another species of a wide ecological spectrum is *L. zosterae*, which inhabits a large variety of organic substrata, that is, wood, detritus, bryophytes, vascular plant debris, bones, and caribou antlers, but it may also grow directly on calcareous rock.

The habitats of the *L. dispersa* complex representatives include a range from sea level to considerably high elevations, up to 3150 m in the case of *L. wetmorei*, and close to that in *L. flowersiana* (2870 m). However, the majority of species preferentially occur at lower altitudes in nature and in natural situations, although a few commonly grow also in urban environments (e.g., *L. dispersa*, *L. hagenii*, *L. semipallida*). Several taxa occur predominately in particularly exposed environments, such as deserts (e.g., *L. flowersiana*), tundra (e.g., *L. zosterae*), or the seashore (e.g., *L. salina*).

Distribution

The North American species show different distribution patterns. A few species of the complex are widespread on the continent and occur in arctic, boreal and temperate regions, with the main distribution in the temperate zone, notably *L. crenulata*, *L. dispersa*, *L. hagenii*, and *L. semipallida*. Some scattered species, such as *L. albescens*, *L. persimilis*, and *L. sambuci*, have a boreal to temperate range. The arctic-alpine to boreal element is represented by *L. torrida* and *L. zosterae*. A typical western temperate species is *L. flowersiana* (and perhaps *L. juniperina*), and western temperate to western montane species are *L. percrenata* and *L. wetmorei*. *Lecanora andrewii* and *L. fugiens* have an oceanic distributional pattern, whereas *L. salina* is maritime.

The taxa differ also in frequency. Common species are *L. dispersa*, *L. semipallida* and *L. hagenii*. Frequent species, but with various distribution ranges, include *L. crenulata*, *L. flowersiana*, *L. wetmorei*, and *L. zosterae*. Relatively rare species include *L. albescens* and *L. fugiens*. *Lecanora agardhiana*, *L. perpruinosa*, and *L. salina* represent the rarest taxa in the continent, currently being known only from single localities.

SPECIES GROUPS

Based on morphological and anatomical features, four distinctive groups of species can be recognized within the *L. dispersa* complex. Chemical study showed they are correlated with the presence of certain chemical compounds.

1. *Lecanora dispersa* group s.str.

DIAGNOSTIC CHARACTERS. Epithecial granules fine, on top and between paraphyses tips (inspersed in the whole hymenium), K-insoluble, N-insoluble; paraphyses slender, somewhat branched throughout, with few anastomoses, coherent in K; amphithecial cortex composed of adglutinated hyphae; ascospores ellipsoid; chemistry – 2,7-dichlorlichexanthone or other xanthones, ±pannarin, or no lichen substances detected; thallus distinct in some species. Included species: *L. andrewii*, *L. albescens*, *L. dispersa*, *L. juniperina*, *L. salina*, and probably *L. torrida*.

2. *Lecanora semipallida* group

DIAGNOSTIC CHARACTERS. Epithecial granules coarse, on top and between paraphyses tips, K-soluble, N-insoluble; paraphyses slender, rarely dichotomously branched at top, sometimes with the apical cells slightly expanded, free in K; ampithecial cortex prosoplectenchymatous; ascospores broadly ellipsoid; chemistry – 5-chloro-3-O-methylnorlichexanthone (vinetorin); pycnidia frequent; often grow commensally on other lichens. Included species: *L. invadens*, and *L. semipallida*. Note: *L. fugiens* has the same anatomical features but differs in chemistry.

3. *Lecanora crenulata* group

DIAGNOSTIC CHARACTERS. Epithecial granules coarse, on top and between paraphyses tips, K-insoluble, N-soluble or absent; paraphyses slender, apical cells expanded to capitate, often pigmented,

coherent in K (adglutinated); amphithecial cortex gelatinous or distinctly paraplectenchymatous; ascospores ellipsoid to narrowly ellipsoid; chemistry – no lichen products detected; disc abundantly pruinose or margin distinctly crenate or cracked; primarily saxicolous species. Included species: *L. crenulata*, *L. flowersiana*, *L. percrenata*, *L. perpruinosa*, and probably *L. agardhiana*.

4. *Lecanora hagenii* group

DIAGNOSTIC CHARACTERS. Epithecial granules absent (only an epipsamma observed, K-insoluble and N-soluble) or coarse, on top and between the paraphyses tips, K-soluble, N-insoluble; paraphyses slender, apical cells expanded to capitate, often pigmented, free in K; amphithecial cortex gelatinous, or rarely composed of adglutinated hyphae; ascospores ellipsoid to narrowly ellipsoid; chemistry – no lichen products or unknown substance detected; margin of young apothecia often slightly crenate or incised, in older apothecia often flexuose; inhabits a large variety of organic substrata. Included species: *L. hagenii*, *L. persimilis*, *L. sambuci*, and probably *L. wetmorei* and *L. zosterae*.

KEY TO THE SPECIES

1. Asci 12- to 16-spored . . . . . *L. sambuci*
1*. Asci up to 8-spored 2
2. Epithecium granular (pol+), coloured or not; epipsamma if present soluble in N 3
2*. Epithecium not granular or granules not prominent in polarizd light (pol–), coloured; epipsamma if present soluble or insoluble in N 14
3. Granules in epithecium coarse or fine, insoluble in K and insoluble in N (the same kind of granules dispersed through the whole hymenium and sometimes also the hypothecium, prominent even if sparse or lacking in the epithecium); paraphyses somewhat branched throughout, sometimes with a few anastomoses; apothecia UV+ dull greenish or yellowish, or UV– 4
3*. Granules in epithecium coarse, solubility different than above; paraphyses simple or branched only at the top, never with anastomoses; apothecia UV+ yellow to dark orange or UV– 9
4. Thallus inconspicuous or immersed and not apparent, endolithic or endophloedal 5
4*. Thallus distinct, well developed or scarcely visible, epilithic 6
5. Apothecia 0.3–0.9 mm diam.; apothecial margin entire, often PD+ (pannarin); disc very variable in colour, yellowish grey, brownish to dark brown or almost black, mostly epruinose; thallus endolithic or visible as a very thin superficial layer or inconspicuous granules (distinct coarse granules sometimes observed are usually those that will produce apothecia); on all kinds of substrata, also commensally on other lichens; widespread . . . . . *L. dispersa*
5*. Apothecia 0.3–1.2 mm diam.; apothecial margin crenate, PD–; disc pale, or yellowish (often turning lead-colored), moderately to heavily pruinose; thallus granulose to areolate-rimose; corticolous species; occurs in western North America . . . . *L. juniperina*
6. Thallus white, cream or pale grey yellowish, C–; arctic-alpine or widespread 7
6*. Thallus yellow, yellowish green to pale brownish, C+ pink or yellow to orange; rare, maritime or oceanic 8
7. Thallus forming rosettes with many apothecia on top, usually slightly lobate at the margin; apothecial disc pale to brown and often pruinose; widespread . . . . . *L. albescens*
7*. Thallus forming areoles around or restricted only to closest vicinity of apothecia; apothecia disc brown to black and usually epruinose; arctic-alpine to boreal . . . . . *L. torrida*
8. Thallus and apothecial margin PD–, often C+ pink (gyrophoric acid); apothecial margin almost concolorous with the disc or slightly paler . . . . . *L. salina*
8*. Thallus and apothecial margin PD+ (pannarin), C+ yellow to orange (arthrothelin); apothecial margin paler than disc, often whitish . . . *L.* cf. *andrewii*
9. Epithecial and/or epipsamma granules soluble in K and insoluble in N (sometimes sparse!) 10
9*. Epithecial and/or epipsamma granules insoluble in K and soluble or insoluble in N 14
10. Thallus within the substrate, endolithic or endophloedal 11
10*. Thallus partly superficial (sometimes evanescent), more evident around the apothecia, epilithic 13
11. Apothecial disc moderately to heavily white pruinose, K–, C– and UV– (sometimes traces of an unknown lichen product present); corticolous or lignicolous; continental North America . . . . . *L. wetmorei*
11*. Apothecial disc epruinose or faintly yellowish

pruinose, K+ and/or C+, UV+ all yellow to orange (xanthones present); predominately calcicolous; distribution not only continental 12

12. Apothecia widely sessile, rarely constricted at the base; apothecia flat, only rarely flexuose; apothecia margin thick, prominent; ascospores broadly ellipsoid; often commensally on other lichens; widespread . . . . . *L. semipallida*

12*. Apothecia constricted at the base, sometimes apparently stipitate; apothecia often flexuose; apothecia margin thin or partly excluded; ascospores narrowly ellipsoid; often on bones; arctic-alpine [chemotype with a high concentration of xanthone] . . . . . *L. zosterae* var. *beringii*

13. Apothecia 0.4–1.0 mm diam., constricted below; disc yellowish to black, plane to convex; apothecial margin C– or C± yellow, PD– (±vinetorin); on weakly calcareous rocks, often parasitic on other lichens . . . . . *L. invadens*

13*. Apothecia 0.3–0.8 mm diam., sessile; disc pale brown to reddish brown; apothecial margin and/or disc C+ orange, PD+ orange (arthrothellin and pannarin); on siliceous maritime rocks . . . *L. fugiens*

14. Ascospores ellipsoid to broadly ellipsoid, spore length to width ratio averaging mostly 2 or less; exclusively on calcareous rocks, especially on limestone 15

14*. Ascospores ellipsoid to narrowly ellipsoid, spore length to width ratio averaging mostly over 2.3; on various kinds of organic substrata, also calcicolous 17

15. Apothecial margin cracked or crenate; disc pale to dark brown; epithecium pale brown; cortex thick, well delimited . . . . . *L. crenulata*

15*. Apothecial margin entire; disc dark brown or black; epithecium dark brown or greenish black; cortex thick or thin or not well delimited 16

16. Thallus endolithic; apothecia immersed into rock surface; algae in amphithecium not very abundant or sparse, often in groups; cortex thick, composed of adglutinated hyphae; paraphyses more or less loose, faintly expanded at top; ascospores 10.5–12 × 5–7.5 µm . . . . . *L. agardhiana*

16*. Thallus epilithic, distinct or inconspicuous; apothecia sessile or constricted at the base; algae abundant, filling densely almost whole amphithecium; cortex thin, composed of paraplectenchyma; paraphyses adglutinated, gradually expanded at top, submoniliform apically; ascospores 10–14 × 5–6 µm . . . . . *L. perpruinosa*

17. Apothecial margin distinctly cracked; hymenium deeply coloured (up to 1/3 of the height); paraphyses distinctly adglutinated, expanded at the top to capitate, sometimes apparently submoniliform apically 18

17*. Apothecial margin entire or slightly crenate; only uppermost part of hymenium colored; paraphyses ±loose, faintly expanded at top 19

18. Apothecia widely attached or base immersed in rock; apothecial margin cracked; disc brown, black or almost black; epithecium brown or olive-green, or bluish green; ascospores 12–18 × 4– 6 µm; pycnidia sometimes present; continental part of North America and Asia . . . . . *L. percrenata*

18*. Apothecia widely sessile or constricted at the base; apothecial margin cracked but often only faintly crenate or continuous in older apothecia; disc reddish brown, dark brown to blackish; epithecium brown or reddish; ascospores 10.5–16.5(–18) × 4–6 µm; pycnidia not observed; continental part of North America . . . . . *L. flowersiana*

19. Apothecial disc yellow or reddish brown, lead-brown to blackened; arctic-alpine 20

19*. Apothecial disc pale to dark brown, sometimes with some orange to reddish tint, or chocolate brown and ±glossy; not arctic-alpine 21

20. Apothecia epruinose, clustered in groups and raised on a short stipe; calcicolous, primarily on bones [chemotype with no lichen substances] . . . . . *L. zosterae* var. *beringii*

20*. Apothecia faintly to moderately pruinose, scattered and sessile; on various kinds of organic substrata, also on bones . . . . . *L. zosterae* var. *palanderi*

21. Apothecia 0.4–1.6(–3.5) mm diam., constricted at the base, often peltate; epithecium brown or reddish; hypothecium yellowish, prosoplectenchymatous; ascospores narrowly ellipsoid, up to 16.5 µm long; occurs also on all kinds of organic substrata . . . . . *L. zosterae*

21*. Apothecia 0.4–1.2(–1.5) mm diam., widely sesille; epithecium brown; hypothecium hyaline; ascospores ellipsoid or narrowly ellipsoid, less than 13.5 µm long; mostly on wood and bark but also calcicolous 22

22. Apothecial disc epruinose; margin concolorous or paler than disc; young apothecia often in groups of 2–3 . . . . . *L. persimilis*

22*. Apothecial disc moderately to heavily pruinose; margin paler than disc or whitish; apothecia scattered, evenly distributed 23

23. Margin faintly incised, at least in some apothecia; cortex thin, ±uniform in thickness or faintly thickened at base; no lichen substances detected; widespread . . . . . *L. hagenii*

23*. Margin entire; cortex thick, expanded at the base; sometimes traces of unknown lichen product present; continental North America . . . . . *L. wetmorei*

THE SPECIES

Twenty one taxa recognized from the study area are presented here: *L. agardhiana* Ach., *L. albescens* (Hoffm.) Flörke, *L.* cf. *andrewii* B. de Lesd., *L. crenulata* Hook., *L. dispersa* (Pers.) Sommerf., *L. flowersiana* H. Magn., *L. fugiens* Nyl., *L. hagenii* (Ach.) Ach., *L. invadens* H. Magn., *L. juniperina* Śliwa, *L. percrenata* H. Magn., *L. perpruinosa* Fröberg, *L. persimilis* (Th. Fr.) Nyl., *L. salina* H. Magn., *L. sambuci* (Pers.) Nyl., *L. semipallida* H. Magn., *L. torrida* Vainio, *L. wetmorei* Śliwa, *L. zosterae* (Ach.) Nyl., *L. zosterae* var. *beringii* (Nyl.) Śliwa, and *L. zosterae* var. *palanderi* (Vain.) Śliwa. The morphology, anatomy, chemical content, and ecology of these species are discussed below. All species are illustrated and their distribution in North America is presented on maps. General distribution of the species given is based on specimens seen.

Lecanora agardhiana Ach. Figs 31 & 32

Synops. Lich.: 152. 1814. – LECTOTYPE (designated by P. W. James, in Wunder, Biblioth. Lichenol. **3**: 44. 1974): [Switzerland] 'Helvetia' no. 695a (H-ACH 1175!).

Thallus within the substratum, immersed and not apparent, endolithic, rarely superficial and then whitish and inconspicuous. Apothecia lecideine or lecanorine, occurring singly, sessile, flat when mature, whole or partly immersed in the rock, 0.3–1.2 mm diam.; disc plane, dark brown, black or almost black, epruinose, or slightly to heavily pruinose, sometimes umbonate (with sterile columns in apothecial disc); margin level with the disc, thin, smooth, entire, even, or flexuose, uniform, epruinose, or pruinose, paler than disc, or the same colour, or sometimes thalline

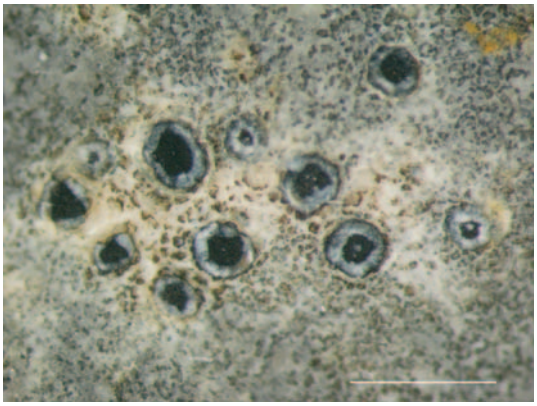


Fig. 31. *Lecanora agardhiana* Ach. (Arnold, *Lich. Exsicc.* 1225, KRAM). Scale bar = 1 mm.

margin excluded and then the dark true exciple usually distinct. Amphithecium 70–180 μm thick, corticate, with a discontinuous algal layer, algae sparse, in groups, often restricted to the base; cortex indistinctly delimited, clearly expanded at the base, ±80 μm thick laterally and 120–150 μm thick at the base, composed of adglutinated hyphae (lumina of cells irregular), not gelatinous, usually more or less obscured by crystals (pol+, insoluble in K, soluble in N); parathecium distinct, thin, overlapping the margin; epithecium shades of brown, olive, greenish or blueish black, not at all granular, unchanged with K, N+ pink or purple (part of the hymenium below also often turning pink), epipsamma absent, or present and undifferentiated (pol±, insoluble in K and soluble in N); hymenium hyaline, 60–70 μm high; subhymenium indistinct; hypothecium hyaline or almost so, 40–130 μm high, composed of pseudoparenchyma, without granules. Paraphyses slender, simple, not expanded or thick and adglutinated, pigmented, free in K. Asci clavate, 8-spored; ascospores hyaline, simple, mostly ellipsoid (broadly ellipsoid to ellipsoid), 10.5–[11.1]–12 × 5–[5.8]–7.5 μm, Q = 1.6–[1.9]–2.4. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. Growing directly on calcareous rock, often on limestone.

Fig. 32. Known North American distribution of *Lecanora agardhiana* Ach.

DISTRIBUTION. Europe, New Zealand, and North America, but in the U.S.A. recognized from only one locality in Oklahoma.

DISCUSSION. The species is most likely to be confused with *L. crenulata*, which also occurs on limestone, but is much more frequent. However, the apothecia of *L. crenulata* are sessile to constricted at the base and always located on the rock surface, and are not wholly or partly immersed in the rock as are the apothecia of *L. agardhiana*. The apothecial disc of the last species is often epruinose or only slightly pruinose, and the thalline margin is thinner and never distinctly crenate or cracked, as it is in case of *L. crenulata*. Moreover, algae in the amphithecium of *L. crenulata* are much more abundant in comparison to the sparse algae, often clustered into group of *L. agardhiana*.

REMARKS. The following taxa of lower rank have been recognized in Europe: subsp. *agardhiana*; subsp. *spadicea* Clauzade & Cl. Roux with var. *spadicea* and var. *lecidella* (Poelt) Leuckert & Poelt. Full characteristics and discussion of the taxa are provided by Poelt *et al*. (1995). The North American specimen represents the typical subspecies, subsp. *agardhiana*.

EXSICCATES SEEN. Anzi, *Lich. Rar. Veneti* 34 (as *L. agardhianoides* var. *cilophthalma*) (MIN); Anzi, *Lich. Rar. Veneti* 35 (as *L. agardhianoides* var. *pacnodes*) (MIN); Arnold, *Lich. Exsicc*. 93 (as *L. agardhianoides*) (M); Arnold, *Lich. Exsicc*. 1225 (as *L. agardhiana* var. *cilophthalma*) (GZU, KRAM, M, MIN); Rabenhorst, *Lich. Eur*. 494 (as *L. agardhiana*) (COLO).

SPECIMEN EXAMINED. U.S.A. OKLAHOMA. Murray Co., summit of Arbuckle Mts, 6 mi. S of Turner Falls, 28 Aug. 1960, *Weber et al. S29054* (COLO).

Specimens have also been seen from Austria (ASU, COLO, FH, GZU), Balkan Peninsula (FH, NY), Belgium (FH), Germany (GZU), Italy (GZU), New Zealand (MSC: Campbell Island), Switzerland (FH), and UK (NY).

Lecanora albescens (Hoffm.) Flörke

Figs 33 & 34

in Flotow, Flora **11**: 633. 1828. – *Psora albescens* Hoffm., Deutschl. Fl. **2**: 165. 1796. – NEOTYPE (designated by Śliwa, Mycotaxon **97**: 295. 2006): [Germany] 'Auf Ziegeln der Kirchhofmauer in Thalkirchen; München, Dezember 1891, *Arnold* und *Schnabl*' [Arnold, *Lich. Monac. Exsicc*. 212; as *L. albescens*] (H!; M!, MIN! – NEOTYPE DUPLICATES).

= *Lecanora galactina* Ach., Lichenogr. Univers.: 424. 1810. – *Parmelia galactina* Ach., Method. Lich.: 190. 1803; *nom. illeg*. (Art. 52.1).

= *Lecanora urbana* (Nyl.) Leight., Ann. Mag. Nat. Hist., ser. 4, **2**: 247. 1868. – *Lecanora galactina* [subsp.] *urbana* Nyl., Bull. Soc. Bot. France **13**: 368. 1866. – HOLOTYPE: [France] 'Gallia. Paris: rue de l'Ouest, sur les murs. 1866, *leg. W. Nylander*' (H-NYL 28057!).

Thallus clearly visible, often forming distinct rosettes, thick or thin, areolate, usually slightly lobate at margins, surface pruinose; white, yellowish, cream or pale grey. Apothecia clustered in groups on thallus areoles, sessile or slightly immersed, flat when mature, 0.4–1.4 mm diam.; disc plane, smooth, yellowish to pale brown, slightly to heavily pruinose; margin prominent,

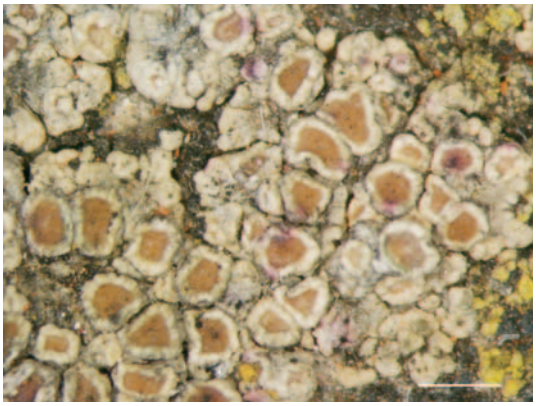


Fig. 33. *Lecanora albescens* (Hoffm.) Flörke (Arnold, *Lich. Monac. Exsicc.* 212, H – neotype). Scale bar = 1 mm.

or level with the disc, smooth, sometimes slightly crenate, even, uniform, epruinose, concolorous with thallus. Amphithecium 90–270 µm thick, corticate, algae fill the area below the cortex or algae sparse, algal layer continuous below hypothecium; cortex indistinctly delimited, or distinctly delimited, ±uniform in thickness, or slightly thicker at the base than at the sides, *ca* 30 mm thick laterally and *ca* 60 µm thick at the base, prosoplectenchymatous, gelatinous, obscured by granules and larger crystals (pol+, insoluble in K, slowly soluble in N); parathecium indistinct to well delimited and up to 30 µm wide; epithecium shades of yellow or brown, granular (pol+), granules superficial and between paraphyses tips, also inspersed in the whole hymenium, coarse, or fine (insoluble in K and insoluble in N), usually with an epipsamma (insoluble in K and soluble in N); hymenium hyaline, or yellowish, 60–90 µm high; subhymenium distinct; hypothecium hyaline or almost so, 60–130 µm high, composed of prosoplectenchyma, without granules. Paraphyses slender, somewhat branched throughout, with few anastomoses, not expanded and not pigmented, ±coherent in KOH. Asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (broadly ellipsoid to narrowly ellipsoid), 9–[11.2]–13(–15) × 4.5–[5.6]–7.5 µm, Q = 1.4–[2.0]–2.7. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD– or PD+ orange; disc K–, C–, KC–, PD–; apothecia UV-negative or UV+ dull greenish. Lichen products: 2,7-dichlorlichexanthone, ±pannarin; or no lichen products detected by TLC.

HABITAT. Growing directly on calcareous rock, also on concrete and mortar.

DISTRIBUTION. Europe and North America. In North America the species is scattered on the north-eastern coast. It represents perhaps a boreal and temperate element.

DISCUSSION. *Lecanora albescens* is closely related to *L. dispersa* and corresponds to the latter in anatomical and chemical characters. It has a much more abundant thallus, however, which is often indistinctly lobate at the margin. Distinct rosettes of the thallus bear numerous, usually pruinose apothecia. *Lecanora dispersa* never has a distinct thallus, and its apothecia are usually epruinose. Another related species is *L. torrida*. For differences, see under the species.

NOMENCLATURAL NOTES. As no original Hoffmann collection could be located in B, GOET or MW, the herbarium in Helsinki was checked to trace any relevant material appropriate for typification. No authentic *L. albescens* was found there, although original collections of its later synonyms, *L. galactina* and *L. urbana*, were located. The nomenclature, citation and typification of the names are discussed, and the neotype of *L. albescens* is designated in Śliwa (2006). Additionally, Flörke is shown in the paper to be the correct author of the combination, according to Art. 34.1 Ex. 3 of the Vienna *Code*.

EXSICCATES SEEN. Arnold, *Lich. Monac. Exsicc.* 29 (as *L. albescens*) (M); Arnold, *Lich. Monac. Exsicc.* 212 (as *L. albescens*) (H, M, MIN; types); Flörke, *Deutsche Lich.* 89 (as *L. angulosa* var. *galactina*) (M); Hepp, *Lich. Helvet. Exsicc.* 900 (as *L. galactina*) (NY); Malme, *Lich. Suecici Exsicc.* 869 (as *L. galactina*) (COLO, WIS); Mereschkowsky, *Lich. Rossiae Exsicc.* 9 (as *L. crenulata*) (COLO); Nowak, *Lich. Polon. Merid. Exsicc.* 63 (as *L. albescens*) (COLO, KRAM, MIN); Rabenhorst, *Lich. Eur.* 596 (as *L. albescens* f. *murorum*) (COLO).

SPECIMENS EXAMINED. CANADA. NEW BRUNSWICK. Albert Co., Fundy National Park, N side of Point Wolfe, 6 Sep. 1981, *Gowan & Wallace 4727*

Fig. 34. Known North American distribution of *Lecanora albescens* (Hoffm.) Flörke.

(CANL). NEWFOUNDLAND. Island of Newfoundland: Bay of Islands, Coal River, 18 Sep. 1896, *Waghorne 616* (MIN), Shoal Point near Bay of Islands, 17 July 1895, *Waghorne 322* (BM, US); St. John's City, along Empire Av., S of Carpasian Road, 6 Aug. 1978, *Ahti & Hamet-Ahti 34902b* (H); *s.loc*., 1897, *Waghorne s.n.* (MICH); *s.loc*., *s.d. Arnold s.n*. (MICH). ONTARIO. Carleton Co., Ottawa region Rockcliffe Park, 2 mi. E of Ottawa, at the base of limestone cliffs at river's edge, 31 May 1978, *Brodo et al. 22789* (CANL); Lincoln Co., Winona, Niagara Escarpment, 26 June 1978, *Wong 2579* (CANL). – U.S.A. NEW YORK. Greene Co., Catskill Park, Blackhead Range Trail, from E of Barnum Road just S of Maplecrest to Camel's Hump, 13 May 1996, *Buck 30206* (NY).

Specimens have also been seen from Austria (ASU, GZU, MIN), Canada (CANL, H, MICH, MIN, US), Denmark (MIN, WIS), Estonia (KRAM), Finland (COLO), Germany (GOET), Luxembourg (herb. Diederich), Malta (NY), Poland (KRAM), Romania (KRAM), Sweden (COLO, LD, MIN, WIS), Switzerland (NY), UK (COLO, KRAM, MSC, NY), and Ukraine (KRAM).

Lecanora cf. ***andrewii*** B. de Lesd.

Figs 35 & 36

in M' Andrew, Transact. and Proceed. Botan. Soc. of Edinburgh **26**, II: 184. 1913.

Thallus clearly visible, thin, areolate, areoles dispersed to aggregated (especially in vicinity of apothecia), pale yellow to yellowish brown, sometimes slightly pruinose. Apothecia occurring in groups, rarely single, broadly sessile to constricted at the base, 0.3–1.1 mm diam.; disc plane, smooth, pale brown to reddish brown or blackish, epruinose or slightly pruinose; margin level with the disc or slightly prominent, smooth, entire, even, or sometimes flexuose, uniform, slightly to moderately white pruinose, paler than thallus and disc, often whitish. Amphithecium ± 60 μm thick, corticate, with sparse algae; cortex indistinctly or ± well delimited, uniform and ± 30 μm thick or slightly thicker at the base than at the sides and then 25–30 μm thick laterally, 30–45 μm thick at the base, composed of adglutinated hyphae or gelatinous, cortical granules sparse and mostly at top of margin (pol+, insoluble in K, soluble in N); parathecium indistinct to well delimited and 10–30 μm wide; epithecium shades of yellow or brown, granular (pol+), granules superficial and between paraphyses tips, some also in hymenium (partly soluble in K but most insoluble in K and insoluble in N), epipsamma absent or present (insoluble in K and soluble in N); hymenium hyaline, 60–70 μm high; subhymenium indistinct, 15–20 μm high, ± granular; hypothecium hyaline or yellowish, 100–120 μm high, composed of adglutinated hyphae, clear, without granules. Paraphyses slender, somewhat branched throughout, with few anastomoses, not or slightly expanded and usually not pigmented, coherent in K. Asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (broadly ellipsoid to narrowly ellipsoid), 10.5–[12.2]–15 × 4.5–[5.4]–6 μm, Q = 1.8–[2.3]–2.6. Pycnidia not seen.

CHEMISTRY. Thallus and apothecial margin K+ yellow, C+ yellow to orange or rarely C–, KC+

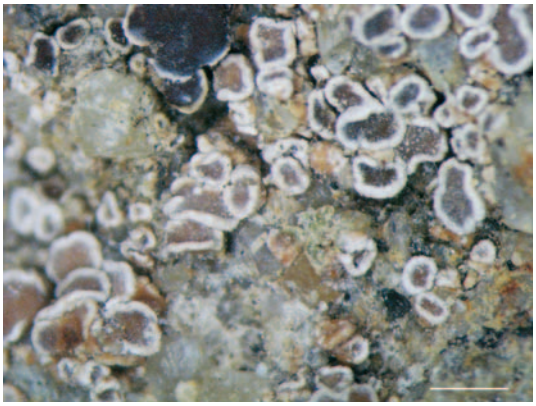


Fig. 35. *Lecanora andrewii* B. de Lesd. (*Ryan 31286b*, ASU). Scale bar = 1 mm.

yellow to orange, PD+ orange; disc K+ yellow, C+ orange, KC+ orange, PD+ orange; apothecia UV+ yellowish or rarely UV–. Lichen products: unknown xanthone (Rf 4–5, UV+ reddish, cf. arthrothellin), ±pannarin detected by TLC.

HABITAT. On siliceous rock (granite, rhyolite) along seashore.

DISTRIBUTION. The species is known from northern Europe. It is scattered on the west and east coasts of North America and is also noted in the area of the Great Lakes. It represents a temperate oceanic element.

DISCUSSION. The species seems most closely related to *L. fugiens*. It has similar spot test reactions and ecology but differs in some morphological and anatomical details. *Lecanora andrewii* has, for example, a more abundant thallus and larger, aggregated apothecia. The presence of *dispersa*-like granules in the epithecium is also distinctive for the species. It is worth noting that European material is mentioned as having a white thallus and indicating a distinct C+ orange-red reaction of the thallus; the North American material seems to differ somewhat. The application of the name to North American material may require reconsideration after comparison with more material from Europe.

NOMENCLATURAL NOTES. The name *L. andrewii* B. de Lesd. was chosen as most appropriate for the material. However, typification of the species is needed after more European material is studied, or if further searches of European herbaria for any original collection prove unsuccessful.

SPECIMENS EXAMINED. CANADA. BRITISH COLUMBIA. Vancouver Island, Sidney, 15 Dec. 1912, *Macoun s.n.* (FH). NEW BRUNSWICK. Alberta Co., Fundy National Park, Herring Cove, 4 July 1980, *Gowan 3067* (CANL). – MEXICO. Baja California, N-facing cliff below top of Sierra Agua Verde (part of Sierra San Francisco), 1 Jan. 1998, *Nash 40096* (ASU). – U.S.A. CALIFORNIA. Santa Barbara Co., Santa Rosa Island, lower portion of Lobos Canyon, 4 Jan. 1994, *Ryan 31286b*, *31314b* (ASU). OHIO. Lake Co., summit of Mt. Willoughby, Aug. 1880, *cf. Willey s.n.* (FH). WASHINGTON. Island Co., Langley, Feb. 1922, *Grant 4221* (FH); Snohomish Co., Marysville, May 1927, *Grant s.n.* (COLO, NY).

Specimen has also been seen from Sweden (WIS).

Fig. 36. Known North American distribution of *Lecanora andrewii* B. de Lesd.

Lecanora crenulata Hook. Figs 37 & 38

in Smith, Engl. Fl. **5**: 190. 1833. – NEOTYPE (designated here): [Germany, Bayern] 'An Dolomitsteinen einer alten Feldmauer unterhalb des Wagnersteinbruches bei Eichstätt. März 1882. *Boll*' [Arnold, *Lich. Exsicc.* 931b, as *L. crenulata*] (M! 35465; M! 35450 – NEOTYPE DUPLICATE).

Thallus within the substratum, immersed and not apparent (endolithic), rarely partly epilithic and then thin, granulose, chalky white, ecorticate. Apothecia occurring singly, sessile or constricted at the base, concave, cup-like, or flat when mature, 0.4–1 mm diam.; disc plane, smooth, pale brown, brown, rarely blackish brown, slightly or heavily pruinose to scabrose; margin prominent and usually thick, cracked (with 3–5 fissures) or crenate, even, uniform, epruinose or pruinose, white. Amphithecium 90–190 μm thick, corticate, algae fill the area below the cortex; cortex distinctly delimited, expanded at the base, 30–70 μm thick laterally and 50–130 μm thick at the base, with gelatinous hyphae, ±obscured by granules (pol+, insoluble in K, slowly soluble in N); parathecium distinct, prosoplectenchymatous, with granules on top, up to 20 μm wide; epithecium shades of brown (more intense in N), granular (pol±), rarely not at all granular, granules superficial, coarse (insoluble in K and soluble in N), epipsamma usually present (insoluble in K and soluble in N); hymenium hyaline or pale yellow, 50–60(–80) μm high; subhymenium distinct, hyaline; hypothecium hyaline or almost so, composed of prosoplectenchyma, clear, without granules but often with numerous droplets of oil, 45–80 μm high. Paraphyses slender to moderately thick, somewhat branched, mostly in upper part, slightly expanded apically, not pigmented or pigmented brown, coherent in K. Asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (broadly ellipsoid to narrowly ellipsoid), 7.5–[10.0]–13(–15) × 4–[5.2]–6 μm, Q = 1.3–[2.0]–2.7. Pycnidia not seen.

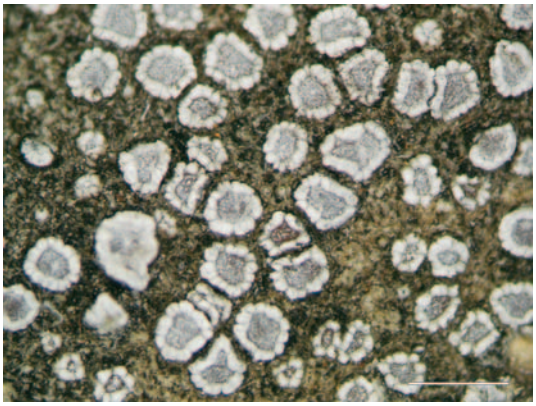


Fig. 37. *Lecanora crenulata* Hook. (*Weber S997*, COLO). Scale bar = 1 mm.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. On calcareous rock, mostly limestone, occasionally also on mortar.

DISTRIBUTION. The species is widespread in Europe and in North America. It is also known from Australia. In North America it represents a boreal to temperate element with its main distribution in temperate regions.

DISCUSSION. *Lecanora crenulata* has distinctive apothecia with a white, crenate margin and usually a heavily pruinose apothecial disc. A similar species is *L. flowersiana*, which has a more distinctly cracked (fissured) apothecial margin; however, the apothecial disc is epruinose, or rarely and only slightly pruinose. The two taxa are easily distinguished by their spores, which are much longer in *L. flowersiana*, and by the paraphyses, which are thicker, capitate and often submoniliform in the uppermost part in *L. flowersiana*. Another related taxon is *L. hagenii*, which has smaller apothecia with a much thinner, entire to incised rather than cracked apothecial margin. The latter species also has a much thinner amphithecial cortex than in *L. crenulata*.

NOMENCLATURAL NOTES. The authorities' citation of the species was cleared up by Laundon (1984).

Although some general indications pertaining to the collection area were given in Hooker's work (southern England localities, as Glasgow, on limestone rocks) there is little chance of tracing the original collection to use as a lectotype. No

original material could be located in BM (Scott LaGreca, in letter); although W. Mudd's allegate of *Lecanora caesioalba β dispersa* from Bilsdale, Yorkshire, labeled 'Neotype specimen, *Lecanora crenulata* (Dicks.) Hook.' by an unknown investigator and, to my knowledge, not published elsewhere, has been found there. Therefore I decided to choose a neotype, giving priority, as in previous cases of species typification within the *L. dispersa* complex, to an exsiccate collection as the most appropriate. The selected neotype represents a typical and well-developed specimen of the species.

EXSICCATES SEEN. Arnold, *Lich. Exsicc.* 931a (as *L. crenulata*) (M); Arnold, *Lich. Exsicc.* 931b (as *L. crenulata*) (M; types); Arnold, *Lich. Exsicc.* 1808 (as *L. crenulata*) (M, MIN); Hasse, *Lich. Exsicc.* 240 (as *L. hagenii*) (FH); Pišut, *Lich. Slovakiae Exsicc.* 290 (as *L. albescens*) (KRAM); Tobolewski, *Lichenoth. Polon.* 187 (as *L. crenulata*) (COLO, KRAM, WIS).

SPECIMENS EXAMINED. CANADA. BRITISH COLUMBIA. Marble Canyon Provincial Park, 23 Aug. 1994, *Ryan 31716* (ASU). NORTHWEST TERRITORIES. Bathurst Island, 10 mi. W of Goodsier Inlet, 18 July 1974, *Miller 7689* (WIS); Little Gull River, 19 July 1966, *Scotter 8367* (H). ONTARIO. Bruce Co., Georgian Bay Islands National Park, Flowerpot Island, 28 July 1976, *Wong 2094* (CANL); Thunder Bay Co., Sleeping Giant Provincial Park, S of Thunder Bay lookout, 24 July 1993, *Sharnoff & Sharnoff 114616* (herb. Brodo). QUEBECK. Gatineau Co., Gatineau Park, King Mountain area off Mountain Road, 6 Oct. 1975, *Brodo 21195* (CANL); Lac St-Jean-O., Ile de la Traverse, 18–19 July 1984, *Lutzoni & Dignard s.n.* (CANL). – U.S.A. ALASKA. along Pitmegera River, 15 mi. upstream from Cape Sabine, 10–17 July 1958, *Thomson 10650*, *10565* (US, WIS); along Kaolak River, S of Wainwright, 9–18 July 1958, *Maher s.n.* (US); Kukpuk River region, Hill 902, Nasorak Ck., 31 July 1964, *Melchior 722* (WIS). ARIZONA. Coconino Co., W fork of Oak Creek Canyon, 30 mi. of Flagstaff, 15 June 1974, *Thomson 18547* (WIS). CALIFORNIA. Los Angeles Co.: Clifton, 1914, *Hasse s.n.* (MIN), Nov. 1912, *Hasse s.n.* (FH), Palo Verde Hills, above Portuguese Bend, 24 Dec. 1952, *Weber S997* (COLO); Santa Barbara Co., Santa Rosa Island, W end at Sandy Point, 2 Jan. 1994, *Nash 32687* (ASU); Ventura Co., W end of San Nicolas Island, 5 Jan. 1995, *Nash 38697* (ASU). COLORADO. San Juan Co., Mesa Verde National Park, Lower Fewkes Canyon, 27 May 1980, *Nash 17783b* (CANL). MICHIGEN. Bluff Delta Co., Burnt, Aug. 1934, *Lowe s.n.* (MICH); Chippewa Co., 0.2 mi. W of D.N.R. office, 9 July 1983, *Fischlin 100* (CANL); Macinac Co.: near Bush Bay, 3 Aug. 1974, *Cole-Schmidt 524* (herb. Cole), Bush Bay, 19 July 1972, *Nimke s.n.* (MICH, WIS). MINNESOTA. International Boundary Rainy Lake City, 1 Aug. 1901, *Fink 1200* (MIN, MICH); Wabasha Co.: 4 mi. E of Zumbro Falls, 15 Apr. 1997, *Wetmore 77231* (MIN), Snake Creek Valley, State Forest Area, 4 mi. NW of Weaver (8 mi. SE of Wabasha), 15 July 1979, *Brako 1937* (MIN), State Forest Area, 1 mi. W of Weaver (12 mi. SW of Wabasha), 16 July 1979, *Brako 1956* (MIN). NEW MEXICO. Otero Co., Lincoln National Forest, near Cloudcroft, above The Pines Campground, 10 June 1966, *Wetmore 14388* (MIN), *Wetmore 14385* (KRAM, MIN). SOUTH DAKOTA. Lawrence Co., Limestone Plateau Region, 4 mi. WSW of Savoy, 11 mi. W of Lead, 4 June 1960, *Anderson S20501* (COLO). WISCONSIN. Iowa Co., 6 mi. W of Arena, Mill Creek Bluff, 19 Aug. 1965, *Foote s.n.* (CANL); Richland Co., T9N R1W Sec. 20, 29 July 1960, *Foote 60799a* (WIS); Sauk Co., Spring Green Reserve State Natural Area, Baraboo Hills, off Jones Road, 4 Sep. 1998, *Buck 34505* (NY); Vernon

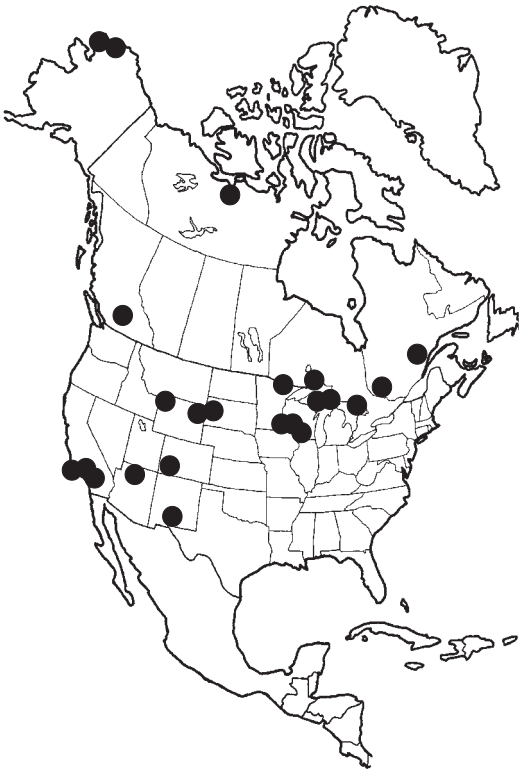


Fig. 38. Known North American distribution of *Lecanora crenulata* Hook.

Co., T12N R3W Sec. 7, 28 July 1960, *Foote 60746b* (WIS). WYOMING. Park Co., Yellowstone National Park, upper Terrace Loop, 1 mi. SW of Mammoth, 20 July 1998, *Wetmore 80943* (MIN); Weston Co., Black Hills, along US 85 at Soldier Creek (20 mi. NW of Newcastle), 12 Aug. 1961, *Wetmore 11280* (MIN, MSC).

Specimens have also been seen from Australia (MIN), Austria (GZU), Czech Republic (MIN), Germany (ASU), Poland (KRAM, MIN), Portugal (WIS), Romania (FH, KRAM), Spain (NY), Sweden (LD), UK (COLO), and Ukraine (KRAM).

Lecanora dispersa (Pers.) Sommerf.

Figs 39 & 40

Suppl. Fl. Lapp.: 96. 1826. – *Lichen dispersus* Pers., Neue Ann. Bot. **1** [Ann. Bot. **7**]: 27. 1794. – NEOTYPE (designated by Śliwa, Mycotaxon **97**: 292. 2006): [Germany, Hessen] 'Mitteldeutschland, Bez. Nordhessen: kleinflächig an licht- undwindoffenen, aber teilweise regengeschützten Stirn- und Überhangflächen stark ausgearbeiteter Dolomitfelsen im *Caloplacetum saxicolae* Du Rietz, 300 m, SO-SW, pH 7.5, naturnaher Trockenrasen auf dem Höhenzug in der Werraschleife von Albungen südlich Hitzerode, *leg. et det. G. Follmann & B. A. Follmann* (IV/1977)' [Follmann, *Lich. Exsicc. Selecti* 387, as *L. albescens*] (MIN!; ASU!, BM!, COLO!, WIS! – NEOTYPE DUPLICATES).

= *Lecanora subluta* var. *perspersa* Nyl., Flora **59**: 233. 1876. – LECTOTYPE (designated by Śliwa, Mycotaxon **97**: 293. 2006): [Ireland] 'Hibernia, Dawros Bridge, 1875, *leg. C. Larbalestier 19*' (H-NYL 28069!; BM! – 2 LECTOTYPE DUPLICATES).

Thallus within the substratum, immersed and not apparent, mostly endolithic, or superficial but indistinct, very thin, ecorticate, or composed of inconspicuous granules (distinct coarse granules sometimes observed are usually those producing apothecia); pale grey, yellowish or whitish. Apothecia occurring singly, or clustered in groups, sessile, or constricted at the base, concave, flat when mature, or soon convex, 0.3–0.9 mm diam.; disc plane, smooth, yellowish grey, pale brown, dark brown or almost black, epruinose or rarely slightly pruinose; margin prominent, or level with the disc, smooth, entire, even, or slightly flexuose, uniform, epruinose or pruinose, white, or concolorous with thallus, rarely concolorous with disc. Amphithecium (60–)90–200 μm thick,

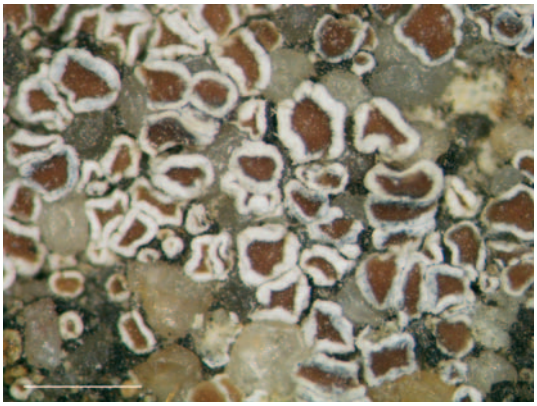


Fig. 39. *Lecanora dispersa* (Pers.) Sommerf. (*Wetmore 15510*, KRAM). Scale bar = 1 mm.

corticate, algae fill the area below the cortex or algae sparse, algal layer often discontinuous below hypothecium; cortex indistinctly delimited, ± uniform in thickness, or slightly thicker at the base than at the sides, 30–80 μm thick laterally and 35–120 μm thick at the base, composed of adglutinated hyphae to apparently cellular, ± obscured by granules (pol+, insoluble in K, soluble in N); parathecium indistinct to well delimited and up to 30 μm wide; epithecium shades of yellow or brown, granular (pol+), granules superficial and between paraphyses tips, or also inspersed in the part or whole hymenium (often the same kind of granules dispersed also through the hypothecium), fine (insoluble in K and insoluble in N), sometimes with an epipsamma (insoluble in K and soluble in N); hymenium hyaline, or pale yellow, 45–70 μm high; subhymenium indistinct; hypothecium hyaline or almost so, 40–120 μm high, composed of adglutinated hyphae to apparently cellular, often with some granules. Paraphyses slender, somewhat branched throughout, with few anastomoses, not expanded and usually not pigmented, coherent in K. Asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (broadly ellipsoid to narrowly ellipsoid), 8–[10.3]–12 × 4.5–[5.3]–6 μm, Q = 1.5–[2.0]–2.7. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD– or PD+ orange (± 75%); disc K–, C–, KC–, PD–; apothecia UV-negative or ± pale yellow or

dull greenish. Lichen products: 2,7-dichlorlichexanthone, ±pannarin; or no lichen products detected by TLC.

HABITAT. On a wide range of substrata, including calcareous and siliceous rock, concrete and mortar, dusty bark and many man-made substrates including metal, also commensally on other lichens.

DISTRIBUTION. The species is widespread in Europe and North America. It is also known from South America, Asia, Australia and Antarctica. In North America the species is a boreal to temperate element with its main distribution in temperate regions.

DISCUSSION. *Lecanora dispersa* was hitherto considered an aggregation of a few taxa. Thanks to recent progress in research on the lichen complex, *L. dispersa* s.str. is currently recognized as having epithecial granules, often inspersed in part of the hymenium or the whole of it, which are insoluble in K and insoluble in N. The presence of pannarin and the PD+ orange reaction of the apothecial margin (detectable especially on the inner side of the thalline margin) are also significant diagnostic characters in many specimens. *Lecanora dispersa* is one of the most widely distributed species of the complex, apart from *L. semipallida*, from which it differs both anatomically and chemically. The latter is well distinguishable by its K-soluble epithecial granules. The presence of vinetorin is also diagnostic (C+ yellow or orange, UV+ yellow-orange). For comparison with *L. albescens*, see under the species.

NOMENCLATURAL NOTES. In the Persoon herbarium in L there is now no collection of *L. dispersa*. Nor could any Persoon specimen of the taxon be traced in the Acharius herbarium in Helsinki. Other herbaria supposedly holding Persoon's material were contacted, also unsuccessfully. Apparently all original material has been lost. Thus the neotype was designated and exsiccate collections were chosen to supply an easily accessible reference collection (Śliwa 2006).

EXSICCATES SEEN. Arnold, *Lich. Exsicc.* 1703 (as *L. albescens*, lignicolous) (M, MIN); Arnold, *Lich. Monac. Exsicc.* 142 (as *L. albescens*, lignicolous) (M); Arnold, *Lich. Monac. Exsicc.* 232 (as *L. dispersa*) (M); Arnold, *Lich. Monac. Exsicc.* 432 (as *L. albescens*, lignicolous) (M); Arnold, *Lich. Monac. Exsicc.* 433 (as *L. dispersa*) (M); Arnold, *Lich. Monac. Exsicc.* 513 (as *L. dispersa*) (M, MIN); Cummings, *Decad. North Americ. Lich.* 300 (as *L. hagenii*) (WIS); Cummings *et al.*, *Lich. Boreali-Americ.* 249 (as *L. hagenii*) (COLO, FH, MICH); *Erbar. Crittogam. Ital. Ser. II.* 615 (as *L. flotowiana*) (MIN); Follmann, *Lich. Exsicc. Selecti* 387 (as *L. albescens*) (ASU, BM, COLO, MIN, WIS; types); Hasse, *Lich. Exsicc.* 240 (as *L. hagenii*) (COLO); Malme, *Lich. Suecici Exsicc.* 496 (as *L. hagenii*) (MIN, WIS); Merril, *Lich. Exsicc.*113 (as *L. hagenii*) (COLO, FH, MICH); Nowak, *Lich. Polon. Merid. Exsicc.* 223 (as *L. umbrina*) (KRAM, MIN); Rabenhorst, *Lich. Eur.* 624 (as *L. hagenii* f. *lithophila*) (KRAM).

SPECIMENS EXAMINED. CANADA. BRITISH COLUMBIA. Queen Charlotte Islands, Graham Island 29 June 1967, *Brodo 10693* (CANL, MIN); Vancouver, Sidney, 17 Aug. 1913, *Macoun s.n.* (FH). NEW BRUNSWICK. Alberta Co., Fundy National Park, near headquarters, 26 Aug. 1981, *Gowan 4442* (CANL). NEWFOUNDLAND. St. John's City, Bannerman Park, 6 Aug. 1978, *Ahti 34903a* (H). NORTHWEST TERRITORIES. Eskimo Lakes, 30 July 1966, *Scotter 8691*, *8692* (H), Five Hundred Lake, 27 July 1966, *Scotter 8589b* (H); Southampton Island, near the Hudson Bay Post, E of Coral Harbor, 15 Aug. 1959, *Thomson 13842* (WIS). NOVA SCOTIA. Halifax Co., Halifax: Fairview Cemetery, 24 Dec. 1968, *Ward s.n.* (CANL), Fleming Park, 22 Mar. 1969, *Ward 115* (CANL), by the Halifax Memorial Library, 9 Jan. 1969, *Ward 5* (CANL), corner of Sackville St. and Brunswick St., 14 Dec. 1989, *Ward s.n.* (CANL), along Tower Rd., N of Univ. Av., 20 Dec. 1968, *Ward s.n.* (CANL), Watt St., 9 Jan. 1969, *Ward 8* (CANL); Lonenburg Co., Mahone Bay, 4 May 1969, *Ward 154* (CANL); Queens Co., Kejimkujik National Seaside, adjunct Port Joli, 9 May 1999, *Buck 35826* (NY). ONTARIO. Bruce Co., 2 mi. SE of Miller Rd., on Hwy 6, 28 July 1976, *Wong 2046* (CANL, MICH), *Wong 2048* (CANL); Carleton Co., Ottawa, rocks along Rideau River, Hot's Back, 8 Oct. 1976, *Harris 12145* (MICH); Niagara Regional Municipality, Old Welland Canal Island, near E end of Quaker Rd., Welland, 14 Sep. 1999, *Olszewski 4984b* (ASU), *Olszewski s.n.* (OMA); Dufferin Co., Monsfield, 5 June 1984, *Wong 3632*, *3638* (CANL); Frontenac Co., Clarendon, 2 mi. S of town, 26 June 1979, *Wong 2904* (CANL); Hastings Co., L'Amable, L'Amable Lake, 22 Aug. 1986, *Wong 4332* (CANL); Leeds and Grenville United Co., Chaffey's Locks, Queens Univ. Biol. Station, Lake Opinicon,

6 Mar. 1976, *Brodo 21038* (CANL); Renfrew Co.: 1 mi. SW of Shamrock, off Hwy 132, 18 May 1972, *Wong 822*, *Wong 830* (CANL), Black Donald Lake, 19 Aug. 1986, *Wong 4175* (CANL), Calabogie, Calabobie Lake, 21 Sep. 1973, *Wong 1378a* (COLO). QUEBECK. Gaspé-Est Co., Forillon National Park, Gaspe Peninsula, near Cap Bon-Ami, 10 Aug. 1971, *Brodo 18620* (CANL); Gatineau Co., Ottawa Region, King Mountain area, off Mountain Road, 28 Oct. 1972, *Brodo 19100* (CANL). – MEXICO. Baja California, Guadalupe Island: near the N peak, on ridge, 2 Jan. 1996, *Nash 38342* (ASU), 19–29 Apr. 1963, *Weber & McCoy L36632* (COLO). – U.S.A. ARIZONA. Cochise Co., Chiricahua Mts, below Herb Martyr Reservoir, 30 Mar. 1961, *Weber & Awasthi S28047* (COLO). ARKANSAS. Jefferson Co., Pine Bluff Arsenal, along S side of Arkansas River, N of Pine Bluff, along Sibert Road, *ca* 1.6 mi. SE of Plainview Gate, 2 Dec. 1999, *Ladd & Peterson 21928* (NY). CALIFORNIA. Contra Costa Co., Mt. Diablo State Park, July 1984, *Ryan 11161* (ASU); Mendocino Co., near Abion along Route 1, 14 Aug. 1975, *Nash 11430* (ASU); Monterey Co., Foothills Road, 3 mi. SW of Soledad, 8 Oct. 1989, *Ryan 26826* (ASU); Riverside Co., Eden Hot Springs, 1911, *Hasse s.n.* (MIN); San Luis Obispo Co., Morro Rock Reserve, 1 May 1990, *Riefner 9059* (WIS); San Mateo Co., Fatjo ranch, Skyline Blvd., Devil's Canion, 24 Aug. 1957, *Shushan S14544* (COLO); Santa Barbara Co., Santa Rosa Island: E Point, 3 Jan. 1994, *Ryan 31187* (ASU), S Point, 5 Jan. 1994, *Ryan 31373* (ASU), lower end of Old Ranch Canyion, 3 Jan. 1994, *Nash 32889* (ASU); Santa Barbara Co., San Miguel Island, along ridge extending W of Green Mountain, 16 Mar. 1998, *Nash 41236* (ASU); Yolo Co., 631 Oak Avenue, Davis, 1 Mar. 1978, *Weier 549* (COLO). COLORADO. Larimer Co., Lytle Formation, Dakota Ridge, 4.5 mi. SW of Ft. Collins, above Horsetooth Reservoir, 1 July 1960, *Anderson S20276* (COLO). CONNECTICUT. New Haven Co., Guilford 13 Aug. 1925, *Evans s.n.* (FH). IDAHO. Bonner Co., in town of Sandpoint, next to Presbyterian church in boulevard, 14 Apr. 2001, *Spribille 10415* with *Goward & Arvidson* (herb. Spribille); Boundary Co., S of Kingsgate and U.S.A./Canada boundary, Copper Falls, 14 June 2004, *Spribille 14031* (herb. Spribille). INDIANA. Porter Co., Indiana Dunes National Lakeshore: 1 mi. W of visitor center on Highway 12, 28 June 1985, *Wetmore 54026* (MIN), Howes Prairie, just S of E end of Dune Acres, 20 June 1985, *Wetmore 53695b* (MIN); Putnam Co.: 1 mi. SE of Limedale, 20 May 1945, *Wagner 415* (NY), 3 mi. SW of Greencastle, 11 May 1945, *Wagner 932* (NY), Varmillion Falls, 6 mi. NE of Greencastle, 22 Aug. 1970, *Egan 3106* (MIN). IOWA. Bremer Co., along Iowa Highway 3, 5 mi. E of Waverley, 28 Mar. 1967, *Wetmore 15560* (MIN), *Wetmore 15561* (KRAM, MIN); Butler Co.: 5 mi. NW of Clarksville, along Rock River, 6 May 1967, *Wetmore 15668* (KRAM, MIN), in low area at E edge of Greene on N side of road, 13 June 1965, *Wetmore 12574* (MIN); Clayton Co.: along Mississippi River, S of McGregor, 8 Oct. 1966, *Wetmore 15461* (MIN, MSC), *Wetmore 15465* (US), SW of town of Volga along road to Arlington, on S – facing rock outcrop, 10 Oct. 1965, *Wetmore 13536* (MIN); Dobuque Co., White Pine Hollow State Preserve, NW of Luxemburg, 6 Nov. 1965, *Wetmore 15510* (KRAM, MIN); Fayette Co.: Fayette, 1895, *Fink s.n.* (MICH), 28 Oct. 1895, *Fink s.n.* (US), Echo Valley State Park, E of West Union, 30 Oct. 1965, *Wetmore 13617* (MIN), 1 mi. E of Wadena, 10 Oct. 1965, *Wetmore 13562* (MIN); Franklin Co., Beeds Lake State Park, 3 mi. NW of Hampton, 13 Aug. 1967, *Wetmore 17498* (KRAM, MIN); Osceola Co., Ocheyedan Mound, 1 mi. S of Ocheyedan, 26 July 1965, *Wetmore 12616* (MIN). KANSAS. Crawford Co., 8 mi. N of Pittsburg, 24 Apr. 1954, *Kramer 425* (NY); Ellis Co.: 8 mi. S of Hays, 29 Nov. 1953, *Farland s.n.* (US), 10 mi. SE Hays, 20 Nov. 1953, *Farland s.n.* (US). KENTUCKY. Madison Co., Glade, 10 mi. N of Richmond, 18 Aug. 1937, *Hubricht s.n.* (US). MAINE. Hancock Co., Acadia National Park, Mt. Desert, Island Great Head (4 mi. S of Bar Harbor), 8 July 1983, *Sullivan 1491* (MIN). MARYLAND. Allegany Co., near Cumberland, 28 Aug. 1911, *Plitt 38* (FH); Baltimore Co., Hampden, 24 Oct. 1911, *Plitt 465* (FH), Ridge Road and Falls Road, 20 Apr. 1980, *Worthley s.n.* (NY); Washington Co., along Route 40, 0.1 of a mi. W of Route 57, 29 Oct. 1974, *Norden & Norden s.n.* (NY). MASSACHUSETTS. Barkshire Co., Lanesboro, Aug. 1911, *Hill 1135* (MIN); Barnstable Co., Somerville, Cenral Av., 29 July 1978, *Sherwood s.n.* (CANL, COLO, FH); Berkshire Co., Town of Cheshire, E of Lanesborough, along Pittibone Brook, 5 May 1995, *Buck 27670* (NY); Dukes C., Penikese Island, 1923, *Fink s.n.* (MICH); Middlesex Co., City of Cambridge, Farlow Herb., Harvard University, 6 Nov. 2001, *LaGreca s.n.* (MIN); Roxbury Co., Boston, Eustis Playground, July 1979, *Sherwood & Kneiper s.n.* (FH); Suffolk Co.: Boston, Harbor Islands National Rec. Area: Lovell's Island, 15 May 2001, *LaGreca 647* (MIN), Thompson Island, on the S part of the island, 18 July 2001, *LaGreca 652* (FH); Worcester Co.: Boylston, opposite Town Hause, 26 Sep. 1960, *Gates 2581* (COLO), Lancaster, Devens Reserve Forces Training Area, 10 m off E side of Jackson Road, *ca* 0.5 km SE of Range Control, 10 Oct. 1998, *Kneiper 98746* (FH), Spencer, in Pine Grove Cemetary, 5 Apr. 1958, *Gates 2383* (COLO). MICHIGAN. Barry Co., Barry

State Game Area, 29 Mar. 1963, *Mazzer 1437* (MICH); Chippewa Co., 0.5 mi. S of Detour, 13 Aug. 1974, *Harris 9501* (MICH); Delta Co., *ca* 0.25 mi. S of Portage Bay Campground, 15 Sep. 1976, *Harris 11694* (CANL, MICH); Ingham Co., MSU campus, 7 June 1974, *Harris 8705* (MSC); Jackson Co., Old Fields S of Glenn Road, 0.5 mi. E of Katz Road, 10 Apr. 1977, *Harris 12204* (MICH); Livingston Co.: Old Homestead, Brighton Recreation Area, NW corner of Hamburg and Bishop Lake Roads, 16 July 1978, *Buck s.n.* (MICH), road bank at intersection of Tiplady and Silver Hill Roads, 8 Nov. 1975, *Harris 10492* (MICH); Mackinac Co., mouth of Cut River below Cut River Bridge on US Hwy. 2, 20 Aug. 1977, *Harris 12587* (MICH); Rockland Co., Hudson River, 9 June 1963, *Fleming & Nearing s.n.* (NY); Washtenaw Co.: near small bog at intersection on Bush Rd. just E of Mill Lake, 27 Sep. 1975, *Harris 10335* (MICH), E of Hankard Lake, 26 May 1972, *Harris 7725* (NY), NE edge of field at corner of South Main and Eisenhower Roads, 20 Oct. 1977, *Harris 12664* (MICH). MINNESOTA. Beltrami Co.: Bemidji, 11 July 1900, *Fink 640* (CANL, MIN), Red Lake Peatlands, (27 mi. S of Baudette) W of Highway 72, 30 Aug 1978 Wetmore 36486 (MIN, US); Blue Earth Co., Mankato: (Rapidon), 28 June 1899, *Fink 173* (MIN), 1 July 1899, *Fink 215* (MIN, MICH); Chisago Co.: across St. Croix River from Osceola Wisconsin, 30 Sep. 1988, *Wetmore 62810* (MIN), Taylors Falls, 14 Aug. 1897, *Fink 103* (MIN), *Fink 118* (MICH, MIN); Chippewa Co.: Granite Falls, 13 July 1899, *Fink 2526* (MICH), *ca* 1.5 mi. NW of Granite Falls on Palmer Creek Road, W of road, 22 May 1998, *Wheeler 18690* (MIN), *ca* 16 mi. N of Maynard on Rte. 4, County Park No. 1, 30 June 1997, *Wheeler 16399* (MIN); Cottonwood Co.: *ca* 7.5 mi. NE of Jeffers, Jeffers Petroglyph Hist. Site, 10 June 1999, *Wheeler 19978* (MIN), Red Rock Falls County Park at Red Rock Dells, 28 Sep. 1991, *Buck 20878* (NY); Huston Co., Crooked Creek Valley, 3 mi. W of Caledonia, 23 Apr. 1977, *Trana 1819* (MIN); Lac Qui Parle Co., *ca* 4.5 mi. N of Bellinham on Rte. 75, E of road, 21 May 1998, *Wheeler 18656* (MIN), 26 May 1998, *Wheeler 18778* (MIN); Lake Co., Gooseberry River State Park, the mouth of Gooseberry River, 22 May 1943, *Thomson 2177* (WIS); Lake of the Woods Co., Clemenston, 8 mi. E of Baudette, 18 Aug. 1994, *Wetmore 74864* (MIN); Le Sueur Co.: *ca* 2.5 mi. SW of Kasota Prairie, 16 June 1998, *Wheeler 19224* (MIN), in Minnesota River Valley, 3.5 mi. SE of St. Peter on County Road 101, near the Kasota Prairie (10 mi. N of Manakato), 23 Apr. 1983, *Schuster 349* (MIN); Mahnomen Co., 3 mi. SE of Waubun, 7 Aug. 1974, *Wetmore 23391* (MIN); Mcleod Co., *ca* 3 mi. S of Hutchinson,

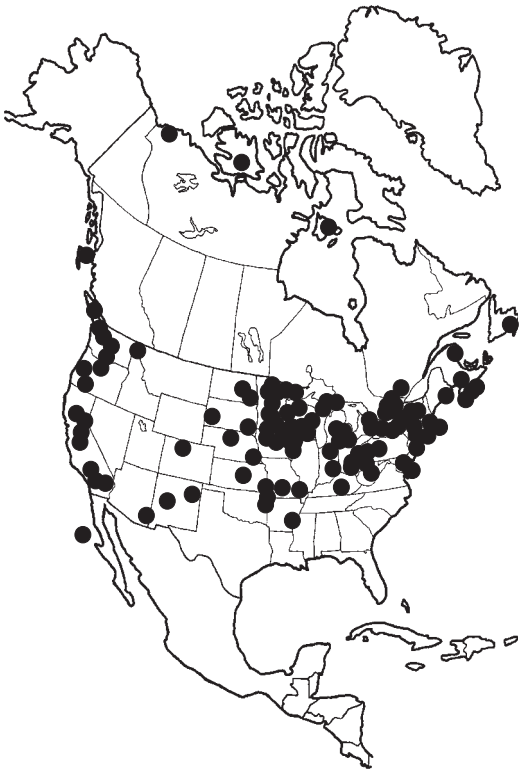


Fig. 40. Known North American distribution of *Lecanora dispersa* (Pers.) Sommerf.

on Rte. 15, 5 June 1999, *Wheeler 19919* (MIN); Otter Tail Co., Battle Lake, 20 June 1900, *Fink 54* (MIN); Pipestone Co., NW edge of Pipestone, Hiawatha State Game Refuge, 14 May 1999, *Wheeler 19601* (MIN); Ramsey Co., Mounds View, N of Highway H, SW of, 10 May 1977, *Berbee 51* (MIN); Redwood Co., *ca* 5.5 mi. N of Belview on Rte. 7, W of road, 1 July 1997, *Wheeler 16468* (MIN); Renville Co.: *ca* 3.5 mi. SE of Franklin on Rte. 5, 3 July 1997, *Wheeler 16543*, *Wheeler 16556* (MIN), Morton Rock Outcrop, S side of Morton, 25 June 1997, *Wheeler 16226* (MIN), W side of Morton, Morton Outcrop complex, 1 Sep. 1997, *Wheeler 17521* (MIN); Rock Co., *ca* 6 mi. W of Hardwick on Rte. 7, 15 May 1999, *Wheeler 19636* (MIN); Scott Co.: 4.5 mi. NNE of Jordan, 1.1 mi. W of Rte. 169, Louisville Swamp, 10 June 1998, *Wheeler 19049* (MIN), 5 mi. SW of Shakopee along US 169, 17 Apr. 1971, *Wetmore 19796* (MIN, NY), 5 mi. SW of Shakopee, 17 Nov. 2001, *Śliwa 1508*, *1509*, *1510* (KRAM); Stearns Co.: Cold Spring, E bank of Sauk River, 21 July 1997, *Wheeler 16690* (MIN), St. Cloud, Sep. 1891, *Morgan*

s.n. (MICH); Swift Co., *ca* 12 mi. N of Murdock on Rte. 33, W of road, 7 Aug. 1997, *Wheeler 16972* (MIN); Traverse Co., 3 mi. SW of jct. of Rtes. 27 and 117, SE of Rte. 27 17 May 1999 Wheeler 19708 (MIN); Wabasha Co.: 4 mi. E of Zumbro Falls, 15 Apr. 1997, *Wetmore 77228* (MIN), East Indian Creek, 5 mi. W of Weaver (10 mi. S of Wabasha), 26 June 1979, *Brako 1406*, *1407*, *1411*, *1416* (MIN), West Albany Quarry, 4 mi. NE of West Albany (12 mi. SW of Wabasha), 26 June 1979, *Brako 1445b*, *1446* (MIN); Washington Co.: along North Point Douglas Road, at N edge of Afton, 5 Oct. 1988, *Wetmore 63014* (MIN), 3 mi. N of Prescott, Wisc. at Control Data Park, 13 Oct. 1988, *Wetmore 63170* (MIN); Winona Co.: Big Trout Creek, 1 mi. S of Pickwick, 16 June 1979, *Brako 825a*, *831*, *832*, *834* (MIN), near Garvin Brook, 3 mi. S of the Arches, 18 June 1979, *Brako 976* (MIN), St. Charles (20 mi. SW of Winona), 18 June 1979, *Brako 1037b* (MIN), Stockton Hill Quarry, 2.5 mi. E of Stockton (7 mi. W of Winona), 12 June 1979, *Brako 472* (MIN), Troy, SW-most corner of Winona Co., 18 June 1979, *Brako 1015*, *1016*, *1024* (MIN), Whitewater Wildlife Management Area 3 mi. N of Elba (23 mi. NW of Winona), 13 Oct. 1979, *Brako 2394* (MIN); Yellow Medicine Co., Granite Falls, 1 July 1899, *Fink s.n*. (MICH), 11 July 1899, *Fink 436* (MICH, MIN). MISSOURI. Carter Co., Peck Ranch Conservation Area, vicinity of Stegal Mt. Fire Tower, *ca* 1.8 mi. N of Peck Ranch Road, *ca* 3.7 mi. E of Co. Hwy, 5.3 mi. NE of MO 19 at Winona, 16 Apr. 1997, *Harris 40410* (NY); Greene Co., Wilson's Creek National Battlefield, Wire Road, 29 Oct. 2000, *Harris 44170* (NY). NEBRASKA. Cherry Co., Niobrara Valley Preserve, W section, 13 June 1992, *Ladd 16531* (COLO); Gage Co., Homestead National Monument, 4 mi. NW of Beatrice: Freeman School, 24 July 1996, *Wetmore 76616* (MIN), around edge of prairie of park, 24 July 1996, *Wetmore 76591* (MIN). NEW JERSEY. Sussex Co., Delaware Water Gap Nat. Rec. Area: just N of Milford Bridge, 13 Aug. 1986, *Wetmore 56731* (MIN, US), 2 mi. S of Wallpack Center, 9 Aug. 1986, *Wetmore 56458* (MIN). NEW MEXICO. Carton Co., San Francisco Mts, above pass where US 180 crosses mountains, 9 Oct. 1983, *Nash 22586* (ASU), San Miguel Co., Santa Fe National Forest, El Porvenir Campground, 15 mi. NW of Las Vegas, 22 Apr. 1970, *Egan 5100* (MIN). NEW YORK. Albany Co.: Karner Pine Bush, *s.d*., *Dirig L1143b* (NY), Ravina, SW of Albany, 6 Apr. 1962, *Brodo 3467b*, *3491* (CANL); Dutchess Co.: W shore of Cruger's Island, Hudson River, town of Red Hook, 17 Sep. 1977, *Feeley s.n*. (NY), near mouth of Sawkill River at Hudson River, N side, 14 Sep. 1977, *Feeley s.n*. (NY); Essex Co., Adirondack Region, Newcomb, 29 Aug. 1934, *Lowe 4918* (NY); Genesee Co.: Batavia, 24 July 1883, *Green s.n*. (NY), *Green L79218* (COLO), *s.loc*., *s.d*., *Muenscher s.n*. (NY); Jefferson Co., E1 Dorado Shore Preserve, 24 May 1997, *Harris 40810* (NY); Madison Co., Bridgeport Cornell University Field Biol. Station, 11 July 1958, *Brodo s.n*. (CANL), 21 July 1958, *Brodo s.n*. (CANL), 28 Sep. 1958 *Brodo s.n*. (NY); Niagara Co., Niagara Falls Three Sisters: E part of second Sister, 2 Nov. 1988, *Harris 22908* (NY), W part of second Sister, 2 Nov. 1988, *Harris 22902* (NY); Rockland Co.: Pine Meadow Mts, 24 July 1963, *Fleming et al. s.n*. (NY), Harriman State Park, along Woodtown Rd. W. and Pine Meadow Rd. W. from dam at S end of Lake Sebago on Seven Lakes Dr. to Pine Meadow Mts, 26 March 1997, *Buck 31750* (NY); Suffolk Co.: Cranberry Bog Nature Preserve, along Co. Rd. 52, *ca* 0.5 mi. S of Riverhead, 20 Sep. 1986, *Harris 19426* (NY), Orient Point State Park Long Island, Long Beach, 18 July 1961, *Brodo 2839* (MSC). NORTH DAKOTA. High prairie, 10 Aug. 1907, *Brenckle s.n*. (CANL); La Moure Co., Kulm, Jan. 1908, *Brenckle s.n*. (NY), Feb. 1908, *Brenckle s.n*. (FH), Mar. 1908, *Brenckle s.n*. (FH), Apr. 1908, *Brenckle s.n*. (MIN), May 1908, *Brenckle s.n*. (FH), Oct. 1907, *Brenckle s.n*. (NY); Wells Co., 6 mi. SE of Harvey, 5 June 1977, *Trana 1965* (MIN). OHIO. Butler Co.: near Oxford, 7 Feb. 1927, *Fink & Hatrick s.n*. (MICH, FH), Seven Mile, 25 Jan. 1901, *Fink s.n*. (WIS); Champaign Co., near Urbana, 14 Apr. 1926, *Fink s.n*. (MICH); Cuyahoga Co., Cuyahoga Valley Nat. Rec. Area: 0.5 mi. S of Brecksvill, 21 July 1985, *Wetmore 54269* (MIN), area SE of Independence, around gravel pit, 22 July 1985, *Wetmore 54317* (MIN); Erie Co., Baybridge, *s.d*., *Fink 140a* (MICH); Greene Co., 2 mi. E of town of Yellow Springs, at Clifton Gorge of the Little Miami River, 2 Sep. 1968, *Wetmore 18132* (MIN); Morgan Co., Morgan Twp., 28 Feb. 1972, *Flenniken 7234* (CANL); Portage Co., Great Lakes Region, near Dix Stadium, Kent State University, 2 Mar. 1990, *Mazzer 37081* (NY); Summit Co., Cuyahoga Valley Nat. Rec. Area, 1 mi. SE on Wetmore Road S of Peninsula, 13 July 1985, *Wetmore 54125* (MIN). OKLAHOMA. Cherokee Co., J. T. Nickel Family Nature and Wildelife Preserve, *ca* 1.2 mi. N of Sparrowhawk Mts, Goats Bluff above Illinois River, 30 Oct. 2000, *Harris 44345a* (NY); Ottawa Co., Bicentennial State Park, *ca* 3.5 mi. E of Quapaw, along Spring River, 31 Oct. 2000, *Buck 38571* (NY). OREGON. Klamath Co., Fremont National Forest, 800 m W of Rd 335, across from Anderson Field, 9 July 1991, *Ryan 28292b* (ASU); Lane Co., Eugene, U. of Oregon campus, 5–7 Aug. 1978, *Sherwood s.n*. (CANL, FH); Wasco Co., 48 km N of Madras, between Shaniko and Antelope, along

Ward Creek, 24 Apr. 1877, *Rossman L65576* (COLO), 30 May 1977, *Rossman s.n.* (MIN). PENNSYLVANIA. Allegheny Co., W of Wildwood, North Park, on Hemlock Drive, 3 May 1965, *Brodo 5523* (CANL, MSC). SOUTH DAKOTA. Custer Co., Black Hills: 8 mi. W of Custer near US 16, 29 June 1960, *Wetmore 6528* (MSC), Custer State Park, 0.5 mi. W of S.D. 87, 4 July 1960, *Wetmore 6837c* (MSC); Turner Co., 1 mi. S, 1.5 mi. E of Parker, Parker Township, 28 Dec. 1958, *Anderson S20756* (COLO). VERMONT. Rutland Co., Brandon, 19 June 1920, *Dutton s.n.* (FH), May 1923, *Dutton s.n.* (NY), 28 July 1922, *Dutton s.n.* (COLO, MICH); Island Co., Langley, Apr. 1924, *Grant 208a* (FH), *Grant s.n.* (WIS). WASHINGTON. Kitsap Co., Puget Sound Islands, 28 June 1906, *Fink 41* (MICH); Klickitat Co., vicinity Bingen, 15 June 1952, *Weber S968* (COLO); Snohomish Co., Marysville, June 1930, *Grant s.n.* (US); Yakima Co.: Naches, May 1931, *Grant s.n.* (US), 2.4 km ESE of town of Naches, 1 July 1985, *Ryan 16352a* (ASU, MIN), *Ryan 16352b*, *16352c* (ASU). VIRGINIA. Pocahontas Co., Gum farm near Cass, 19 Nov. 1923, *Gray s.n.* (FH, NY). WISCONSIN. Ashland Co., Apostle Island National Lakeshore: Devils Island, at N end and along shore, 11 Aug. 1987, *Wetmore 60758* (MIN), Long Island, 15 Aug. 1995, *Wetmore 75667* (MIN); Brown Co., SW of Dyckesville, July 1953, *Culberson 3020* (US); Dane Co.: Ashton, N of Middleton, 13 Apr. 1926, *s.coll.*, *s.n.* (WIS), Madison, Shorewood Quarry, Apr. 1956, *Iltis s.n.* (FH, WIS), 2.5 mi. W of Marshall, Charles Schroeder farm, 19 Aug. 1968, *Schroeder s.n.* (WIS); Green Co., 1 mi. S of county line, 2 mi. NE of New Glarus, 24 Sep. 1949, *Thomson 24594* (WIS); Green Lake Co., E of Markesan, site of former Utley, 20 Oct. 1973, *Thomson 17866* (WIS); Hollandale Co., *s.loc.*, 17 June 1925, *s.coll. s.n.* (FH); Iowa Co.: Blue Mounds, 16 June 1953, *Thomson 4235* (WIS), 3 mi. S of Blue Mounds, 8 June 1953, *Thomson 4294* (WIS), Thomson Praire, 30 Aug. 1992, *Thomson 24288* (CANL, WIS), Thomson Praire, S of Blue Mounds, July 1992, *Thomson 24262* (WIS); Lafayette Co., T3N R1E S.5, 20 July 1960, *Foote 60438b* (WIS); Richland Co., T. 10N; R. 1E, Sect. 36, 7 Oct. 1969, *Nee 2730* (WIS); Veron Co., St. Peter sandstone, 16 July 1962, *Foote 621054* (WIS); Walworth Co.: Elkhorn, 24 July 1940, *Thomson 2176* (WIS), Whitewater, 30 June 1940, *Thomson 2171* (WIS).

Specimens have also been seen from Antarctica (Śliwa & Olech 2002), Armenia (COLO), Australia (COLO, MIN), Austria (GZU, KRAM), Chile (COLO), Estonia (KRAM), Germany (COLO, GOET, L, MSC, WIS), Hungary (NY), Norway (KRAM: Spitsbergen), Poland (KRAM), Romania (KRAM), Sweden (ASU, COLO, LD, NY, WIS), Switzerland (COLO), UK (KRAM, NY), and Ukraine (KRAM).

Lecanora flowersiana H. Magn. Figs 41 & 42

Acta Horti Gotob. **19**(2): 38. 1952. – HOLOTYPE: 'U.S.A. UTAH. Wayne Co., Ekker's Ranch, on dry exposed sandstone at 6000 ft., 19–20.5.1951, *coll. Dr Seville Flowers*' (UPS!; COLO! – ISOTYPE).

Thallus within the substratum, immersed and not apparent (endolithic or endophloedal) or rarely crustose and composed of dispersed inconspicuous areoles, greyish. Apothecia occurring singly, widely sessile or constricted at the base, concave, cup-like or flat to slightly convex when mature, 0.3–1.0 mm diam.; disc plane to slightly convex, smooth, reddish brown, dark brown to blackish, epruinose; margin prominent or level with the disc, thick, smooth, distinctly cracked (with 3–10 fissures) when young then thin and entire or slightly crenate in older apothecia, even, uniform, epruinose, white or rarely slightly brownish on inner side (close to the disc), paler than the disc. Amphithecium 100–170 µm thick, corticate, algae fill the area below the cortex and reach the top of margin; cortex indistinctly delimited, ± uniform in thickness, 30–50(–70) µm thick laterally and at the base, amorphous (cell walls and lumina indistinct), gelatinous, more or less obscured by granules (pol+, insoluble in K, soluble in N); parathecium ± distinct, 10–15 µm wide; epithecium deeply pigmented (up to 1/3 of the upper hymenium), shades of brown or reddish (colour disappearing or unchanged with K and more intense red with N), not at all granular, epipsamma absent, or rarely present and then undefined (insoluble in K, soluble in N); hymenium partly coloured by extended epithecial pigment, hyaline below, 40–60 µm high; subhymenium distinct, granular, not transparent, 20–30 µm high; hypothecium hyaline or almost so, 50–90 µm high, composed of adglutinated hyphae, darkened by granules (pol–) and oil droplets. Paraphyses simple or scarcely branched in upper part, thick and adglutinated, uppermost part (2–3 highest segments) apparently submoniliform and pigmented, distinctly septate, expanded to capitate apically, coherent in K. Asci clavate,

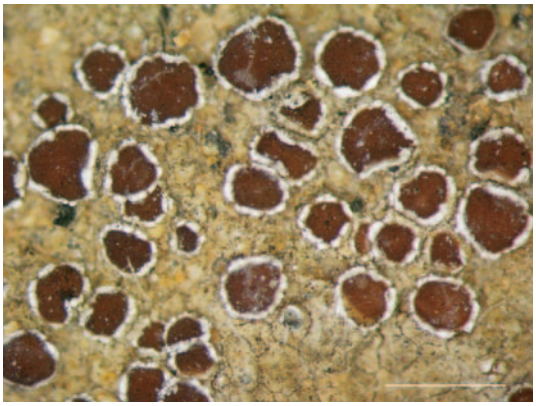


Fig. 41. *Lecanora flowersiana* H. Magn. (*Trana 4995*, MIN). Scale bar = 1 mm.

8-spored; ascospores hyaline, simple, mostly narrowly ellipsoid (broadly ellipsoid to narrowly ellipsoid), 10.5–[13.0]–16(–18) × 4–[5.1]–6 µm, Q = 1.8–[2.6]–3.7. Pycnidia not observed.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. On dry, exposed sandstone and granite rock, occasionally also on wood; in desert to montane habitats. Mostly at elevation of above 1000 m and up to 2870 m.

DISTRIBUTION. The species occurs exclusively in central and western North America. It represents western temperate element.

DISCUSSION. *Lecanora flowersiana* is characterized by a reddish brown, dark brown to black, usually epruinose apothecial disc and a white, distinctly cracked apothecial margin. It is also easily distinguishable by its pigmented upper part of the hymenium, its thick adglutinated paraphyses which may become submoniliform apically, and its narrowly ellipsoid spores. The taxon was first recognized by W. A. Weber in the 1950s (label information) but was subsequently neglected and for a long time not even considered a member of the *L. dispersa* complex. The species is closely related to *L. percrenata* H. Magn., a taxon described from Central Asia (Magnusson 1940). The type collection of the latter species is too poor a specimen to elucidate potential differences, but part of the North American collections vary from typical *L. flowersiana* and were recognized as conspecific with *L. percrenata*. *Lecanora percrenata* differs in epithecium colour and in having a more distinct thallus. Epithecium colour can be influenced by habitat conditions such as insolation, and is also altered by parasitic fungi; thus it is not very reliable as a diagnostic character. The taxonomic relation between the two species needs more attention since their separation from each other is open to question. Further investigations in Asia might yield an explanation. For further comparison with *L. percrenata*, *L. crenulata* and *L. hagenii*, see under those species.

SPECIMENS EXAMINED. CANADA. ALBERTA. 15.5 mi. N of Twin Buttes, 27 July 1985, *Ryan 13964* (OMA). SASKATCHEWAN. Halbrite, Lampnd C.P., 1 June 1960, *Looman 600113* (COLO). – U.S.A. ARIZONA. Apache Co., Carrizo Mountains: canyon E of Pastora Peak, 4 July 1974, *Nash* 9096, *Nash 9097* (ASU), Pastora Peak, 14 Aug. 1974, *Marsh 418* (ASU); Coconino Co., along Arizona Hwy 64, 18.5 mi. N of Williams, 3 Jan. 1986, *Ryan 15151* (ASU). CALIFORNIA. Orange Co., Newport, 1906, *Hasse s.n.* (FH); San Bernardino Co., W side of Hwy 18, *ca* 16 km NNE of Big Bear Lake Village, 8 June 1985, *Ryan 14817* (ASU). COLORADO. Albany Co., between Bosler Junction and base of Laramie Hills, 30 Apr. 1954, *Shushan & Weber S2215* (COLO); Archuleta Co., Simms Ranch, 2 mi. N of Chromo, 14 June 1955, *Shushan S9896* (COLO); Boulder Co., Lytle Formation, Dakota Ridge, W and NW of Boulder, 30 July 1960, *Anderson S20047a* (COLO); Elbert Co., 4 mi. NW of River Bend, 2 Sep. 1955, *Shushan S8000* (COLO); Jefferson Co., Niobrara Valley Preserve at mouth of Mt. Vernon Canyon near Hwy I-70, 11 Sep. 1981, *Weber et al. L72122* (COLO); Larimer Co., Lytle Formation, Dakota Ridge, 22 mi. N of Ft. Collins, two mi. SE of Table Mt., 26 June 1960, *Anderson S20149* (COLO); Mesa Co., N end of Colorado National Monument, at mouth of Fruita Canyon, 12 May 1955, *Shushan & Weber S5272* (COLO); Montezuma Co., *ca* 30 mi. W of Cortez, vicinity of junction of Yellowjacket and McElmo Creeks, 10 June 1958, *Shushan S11366* (COLO); San Juan Co., Mesa Verde National Park, E side of Navajo Canyon, 27 May 1980, *Nash 18021* (ASU); Weld Co., NW of Raymer, *ca* 0.5 mi. SW of twin Pawnee Buttes, 22 Dec. 1954, *Shushan & Higgins S5654* (COLO); Yuma Co., 6 mi. E of Wray, 22 Aug. 1960, *Shushan & Anderson L32946* (COLO). IDAHO. Lemhi Co., SE of Salmon,

4 June 1986, *Rosentreter 3822* (WIS); Owyhee Co., Ox Lake Grade, John's Pasture, 24 June 1991, *McCune 6943b* (KRAM, OSC). KANSAS. Rooks County Co., 16 July 1883, *A.K. s.n.* (NY); Scott Co., Scott County State Park, 15 Aug. 1950, *Fearing 537* (NY), 22 July 1950, *Kramer 447* (NY); Stanton Co., 2 mi. N of Saunders, 21 May 1956, *Shushan S8136* (COLO). MONTANA. Gallatin Co., Yellowstone National Park, below Black Butte along Hwy 191, near NW corner of park, 15 July 1998, *Wetmore 80566* (MIN); Lake Co., Rocky Mountains Summit of Cedar Peak, Mission Range, 30 Sep. 1978, *McCune 10008* (KRAM, OSC); Liberty Co., Tiber Dam Rec. Area, 35 mi. ESE of Shelby, 1 Aug. 1978, *Trana 4995* (MIN). NEBRASKA. Garden Co., Ash Hollow, 22 mi. NW of Ogallala, 29 June 1997, *Wetmore 77410* (MIN); Keya Paha Co., Niobrara Valley Preserve, along N side of Niobrara River, ca 5 mi. SSE of Norden, 12 June 1992, *Ladd 16469* (COLO); Sioux Co.: 13 mi. N of Mitchell, 6 July 1997, *Wetmore 77746* (MIN), Agate Fossil Beds National Monument: 1 mi. E of entrance on N side of road, 9 July 1997, *Wetmore 77969* (MIN), 1 mi. W of headquarters on N side of road, 9 July 1997, *Wetmore 77885* (MIN), 1 mi. W of Carnegie Hill on S side of road, 9 July 1997, *Wetmore 77935* (ASU, MIN), Stenomylus Quarry, unit SE of main park unit, 8 July 1997, *Wetmore 77863* (MIN), W of headquarters at S end of ridge, near road, 7 July 1997, *Wetmore 77783* (MIN). NEVADA. Washoe Co., road to the 'Pyramid', E side of Pyramid Lake, 25 June 1985, *Ryan 13193b* (ASU). NEW MEXICO. San Juan Co., Chaco Canyon National Monument: Charca Mesa S of Wijiji ruins, 6 Aug. 1979, *Nash 16420* (ASU), S side of Gallo Wash, across from campground, 5 Aug. 1979, *Nash 16180* (ASU); San Juan Co.: Hogback North, 20 mi. NW of Farmington, 19 Sep. 1973, *Rogers 39d* (ASU), P21, 31 Aug. 1974, *Marsh 317* (ASU), W slope of mesa, 2 mi. S of state line, U.S. Hwy 666, N of Shiprock, June 1957, *Shushan S11223* (COLO). NORTH DAKOTA. Billings Co.: Badlands S of town Medora, 30 July 1965, *Wetmore 12755*, *12761*, *12769* (MIN), Theodore Roosevelt National Park, S Unit.: 1 mi. ESE of Bison Corral (6 mi. N of Medora), 28 June 1998, *Wetmore 80349* (MIN), ridge NW of Buck Hill (6.5 mi. E of Medora), 26 July 1982, *Wetmore 45168* (MIN), SE of Wind Canyon (5.5 mi. NE of Medora), 28 July 1982, *Wetmore 45383* (MIN); McKenzie Co., Theodore Roosevelt National Park, N Unit.: SW corner of Steves Plateau (14 mi. SW of Watford City), 22 July 1982, *Wetmore 44875* (MIN). OKLAHOMA. Roger Mills Co., 6 mi. NE of Durham, 28 July 1929, *Stratton 101a* (MICH). SOUTH DAKOTA. Custer Co., Black Hills: 16 mi. SW of Custer along Pass Creek Road, 3 July 1960, *Wetmore 6776* (MSC),

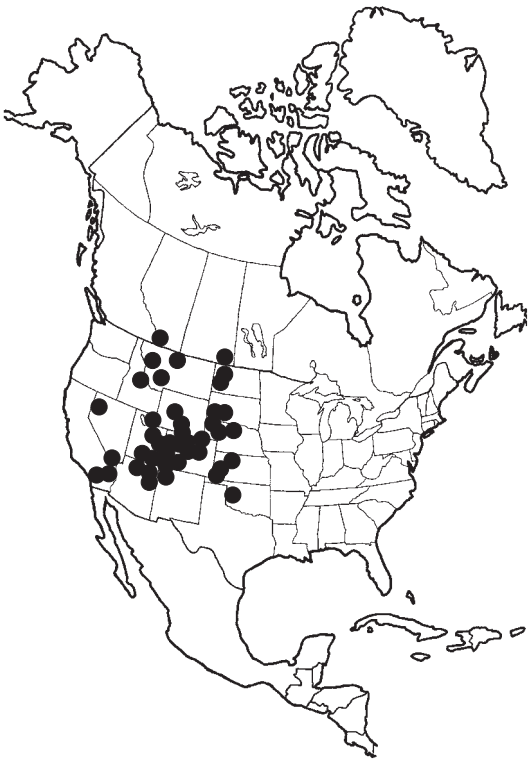


Fig. 42. Known North American distribution of *Lecanora flowersiana* H. Magn.

3.6 mi. S of U.S. 16, on Fourmile Creek Road, 2 July 1960, *Wetmore 6715a* (MSC); Jackson Co., Badlands National Park, just N of Ceder Pass Lodge near Cliff Shelf parking lot, 11 July 1997, *Wetmore 78068* (MIN). UTAH. Carbon Co., N side of Consumer Road, 14 Aug. 1985, *Ryan 18083* (ASU); Grand Co.: Arches National Monument, near Campground at Devils Garden Trail, 10 June 1967, *Wetmore 16485a* (MIN), along Rte 128, above the Colorado River, 2 Aug. 1984, *Nash 22989* (ASU); Kane Co.: about 10 mi. E of Kanab, along U.S. Hwy 89, in Johnson Canyon near the Kanab State Welfare Farm, *s.d.*, *Nebecker 1560* (ASU), Kaparowitz Plateau, 22 Dec. 1971, *Nash 3612* (ASU); Rich Co., 3 km SE of Bear Lake and 8 km E of Laketon, 23 July 1983, *Nash 21335* (ASU); San Juan Co.: about 10 mi. NW of Blanding, on road to Red Bluffs Campground, *s.d.*, *Nebecker 2476* (ASU), S side of Navajo Mountain, 24 Sep. 1973, *Nash 8271* (ASU); Washington Co., Zion National Park: *Abies* area in Refrigerator Canyon, 19 May 1979, *Sigal & Nash 15382* (ASU), Watchman Campground, 17 May 1979, *Sigal & Nash 15381* (ASU); Wayne Co., Cainesville Wash, 9 mi. W of Hanksville,

on road to Capitol Reef National Park, 24 Oct. 1988, *Timdal et al. L83598* (COLO). WYOMING. Carbon Co., 7 mi. W of Rawlins, along Interstate 80, 12 Aug. 1975, *Wetmore 24255* (MIN); Fremont Co., Wind River Range, along Papo Agie River, below Sinks Canyon State Park, 25 July 1983, *Nash 21409* (ASU).

Lecanora cf. *flowersiana*: U.S.A. NEVADA. Clark Co., W of Las Vegas, Red Rock Canyon National Conservation Area, 23 Dec. 1997, *Diederich 14156* (herb. Diederich).

Lecanora fugiens Nyl. Figs 43 & 44

Flora **56**: 289. 1873. – HOLOTYPE: [UK: Channel Islands] 'on dry rocks, Rozel…[illegible], Jersey, 1873, *CL.*' [*C. Larbalestier*] (H-NYL 26858!; BM – ISOTYPE).

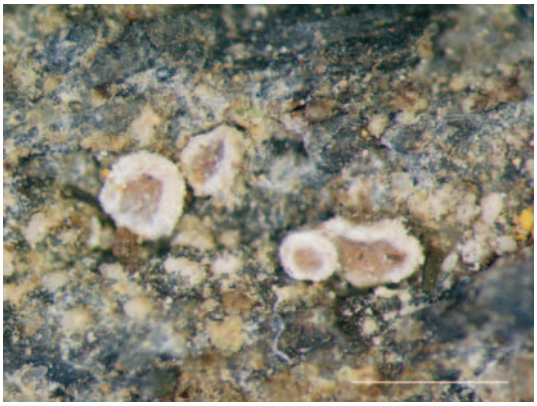


Fig. 43. *Lecanora fugiens* Nyl. (*Ryan 25060*, ASU). Scale bar = 1 mm.

Thallus partly superficial (evenascent), crustose, indistinct, thin, effuse, consisting of very small dispersed areoles, more evident around the apothecia or occasionally thicker, granulose to irregularly areolate, ecorticate but sometimes corticate with a loose unorganised alga-free layer, beige or pale yellow to yellowish brown, sometimes slightly to moderately pruinose, with distinct prothallus as white dendroid hyphae. Apothecia arising each on a discrete, single areole of thallus, sessile, flat or soon convex, 0.3–0.8 mm diam.; disc plane to slightly convex, smooth, pale brown to reddish brown, pruinose; margin level with the disc, smooth, entire, even, uniform, slightly to moderately white pruinose, paler than thallus and disc. Amphithecium ±60 µm thick, corticate, with sparse algae; cortex indistinctly or ±distinctly delimited, uniform or slightly thicker at the base than at the sides, 25–30 µm thick laterally, 30–45 µm thick at the base, composed of adglutinated hyphae, gelatinous, cortical granules sparse and mostly at top of margin (pol+, insoluble in K, soluble in N); parathecium indistinct to well delimited and 10–30 µm wide; epithecium shades of yellow or brown to reddish brown, granular (pol+), granules coarse, superficial and between the paraphyses tips (soluble in K and insoluble in N), unchanged with K and unchanged with N, epipsamma present (insoluble in K and soluble in N); hymenium hyaline, 50–60(–70) µm high; subhymenium indistinct, ±granular, 15–20 µm high; hypothecium hyaline or yellowish, more intense in K, 100–120 µm high, composed of adglutinated hyphae, clear, without granules. Paraphyses slender (averaging less than 2 µm wide), simple or scarcely branched in upper part, slightly or not expanded, usually not pigmented, free in K. Asci clavate, 8-spored; ascospores hyaline, simple, mostly ellipsoid (broadly ellipsoid to narrowly ellipsoid), 9–[10.4]–13(–15) × 4.5–[5.0]–6 µm, Q = 1.5–[2.2]–3.1. Pycnidia not seen.

CHEMISTRY. Thallus and apothecial margin K+ yellow, C+ orange, KC+ orange, PD– or PD+ orange; disc K+ yellow, C+ orange, KC+ orange, PD+ orange; apothecia UV+ yellowish to yellow-orange. Lichen products: unknown xanthone (Rf 4–5, cf. arthrothellin), ±pannarin detected by TLC.

HABITAT. On siliceous rock, predominantly on coastal cliffs, very likely also on vegetation detritus.

DISTRIBUTION. The species is known from northern Europe and it is scattered on eastern and western seashores of North America. Inland locations are noted in the Great Lakes area. The species has a distinctly temperate oceanic distribution.

DISCUSSION. The species is distinguished from *L. dispersa* by the positive K and C reactions of its thallus and apothecia and by the distinct PD+ orange reaction of its apothecial disc. It also has

smaller, regular and pruinose apothecia, which each arise on a discrete, single areole of the thallus. The characteristic prothallus and K-soluble epithecial granules of *L. fugiens* distinguish it further. *Lecanora fugiens* is a typical oceanic species. The most closely related species that occurs in a similar habitat is *L. andrewii*. The latter, however, has a much more abundant thallus and larger apothecia, with a mostly prominent thalline margin and epruinose disc. *Lecanora andrewii* also differs by the presence of *dispersa*-like epithecial granules which are absent in *L. fugiens*. The epithecial granule properties also distinguish *L. fugiens* from the maritime species *L. salina*, which additionally differs in chemistry: it indicates a C– positive reaction, but its C+ pink reaction reveals the presence of gyrophoric acid and not xanthones (C+ orange). *Lecanora conferta* is similar to *L. fugiens* in its spot test reactions, pruinose apothecial disc and epithecial granule properties, but has much more abundant apothecia which often become angular by compression. *Lecanora conferta* also occupies a different habitat; it occurs on hard limestone.

REMARKS. The history of the species as well as its detailed characteristics are provided by James (1960).

EXSICCATES SEEN. Malme, *Lich. Suecici Exsicc*. 897 (as *L. hagenii*) (MIN, WIS); Norrlin, *Herb. Lich. Fenniae* 144 (as *L. dispersa* f. *atrynella*) (COLO); Räsänen, *Lichenoth. Fennica* 15 (as *L. crenulata*) (MIN).

SPECIMENS EXAMINED. CANADA. NEW BRUNSWICK. Albert Co., Fundy National Park, Laverty Falls, 30 Aug. 1981, *Gowan 4560* (CANL). ONTARIO. Frontenac Co., Kingston, Lake Opinicon, 27 June 1967, *Wong 324* (CANL). – U.S.A. CALIFORNIA. Siskiyou Co., Klamath National Forest, Road 7F01, Townsend Gul, about 5 mi. SW of town of Scotts Bar, 20 Aug. 1989, *Ryan 25060* (ASU). MAINE. Westroak Co., Spring Straut Rapids, 18 Sep. 1921, *Norton s.n.* (H). MINNESOTA. Cook Co., Gunflint, 1 July 1897, *Fink 357* (MICH, MIN); Lake Co.: Beaver Bay, 15 July 1897, *Fink 707* (MIN), Boundary Waters Canoe Area, E of Boy Scout Camp on E shore of Moose lake, 14 Sep. 1986, *Trana 13974* (MIN), Boundary Waters Canoe Area, E of Boy Scout Camp on E shore of Moose lake, 19 mi. ENE of Ely, 14 Sep. 1986, *Trana 14101* (MIN). WISCONSIN. Douglas Co., Patison State Park West, side of Black River, 21 May 1944, *Thomson & Evans 1939* (FH, WIS).

Fig. 44. Known North American distribution of *Lecanora fugiens* Nyl.

Specimens have also been seen from Finland (COLO, MIN) and Norway (ASU, WIS).

Lecanora hagenii (Ach.) Ach. Figs 45 & 46

Lichenogr. Universalis: 367. 1810. – *Lichen hagenii* Ach., Lichenogr. Suec. Prodr.: 57. 1799 ('*Hageni*'); *nom. cons*. (Śliwa & Hawksworth 2006). – TYPE (designated and conserved by Śliwa and Hawksworth, Taxon **55**(4): 1038. 2006): [Germany] 'An einem alten Brette der Hofeinfassung des Linderl-Anwesens in Nymphenburg. München, 27 Oct. 1889, *F. G. C. Arnold*' [Arnold, *Lich. Monac. Exs*. 31, as '*L. hageni*'] (M!; MIN!, UPS! – TYPE DUPLICATES).

= *Lecanora umbrina* (Ach.) A. Massal., Ric. Auton. Lich. Crost.: 10. 1852. – *Lecanora hagenii* [var.] *umbrina* Ach., Lichenogr. Universalis: 368. 1810. – LECTOTYPE (designated by Laundon, Lichenologist **35**: 98. 2003): *s.loc*. (BM-Ach 422!).

= *Lecanora hagenii* [var.] *cyanescens* Ach., Lichenogr. Universalis: 368. 1810. – LECTOTYPE (designated here): [France] 'Gallia' no. 229 (H-ACH 1197!).

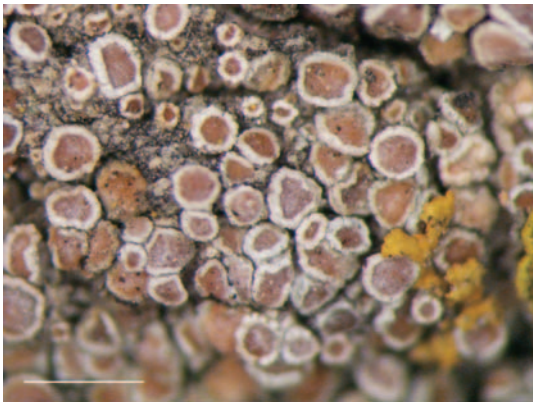


Fig. 45. *Lecanora hagenii* (Ach.) Ach. (*Spribille 8812*, herb. Spribille). Scale bar = 1 mm.

= *Lecanora* '*roridula*' Poelt *et al*., Bibl. Lichenol. **58**: 324. 1995; *nom. nud.*

= *L. dispersella* auct., non. Steiner (see Sérusiaux *et al*. 2003).

Thallus within the substratum, immersed and not apparent (endophloedal or endolithic), very rarely inconspicuous, greenish with bluish pigment. Apothecia occurring singly, evenly distributed, when young apparently immersed in the substratum, later widely sessile, flat when mature, 0.3–0.9 mm diam.; disc smooth, plane, brown with some orange to reddish tint, maroon to brown, slightly, moderately to heavily pruinose (almost frosted) or rarely epruinose, smooth; margin prominent or level with the disc, thin, smooth or rough, entire or incised (especially in young apothecia), even, uniform, epruinose or pruinose, paler than the disc or most often white. Amphithecium 75–90 µm thick, corticate, algae more or less densely fill the area below the cortex, algal layer continuous and extending below the hypothecium; cortex indistinctly delimited, ±uniform in thickness (±30 µm) or differentiated (15–20 µm thick laterally and 20–60 µm thick at the base), composed of adglutinated, gelatinous hyphae, obscured with granules throughout or granules sparse, more abundant only on top of margin (pol+, insoluble in K, soluble in N); parathecium indistinct; epithecium in shades of brown, indistinctly granular, granules superficial, coarse (pol±, insoluble in K and soluble in N), epipsamma present (insoluble in K and soluble in N); hymenium hyaline, 35–60 µm high; subhymenium hyaline, indistinct; hypothecium hyaline or almost so, 20–50 µm high, composed of adglutinated hyphae, without granules. Paraphyses simple, thick, slightly expanded or capitate, brown pigmented at tips, usually free in K. Asci clavate, 8-spored; ascospores hyaline, simple, mostly ellipsoid (broadly ellipsoid to narrowly ellipsoid), 9–[11.1]–13(–15) × 4.5–[4.8]–6 µm, Q = 1.8–[2.3]–3.0. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. On a wide range of organic substrata (bark of trees, wood, bones, bryophytes, vegetation or other lichens), often also directly on rock or concrete and bricks.

DISTRIBUTION. This is a widespread species in Europe and North America. It is also known from Asia. In North America the species occurs in boreal and temperate regions but its main distribution is in temperate areas.

DISCUSSION. *Lecanora hagenii* is closely related to *L. crenulata* but is distinguished by its smaller apothecia with a much thinner apothecial margin, which is entire to incised rather than distinctly crenate. *Lecanora hagenii* also has a considerably thinner amphithecial cortex, lower hymenium, and paraphyses that are ± free in K. Another similar species, *L. flowersiana*, differs from *L. hagenii* in having larger, epruinose apothecia and longer spores. Additionally *L. flowersiana* seems restricted in its occurrence to central and western North America, whereas *L. hagenii* is a widespread species.

Lecanora hagenii was previously assumed to be most closely related to *L. dispersa* from which it was differentiated as having a thin, neat, regular apothecial margin surrounding a small brown disc and growing on bark and wood (Laundon 2003). In the present treatment, *L. hagenii* was observed to differ from *L. dispersa* additionally by the following anatomical characters: (i) the lack of *L. dispersa*-type epithecial granules, (ii) having paraphyses that are simple, thicker, expanded

apically and ± free in K, and (iii) usually having more narrowly ellipsoid spores. In contrast to *L. dispersa*, *L. hagenii* does not produce any lichen substances. Some authors regarded *L. hagenii* as a corticolous form of *L. dispersa* (Poelt *et al*. 1995) or suggested that intermediate forms are frequent (Laundon 2003). This cannot be confirmed, based on the above-listed anatomical and chemical differences between the two species. The taxa do not so markedly differ in their substratum preferences as they were regarded by some authors. Although *L. dispersa* is generally saxicolous and *L. hagenii* corticolous, both can occupy various kinds of substrata. This could cause some confusion since the two species occasionally grow close to each other or may even form mechanical hybrids. For comparison of *L. hagenii* with *L. persimilis* and *L. wetmorei*, see discussion under those species.

NOMENCLATURAL NOTES. The species epithet *hagenii* has a complicated history. Longstanding confusion over the application of the epithet has recently been clarified by Śliwa and Hawksworth (2006); in order to unequivocally preserve the current usage of the name *L. hagenii*, the authors proposed its conservation on the basis of a conserved type specimen that is well developed and corresponds very well in all microscopic and chemical characters with the current concept of the species.

EXSICCATES SEEN. Arnold, *Lich. Exsicc*. 996b (as *L. hagenii* f. *umbrina*) (M, MIN); Arnold, *Lich. Exsicc*. 1377c (as *L. hagenii*) (KRAM, UPS); Arnold, *Lich. Monac. Exsicc*. 31 (*as L. hagenii*) (M, MIN, UPS; types); Arnold, *Lich. Monac. Exsicc*. 205 (as *L. hagenii*, saxicolous) (M, UPS); Arnold, *Lich. Monac. Exsicc*. 213 (as *L. hagenii* f. *umbrina*) (M, MIN, UPS); Arnold, *Lich. Monac. Exsicc*. 266a (as *L. hagenii*, saxicolous) (M, MIN, UPS); Arnold, *Lich. Monac. Exsicc*. 298 (as *L. hagenii* f. *umbrina*) (M, UPS); Arnold, *Lich. Monac. Exsicc*. 346 (as *L. hagenii* f. *umbrina*) (M, MIN, UPS); Arnold, *Lich. Monac. Exsicc*. 378 (as *L. hagenii*) (M, UPS); Arnold, *Lich. Monac. Exsicc*. 511 (as *L. hagenii*) (M, MIN, UPS); Cummings, *Decad. North Americ. Lich.* 132 (as *L. hagenii*) (NY, WIS); Cummings *et al.*, *Lich. Boreali-Americ*. 50 (as *L. hagenii*) (COLO, FH, MICH); Macoun, *Canad. Lich*. 117 (as *L. hagenii*) (COLO, FH, MICH, UPS, WIS); Malme, *Lich. Suecici Exsicc*. 434 (as *L. hagenii*) (MIN, UPS, WIS); Nowak, *Lich. Polon. Merid. Exsicc*. 178 (as *L. hagenii*) (COLO, KRAM, MIN); Rabenhorst, *Lich. Eur*. 205 (as *L. hagenii*) (KRAM); Rabenhorst, *Lich. Eur*. 486 (as *L. umbrina*) (MIN); Räsänen, *Lich. Fenn. Exsicc*. 743 (as *L. hagenii* f. *coerulescens*) (MIN, UPS); Wartmann & Schenk, *Schweiz. Krypt*. 157 (as *L. hagenii*) (MIN).

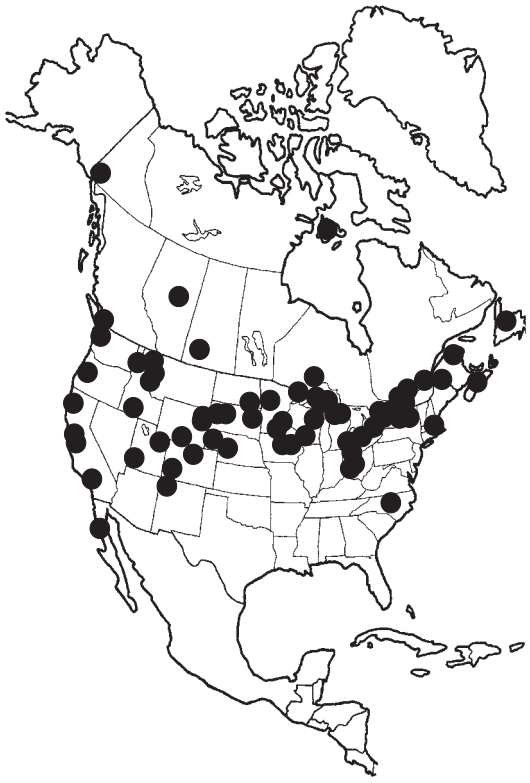


Fig. 46. Known North American distribution of *Lecanora hagenii* (Ach.) Ach.

SPECIMENS EXAMINED. CANADA. ALBERTA. near Athabasca Glacier, 22 Apr. 1962, *Nyland 158*, *Nyland s.n*. (WIS). BRITISH COLUMBIA. Vancouver, 5 Apr. 1986, *Goward 8635* (CANL). NORTHWEST TERRITORIES. Southampton Island, Coral Harbor, 16 Aug. 1959, *Thomson 13880* (WIS). NOVA SCOTIA. Halifax Co., Hubbardas, 29 Mar. 1969, *Ward 129* (CANL). NEWFOUNDLAND. Waghorne, 1897, *Fink s.n*. (MICH). ONTARIO. Frontenac Co., Kingston, near corner of Bagot St. and Barrie St., 6 Sep. 1969, *Ward 132* (CANL); Grenville Co.: 10 mi. S of Kamptville, 20 Aug. 1973, *Wong 1287*, *1299*, *1298* (CANL), 16.1 km S of Kamptville, 1 Dec. 1978, *Wong 1295* (ASU, CANL); Halton Co., Milton, 29 June 1978, *Wong 2781* (CANL); Lampton Co., 1 mi. N of Hwy 7, 4.5 mi. W of Reece's Corners

(junction Hwy 21 S), 10 July 1974, *Wong 1653* (ASU, CANL, COLO), *Wong 1646 1651*, *1655*, *1956* (CANL); Northumberland Co., Brighton, 16 Oct. 1893, *Macoun 164* (CANL, MICH); Ottawa-Carleton Co., Ottawa: 9 May 1885, *Macoun s.n.* (CANL), Richmond Road, 18 Apr. 1896, *Macoun 348* (CANL), Highway 17B, Crystal Bay, 1 July 1975, *Begin-Robitaille s.n.* (CANL); Peterborough Co., Indian River on Hwy 7, 9 mi. W of Norwood, 30 July 1976, *Wong 2210* (CANL); Thunder Buy Co., Breakwater Pt., McIntyre Bay, Lake Nipigon, 16 Aug. 1983, *Garton 23080* (CANL); *s.l.*, Apr. 1890, *Macoun s.n.* (FH). QUEBEC. Gaspe Co., Perce, Cap Barre, 10 Aug. 1907, *Collins 5293* (FH); Gatineau Co., Ottawa Region, King Mountain area off Mountain Road, *ca* 3 mi. NW of Notch Road, 28 Oct. 1972, *Brodo 19099* (CANL, WIS); Ile-de-Montreal Co., Montreal, 4 July 1966, *DeSloover & LeBlanc 14* (CANL), 6 July 1966, *DeSloover & LeBlanc 28*, *30* (CANL), 17 Sep. 1966, *DeSloover & LeBlanc 291* (CANL). SASKATCHEWAN. about 30 mi. N of Swift Current, July 1969, *Jesberger 616a*, *839* (WIS). YUKON TERRITORY. Kluane National Park, Mile 1022 Alaska Highway, on Bear Creek Poad, 27 July 1973, *Douglas & Douglas 5412* (WIS). – MEXICO. Baja California, Cerro Kenton and adjacent area to the E, W of Bahia de San Quintin, 15 Feb. 1987, *Ryan 21233s* (ASU). – U.S.A. CALIFORNIA. Humboldt Co., Samoa Peninsula, 300 yds N of Sanoa Bridge, 11 June 1972, *Lindsay 818* (WIS); Los Angeles Co.: near Santa Monica, 1897, *Hasse s.n.* (NY), Santa Monica Range, 1899, *Hasse s.n.* (FH), 1902, *Hasse s.n.* (NY), near Soldiers Home, 1897, *Hasse s.n.* (NY); San Mateo Co., Searsville Lake, 6 mi. from Stanford University campus, 25 Aug. 1957, *Shushen S14661* (COLO); Santa Cruz Mts., Black Mt., 1903, *Herre s.n.* (NY). COLORADO. Boulder Co., NW slope of Green Mountain, between Scout Cabin and Twin Springs, 17 Apr. 1955, *Shushan & Weber S4840* (CANL, FH, WIS); Ouray Co., Ridgway, 1897, *Betleel s.n.* (FH). CONNECTICUT. New Haven Co., East Haven, 23 Aug. 1923, *[Mu?]Huyrowitz s.n.* (FH). IDAHO. Latah Co., Kamiak Butte, Moskow, 11 Nov. 1932, *Darrow 4* (MICH); Twin Falls Co., Hagerman Fossil Beds National Monument, 0.3 km S of Bell Rapids Rd., 9 Sep. 1998, *Ryan 32759* (ASU). IOWA. Butler Co., at E edge of Greene on N side of road, 13 June 1965, *Wetmore 12569* (MIN, COLO); Bremer Co., on campus of Wartburg College in NW Waverly, 10 Dec. 1965, *Wetmore 13751* (MIN). MAINE. Aroostook Co., Ft. Fairfield, 15 July 1893, *Cummings & Teller s.n.* (NY), *s.d.*, *Cummings s*.n. (FH). MICHIGAN. Cheboygan Co., Pellston, along N Extension Rd, 0.25 mi. from Riggsville Rd., 5 July 1966, *Hinds 334* (MICH); Emmet Co., Cross Villago, 23 July 1966, *Huids s.n.* (MICH); Keweenaw Co., Isle Royale, McCargo Core, 4 Aug. 1930, *Lowe 331* (MICH), *Lowe 334* (FH, MICH); Mackinac Co., along Bush Bay, 21 July 1970, *Clavson 112* (MICH); Washtenaw Co., West Lake, Chelsea, 25 June 1930, *Smith s.n.* (FH); Alger Co., Deerton, Laughing Whitefish Point, 11 June 1933, *Lowe 1877* (FH, MICH), *Lowe 1917* (FH, MICH). MINNESOTA. Becker Co., 1 mi. N of Stinking Lake (18 mi. NW of Detroit Lakes), saxicolous, 31 July 1978, *Wetmore 35967*, *35975* (MIN); Blue Earth Co., Mankato, 1 July 1899, *Fink 48* (MICH), *Fink 217* (MICH, MIN); Hennepin Co., Minneapolis, 1896, *Fink 47a*, *147a* (MICH); Cook Co., Sailboat Island, Susie Island, Sep. 1951, *Thomson 4068* (WIS). MONTANA. Flathead Co.: vicinity of Columbia Mountain trailhead, *ca* 7.5 km E of Columbia Falls, *ca* 1 km S of US Hwy 2, 15 Feb. 1999, *Spribille 8839* (herb. Spribille), city of Kalisoell, 7 Feb. 1999, *Spribille 8812* (herb. Spribille); Missoula Co., Missoula, E Rattlesnake area, 12 Mar. 1960, *Stickney 559* (WIS); Ravalli Co., Bitterroot Range, July 1991, *McCune 19300* (OSC). NEBRASKA. Lincoln Co., E of Maxwell, 3 June 1937, *Kiener 2505* (MICH); Scotts Bluff Co., Scotts Bluff National Monument: N side of South Bluff, SW of Coyote Pass, saxicolous, 1 July 1997, *Wetmore 77494* (MIN), near NW corner of park, along Mitchell Gering Canal, 3 July 1997, *Wetmore 77584* (MIN, ASU). NEW MEXICO. Juan Co.: Archuleta in the San Juan Valley, at the lowest elev. of the San Jose Formation, 18 June 1974, *Carmer 2752* (ASU), H8, 6 Aug. 1974, *Marsh 334* (ASU). NEW YORK. Harknier Co., Jordanville, 12 July 1918, *House s.n.* (MICH); Niagara Co., Goat Island, Niagara Falls, along channel between N side and Luna Island, saxicolous, 1 Nov. 1988, *Harris 22860* (NY); Onondaga Co.: Kirkville, Apr. 1888, *Underwood s.n.* (NY), Syracuse, Oct. 1888, *Underwood s.n.* (NY); Wayne Co., Clyde, Oct. 1887, *Underwood s.n.* (NY). NORTH CAROLINA. *s.l.*, *s.d.*, *s.coll. s.n.* (NY); NORTH DAKOTA. Lamoure Co.: Kulm, saxicolous, 2 June 1907, *Brenckle 1102* (FH), Kulm, June 1908, *Brenckle 1979* (FH). OHIO. Butler Co., Oxford, 28 July 1919, *Fink s.n.* (FH, NY); Clark Co., Springfield, *s.d.*, *Biddlecon s.n.* (FH); Franklin Co., Columbus, 1893, *Bogue s.n.* (FH, MICH); Wood Co., Haskins, 24 July 1919, *Fink s.n.* (MICH); *s.loc.*, *s.d.*, Sargent *s.n.* (FH, NY). OREGON. Lane Co., Eugene, Nov. 1932, *Sipe 731* (MIN). SOUTH DAKOTA. Brookings Co., Brookings, 14 Oct. 2001, *Śliwa 1507* (KRAM); Lawrence Co., vicinity of Timon Camp Ground, 4 mi. WSW of Savoy, 4 June 1960, *Anderson S20501* (MSC); Meade Co., Black Hills, 2.5 mi. E of Piedmont Butte, 30 June 1961, *Wetmore 10405b* (MSC). UTAH. Uintah Co., Dinosaur National Monument, Green River Camp, 4 July 1979, *Board*

s.n. (WIS); Washington Co., Zion National Park, junction of Wild Cat Canyon and West Rim Trail, 18 May 1979, *Sigal s.n*. (ASU). WASHINGTON. Clallam Co., Dungeness, 20 Sep. 1913, *Foster 2531* (FH), 27 Sep. 1913, *Foster 2565* (NY). WISCONSIN. Iowa Co., Blue Mounds, 8 June 1928, *Denniston s.n*. (WIS); Shawano Co., 4 mi. S of Bonduel, 1 June 1964, *Thomson 11574* (WIS). WYOMING. Carbon Co., 30 mi. N of Baggs, 12 Sep. 1986, *Thomson 23175* (WIS); Crook Co., Black Hills, N side of Warren Peak, 6 mi. NW of Sundance, 19 Aug. 1960, *Wetmore 9861* (MIN, MSC); Weston Co., Black Hills, along U.S. 85 at Soldier creek, 12 Aug. 1961, *Wetmore 11304* (MIN, MSC).

Specimens have also been seen from Armenia (NY: Caucasus), Balkan Peninsula (GZU: Montenegro), China (MIN), Denmark (NY, WIS), France (COLO, NY), Germany (GZU, NY), Hungary (US), Luxembourg (herb. Diederich), Poland (KRAM), Portugal (COLO, WIS), Romania (NY), Russia (ASU, COLO: SW Siberia), Sweden (ASU, MIN, NY), Switzerland (NY), UK (NY), and Ukraine (KRAM).

Lecanora invadens H. Magn. Figs 47 & 48

Lichens from Central Asia I, in S. Hedin (ed.), Reports Scientific Exped. North-west. provinces of China (the Sino-Swedish expedition). 13, XI. Botany, **1**. Aktiebolaget, Thule & Stockholm: 87. 1940. – HOLOTYPE: 'China occidentalis: prov. Kansu, Erh-tao-ch'uan (Nan-shan), in latere meridionale, 2950–3050 m, 28.12.1931, *Birger Bohlin 69a*' (S!).

= *L. dispersa* f. *coniotropa* (Fr.) Arnold, Verhandl. zool.-bot. Gesellsch. Wien **29**: 376. 1879. – *Parmelia varia* var. *coniotropa* Fr., Lichenogr. Europ. Reform.: 159. 1831.

Thallus partly superficial (sometimes evanescent), indistinct, crustose, more evident around apothecia, pale grey to greenish grey, often with distinct bluish pigment. Apothecia occurring singly, or clustered in groups, sessile, or constricted at the base to almost raised, flat when mature or flexuose, 0.4–1.0 mm diam.; disc plane to convex, smooth, shades of yellowish, brown to blackish, or ±plumbeous, slightly to heavily pruinose, rarely epruinose; margin level with the disc, or weakly prominent, smooth or rough, entire, even, uniform, pruinose, paler than thallus and paler than disc, white or grey or indistinctly delimited. Amphithecium 160–170 μm thick, corticate, with algae densely filling the area below the cortex;

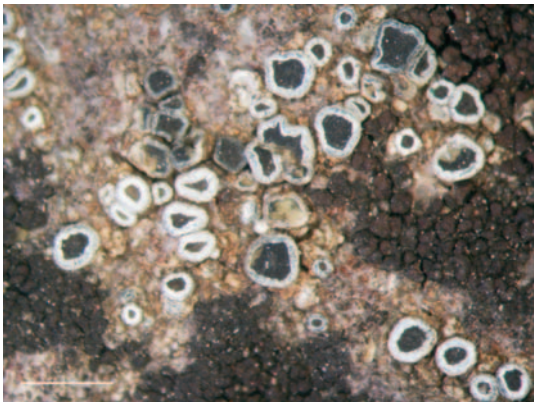


Fig. 47. *Lecanora invadens* H. Magn. (*Śliwa 1819*, KRAM). Scale bar = 1 mm.

cortex usually distinctly delimited, slightly thicker at the base than at the sides, 15–50 μm thick laterally and 45–60 μm thick at the base, composed of adglutinated hyphae, obscured by granules occasionally interfering into the area below the cortex (pol+, insoluble in K, soluble in N), thin and bluish-green at the very top of margin – due to coloured tips of marginal hyphae and bluish-green intracellular pigment (this part becoming purple in N); parathecium usually distinct, prosoplectenchymatous, 10–15 μm wide; epithecium yellowish or shades of brown or olive, sometimes partly bluish-green, granular (pol+ or pol±), granules usually sparse, between paraphyses tips, coarse (soluble in K and insoluble in N), epipsamma usually present (insoluble in K, soluble in N); hymenium hyaline, 45–65 μm high; subhymenium indistinct; hypothecium hyaline or yellow (more intense in K), 50–100 μm high, composed of adglutinated hyphae, distinct from parathecium. Paraphyses simple or dichotomously branched at tips, slender or thickened, not expanded, or slightly expanded apically, often pigmented at top, free in K. Asci clavate, 8-spored; ascospores hyaline, simple, broadly ellipsoid (broadly ellipsoid to ellipsoid), 9–[10.6]–12 × 6–[6.3]–7.5 μm, Q = 1.4–[1.7]–2.0. Pycnidia not seen.

CHEMISTRY. Apothecial margin K– or K± yellow, C– or C+ yellow, KC+ yellow, PD–; disc K– or K± yellow, C–, KC± yellow, PD–; apothecia UV– or some apothecia UV+ yellowish. Lichen

products: vinetorin (5-chloro-3-*O*-methylnorlichexanthone); sometimes only traces detected by TLC.

HABITAT. Directly on noncalcareous or weakly calcareous rock, often overgrowing or parasitic on other lichens, e.g., *Aspicilia* spp., *Lecanora* spp., *Verrucaria* spp.

DISTRIBUTION. Europe, Asia and North America. In North America the species is scattered in boreal and temperate regions with the main distribution temperate, but it has also several localities in the Arctic region.

DISCUSSION. *Lecanora invadens* is a morphologically variable species. For example, thallus abundance, apothecial disc colour and the presence/absence of pruina vary. Its epithecial granule type and chemistry are consistent, however. The species is closely related to *L. semipallida* but differs in having a dark brown to blackish, epruinose or heavily pruinose apothecial disc and blue-green epithecium, and often a more distinct thallus. Its close relation to *L. semipallida* is indicated by the presence of K-soluble granules in the epithecium (sometimes sparse!) and the presence of vinetorin. The taxonomic status of the species should be reconsidered after more material from Europe is studied, to determine whether it merits species level.

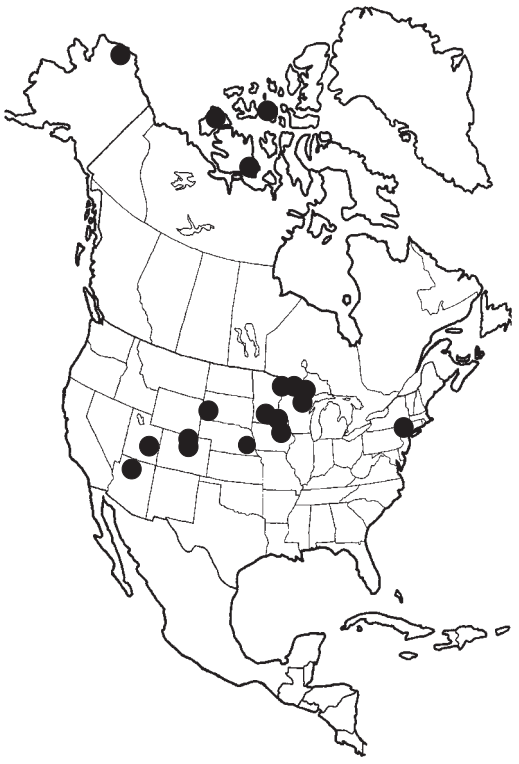


Fig. 48. Known North American distribution of *Lecanora invadens* H. Magn.

NOMENCLATURAL NOTES. *Lecanora dispersa* var. *coniotropa* is included here as a synonym for *L. invadens* H. Magn. although it was considered conspecific with *L. perpruinosa* by Fröberg (1989). The author referred to the collection by Magnusson originating from Torne Lappmark (northern Sweden) and to the collection by Poelt, Steiner and Vězda from Switzerland (distributed in Vězda, *Lich. Selecti Exsicc*. 639). Since I was not able to find the original collection by Fries, I referred to the material studied by Fröberg (1989) here. For further discussion, see also under *L. perpruinosa*.

REMARKS: The affinities of the material of *L. dispersa* f. *coniotropa* (*coniopta*?) reported from France need separate study since, as characterized by Roux (1976: 23), it may represent a different taxon.

EXSICCATE SEEN. Vězda, *Lich. Selecti Exsicc*. 639 (as *L. dispersa* f. *coniotropa*) (COLO).

SPECIMENS EXAMINED. CANADA. NORTHWEST TERRITORIES. Banks Island: near Muskox River, 22 July 1979, *Scotter 30471* (CANL),Thomson River, at confluence of Muskox and Thomson Rivers, 20 July 1990, *Gould 927* (MIN); Bathurst Island, Polar Bear Pass area, June 1975, *Dickson 2277a* (CANL); Cambridge Bay, Victoria Island, 13 Apr. 1959, *Weber S23745* (COLO). – U.S.A. ALASKA. along N ridge of the Colville River, at Umiat, 22–25 July 1958, *Thomson & Shushan 10258* (US, WIS). ARIZONA. Coconino Co., Grand Canyon National Park, N rim, upper part of Kaibab Trail, 17 Aug. 1974, *Nash 9407*, *9507* (ASU). COLORADO. Bolder Co., W slope of Steamboat Mt., 2 mi. NW of Lyons, 30 Apr. 1966, *Weber et al. L41960* (COLO, CANL); Larimer Co., Owl Canyon, 9.7 mi. N of Teds Place, 6 Apr. 1955, *Weber & Shushan S4759* (COLO). IOWA. Fayette Co., Echo Valley State Park, E of W Union, 30 Oct. 1965,

Wetmore 13635 (CANL: with *L. semipallida*, MIN). MICHIGAN. Keweenaw Co., Isle Royale National Park: SW of McGinty Cove, 9 July 1984, *Wetmore 51991* (MIN), near Rock Harbor Lodge, 28 June 1958, *Wetmore 2621* (MSC). MINNESOTA. Goodhue Co., at N edge of Cannon Falls, 24 June 1973, *Wetmore 21367* (MIN); Blue Earth Co., Mankato, 29 June 1899, *Fink 188* (MIN), *Fink s.n.* (MICH); Cook Co.: Grand Marais, 11 July 2002, *Śliwa 1819* (KRAM), Suger Loaf Preserve, 10 mi. SW of Tofte, along Lake Superior, 11 July 1995, *Wetmore 75343* (KRAM, MIN); Lake Co.: Shovel Point near Baptism River, 9 Aug. 1976, *Wetmore 26360* (MIN), Two Harbors, at lakeshore by Stewart River, 3 July 1974, *Wetmore 22818* (MIN); Saint Louis Co., Duluth, 4 Oct. 1942, *Thomson s.n.* (WIS). NEBRASKA. Cass Co.: South Bend, 13 May 1899, *Sheldon s.n.* (FH), Weeping Water, 30 Nov. 1895, *Williams s.n.* (FH). NEW YORK. Rockland Co., Hudson river, 6 June 1963, *Fleming & Nearing s.n.* (NY). SOUTH DAKOTA. Custer Co., Black Hills, 13 mi. W of Custer, 10 July 1997, *Wetmore 78006* (MIN). UTAH. Grand Co., La Sal Mountains, below Oowah Lake, 5 Aug. 1977, *Nash 20929*, *20930*, *20931* (ASU). WISCONSIN. Ashland Co., Apostle Island National Lakeshore, N tip of Twin Island, 11 July 2001, *Wetmore 87059* (MIN).

Specimens have also been seen from China (S: 'China occidentalis: prov. Kansu, Yü-erh-hung, c. 2800 m, 11.2.1932, *Birger Bohlin*' – PARATYPE [not identical]) and Sweden (FH: Torne Lappmark, *coll. H. Magnusson*).

Lecanora juniperina Śliwa Figs 49 & 50

in Nash *et al*. (eds), Lich. Fl. Sonoran **2**: 231. 2004. – HOLOTYPE: 'U.S.A. ARIZONA. Apache, along Arizona route 61.5 km WSW of the New Mexico line, pinyon-juniper stand, on *Juniperus monosperma*, elev. 1970 m, 35°08′00″N 109°05′15″W, 16 April 1996, *coll. T. H. Nash III 38632*' (ASU!).

Thallus indistinct or superficial, inconspicuous, granulose or areolate-rimose, grayish. Apothecia usually clustered in groups, sessile, flat or flexuose when crowded, 0.3–1.2 mm diam.; disc pale, or yellowish (often turning lead-coloured), moderately to heavily pruinose (rarely epruinose), smooth; margin usually prominent, smooth, entire to distinctly crenate or incised, epruinose or pruinose, even, or flexuose, concolorous with thallus, paler than disc. Amphithecium 60–140 µm thick, corticate, algae fill the area below the cortex, algal layer continuous below hypothecium; cortex distinctly delimited, distinctly expanded at the base, 20–30 µm thick laterally and 60–70 µm thick at the base), composed of adglutinated hyphae or gelatinous, cortical granules sparse or obscuring almost entire cortex area (pol+, insoluble in K, soluble in N); parathecium distinct, thin, *ca* 10 µm; epithecium shades of yellow, granular (pol+), granules superficial and between paraphyses tips, fine (insoluble in K and insoluble in N), epipsamma absent or present (insoluble in K and soluble in N); hymenium hyaline, 45–60 µm high; subhymenium indistinct, granular; hypothecium hyaline or almost so, 20–50 µm high, composed of adglutinated hyphae, clear, without granules. Paraphyses slender, somewhat branched throughout, with few anastomoses, not expanded and usually not pigmented, coherent in K. Asci clavate, 8-spored; hyaline, simple, ellipsoid (broadly ellipsoid to ellipsoid), 9–[11.1]–13 × 4.5–[5.9]–7.5 µm, Q = 1.5–[1.9]–2.3. Pycnidia not seen.

Fig. 49. *Lecanora juniperina* Śliwa (*Nash 38632*, ASU – holotype). Scale bar = 1 mm.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. Lichen products: unknown xanthone(s) detected by TLC.

HABITAT. Corticolous species occurring on tree bark (*Juniperus* and *Quercus*), also lignicolous; the species appears to occur typically in pinyon-juniper communities, at intermediate elevations.

DISTRIBUTION. The species is hitherto known

only from the western part of the U.S.A. Perhaps it is a western temperate element.

DISCUSSION. Although *L. juniperina* is superficially similar to *L. hagenii* due to its distinctly pruinose apothecia and often incised apothecial margin, it is in fact more closely related to *L. dispersa* due to its epithecial granule type (insoluble in K and N) and slender and branched paraphyses. It differs from the latter by having a more distinctive thallus and large, pale yellow pruinose apothecia with a conspicuously crenate thalline margin.

SPECIMENS EXAMINED. U.S.A. ARIZONA. Coconino Co.: Kaibab National Forest, secondary road adjacent to Fire Point and at boundary to Grand Canyon National Park, 8 Oct. 1994, *Nash 34640* (ASU), Grand Canyon National Park, Grandview Trailhead, 30 June 1991, *Boykin 2079* (ASU). CALIFORNIA. San Benito Co., W side of Pinnacles National Monument, 30 May 1981 *Nash 18984* (ASU).

Fig. 50. Known North American distribution of *Lecanora juniperina* Śliwa.

Lecanora percrenata H. Magn. Figs 51 & 52

Lichens from Central Asia I, in S. Hedin (ed.), Reports Scientific Exped. North-west. provinces of China (the Sino-Swedish expedition). 13, XI. Botany, **1**. Aktiebolaget, Thule & Stockholm: 88. 1940. – HOLOTYPE: 'China occidentalis: prov. Kansu, Yeh-ma-ta-ch'üan, *ca* 3000 m.s.m., 18.12.1931, *Birger Bohlin 45b*' (S!).

Thallus within the substratum, immersed and not apparent (endolithic or endophloedal), or crustose, thin, edge indefinite, mostly continuous, more or less smooth or rimose, pale, cream or greyish. Apothecia occurring singly, or clustered in groups, sessile or the base of apothecia slightly immersed in rock, flat when mature, 0.3–0.9 mm diam.; disc plane, smooth, dark brown, black or almost black, epruinose, or slightly pruinose; margin prominent, smooth, cracked (with numerous fissures), even or flexuose, uniform, epruinose, white or grey. Amphithecium 80–120(–200) μm, corticate, algae fill the area below the cortex and reach the top of margin, bluish pigmented at top; cortex indistinctly delimited, more or less uniform in thickness, 30–35 μm thick laterally and at the base, composed of adglutinated hyphae, gelatinous, more or less obscured by granules (pol+, insoluble in K, soluble in N), with some bluish pigment at top of margin; parathecium indistinct or very thin, ± 10 μm wide; epithecium deeply pigmented (up to 1/3 of the upper hymenium) shades of brown or olive, or partly bluish-green or greenish (colour unchanged or turning more intense or green in K and turning pink or red in N), not at all granular, epipsamma absent or rarely present and then undifferentiated (insoluble in K, soluble in N); hymenium partly coloured by extended epithecial pigment, hyaline below, 30–50 μm high; subhymenium distinct, granular; hypothecium hyaline or almost so, 45–70 μm high, composed of adglutinated hyphae, with droplets of oil. Paraphyses thick and adglutinated, simple but frequently distinctly branched at tips, uppermost part (2–3 highest segments) apparantly submoniliform and pigmented, end cell distinctly enlarged to subglobose (up to 6 μm wide), coherent in K. Asci clavate to broadly clavate, 8-spored; ascospores hyaline, simple, narrowly ellipsoid (ellipsoid to narrowly ellipsoid), 12–[14.2]–18 × 4.0–[4.7]–6 μm, Q = 2.3–[3.1]–3.7. Pycnidia

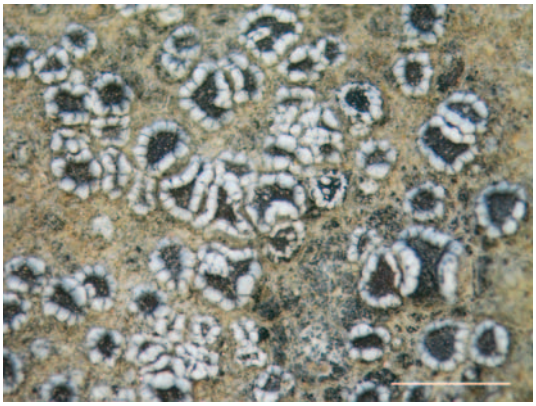


Fig. 51. *Lecanora percrenata* H. Magn. (*Wetmore 12769*, MIN). Scale bar = 1 mm.

rare, black, inconspicuous; conidia falcate – consistently filiform and characteristically curved, 16–19 × 1 μm.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. Growing directly on calcareous rock (sandstone, caliche, limestone) but also on solid field volcanic ash, or on wood. The species occurs at elevation of 610 to 2040 m.

DISTRIBUTION. Scattered in central and western North America and in Asia. In North America it is a western temperate to western montane element.

DISCUSSION. The species is well characterized by the cracked apothecial margin and narrowly ellipsoid spores. These characters make *L. percrenata* superficially resemble *L. flowersiana*, but it differs from the latter by having a very dark to black apothecial disc, an epithecium coloured brown, olive, or bluish green, and usually a more distinctive thallus. *Lecanora fowersiana* usually has a reddish brown or dark brown apothecial disc and an epithecium shaded brown or reddish. Some differences in spore shape were also observed; the spores of *L. percrenata* are longer and most often narrowly ellipsoid. The production of pycnidia by the latter may also prove a significant diagnostic character. See also discussion under *L. flowersiana*.

SPECIMENS EXAMINED. CANADA. ALBERTA. Lost River Badlands, coulee near Manyberries, 7 Oct. 1967, *Moore 4558* (CANL). U.S.A. ARIZONA. Coconino Co., Grand Canyon National Park, S Kaibab Trail, 28 June 1991, *Nash 30785* (ASU). COLORADO. Rio Blanco Co., valley of Piceance Creek, between Little Hills Exp. Sta. and Rio Blanco, 16 May 1959, *Weber & Shushan L24164* (COLO). IDAHO. Twin Falls Co., Hagerman Fossil Beds National Monument: 0.3 km S of Bell Rapids Road, 9 Sep. 1998, *Ryan 32778* (ASU), 0.5 km E of parking area, at S end of 500 E Road, 10 Sep. 1998, *Ryan 32926*, *32928*, *32931* (ASU), 1 km ENE of intersection of 5600 N Road on 400 E Road, 8 Sep. 1998, *Ryan 32736*, *32743* (ASU), 1.5 km ESE of junction of 5700 N Road and 400 E Road, 1 Sep. 1998, *Ryan 32948* (ASU), 1.5 km E of 400 E Road, 9 Sep. 1998, *Ryan 32816* (ASU). MONTANA. Liberty Co., Tiber Dam Rec. Area, 35 mi. ESE of Shelby, 1 Aug. 1978, *Trana 4944* (MIN). NEBRASKA. Scotts Bluff Co., Scotts Bluff National Monument: along top of SW ridge from parking lot, above road, 3 July 1997, *Wetmore 77609* (MIN), on NW spur ridge from parking lot, on top of N bluff, 2 July 1997, *Wetmore 77576* (MIN), on top of bluff, around N Overlook, 30 June 1997, *Wetmore 77439* (MIN), on top of Saddle Rock Ridge on rocky ridge, 2 July 1997, *Wetmore 77539* (MIN), prairie N of South Bluff, SW of Coyote Pass, 1 July 1997, *Wetmore 77523, 77525* (MIN), South Bluff, on point of ridge S of Coyote Pass, 4 July 1997, *Wetmore 77653* (MIN); Sioux Co., Agate Fossil Beds National Monument: Carnegie Hill, S of visitors center, 8 July 1997, *Wetmore 77831* (MIN), University Hill, S of visitors center, 8 July 1997, *Wetmore 77855* (MIN). NEVADA. Washoe Co., road to the 'Pyramid', E-side of Pyramid Lake, 25 June 1985, *Ryan 13193a* (ASU). NORTH DAKOTA. Billings Co., S of town of Medora, 30 July 1965, *Wetmore 12769* (MIN); McKenzie Co., Theodore Roosevelt National Park, N Unit.: E of Edge of Glacier Overlook (15 mi. SW of Watford City), 23 June 1998, *Wetmore 80098* (MIN), S of Grassland Overlook, near N edge of the park (14 mi. SW of Watford City), 15 July 1982, *Wetmore 44341* (MIN); Morton Co., 4 mi. W of Mandon, along U.S. 10, 30 July 1965, *Wetmore 12748* (MIN); Williams Co., Fort Union Trading Post National Hist. Site, Bodmer Overlook, N of fort (25 mi. SW of Williston), 26 June 1998, *Wetmore 80267* (MIN). SOUTH DAKOTA. Jackson Co., Badlands National Monument: Cedar Pass, 26 Aug. 1960, *Wetmore 10127* (MSC), 2 mi. W of Cedar Pass on Hwy 16a, 14 Aug. 1959, *Anderson S20885* (COLO). UTAH. Grand Co., Arches National Monument, near Campground at Devils Garden Trail, 10 June 1967, *Wetmore 16469* (KRAM, MIN). WYOMING. Carbon

Fig. 52. Known North American distribution of *Lecanora percrenata* H. Magn.

Co., 7 mi. W of Rawlins, along Interstate 80, 12 Aug. 1975, *Wetmore 24254* (MIN); Steelwater Co., 3 mi. W of Rock Springs on Flaming Gorge Road, 13 Aug. 1975, *Wetmore 24276* (MIN).

Specimens have also been seen from China (S: 'China occidentalis: prov. Kansu, Yeh-ma-ta-ch'üan, *ca* 3000 m.s.m., 18.12.1931, *Birger Bohlin 45c*', 'China occidentalis: prov. Kansu, Ulan-davan-ku (Humboldt Mts), 12.4.1932, *Birger Bohlin*' – PARATYPES), Kazakhstan (LE), Kyrgyzstan (LE), Tajikistan (LE).

Lecanora perpruinosa Fröberg Figs 53 & 54

Calcicolous Lich. Öland: 50. 1989. – HOLOTYPE: [Sweden] 'Öland: Resmo par., 2.9 km ESE of Resmo church, on the south side of the Rsemo-Stenåsa road. On limestone. 56°31′N 16°29′E. RUBIN 4G312219. Alt. 0–50 m, 1984-07-26, *Lars Fröberg L319*' (LD!).

Thallus clearly visible, thin, edge indefinite but mostly continuous, rimose or areolate, ash-grey. Apothecia usually clustered in groups, sessile, concave, cup-like, or flat when mature, 0.3–0.8 mm diam.; disc black or almost black, or dark brown, heavily pruinose, smooth, without umbos; margin prominent, or level with the disc, smooth, uniform, even, pruinose, thallus-coloured (concolorous with thallus). Amphithecium 130–140 μm thick, corticate, algae densely filling the area below the cortex; cortex indistinctly delimited, more or less uniform in thickness, 15–30 μm thick, paraplectenchymatous, not gelatinous, cells up to 6 μm diam., walls of cells greenish, outer part of cortex N+ purple, cortical granules (pol+) insoluble in K and soluble in N; parathecium indistinct; epithecium shades of brown or greenish black, not at all granular, unchanged with K and unchanged in N or N+ more intense brown to reddish, epipsamma present, undefined (insoluble in K and soluble in N); hymenium hyaline, 70–75 μm high; subhymenium indistinct; hypothecium hyaline or almost so, 70–80 μm high, composed of discrete hyphae, clear, without granules, confluent with exciple, similar in colour. Paraphyses thick, simple, submoniliform in upper part, capitate and pigmented at top, coherent in K. Asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (broadly ellipsoid to ellipsoid), 10.5–[11.3]–12 × 5–[6.1]–7.5 μm, Q = 1.6–[1.9]–2.1. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. Growing directly on calcareous rock (limestone).

DISTRIBUTION. The species is known from Europe and North America. More data are necessary, however, to describe the species distribution pattern.

DISCUSSION. It is a very distinctive species, characterized by the ash-grey thallus and the bluish-white pruina on the dark apothecial disc. The amphithecial cortex, which is distinctly paraplechtenchymatous, and the thick, submoniliform paraphyses, appearing as chains of swollen cells, are also diagnostic. The species seems most similar to *L. agardhiana*. A comparison of the two species is provided by Poelt *et al*. (1995). In my opinion

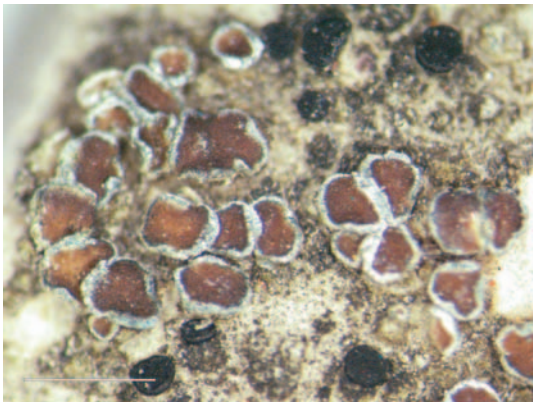


Fig. 53. *Lecanora perpruinosa* Fröberg (*Spribille 9436*, herb. Spribille). Scale bar = 1 mm.

L. perpruinosa is unique in the *L. dispersa* complex due to its distinctive superficial thallus as well as the structure of the amphithecial cortex and paraphyses.

Fröberg considered *L. perpruinosa* to be likely conspecific with the taxon *L. dispersa* var. *coniotropa* (Fr.) Arnold, which was previously mentioned from Sweden by Fries (1831) and later collected from northern Sweden by Magnusson and from Switzerland by Poelt, Steiner and Vězda. In disagreement with Fröberg, Poelt *et al*. (1995) asserted that *L. perpruinosa* is not identical with *L. dispersa* var. *coniotropa*, at least as the taxon was understood by Arnold. Based on investigations of the above-mentioned collections of *L. dispersa* var. *coniotropa* (Magnusson, LD!; Vězda, *Lich. Selecti Exsicc*. 639, LD!) as well as the original material of *L. perpruinosa*, I concur that the two taxa differ in several details. *Lecanora dispersa* var. *coniotropa* lacks such distinct pruina on the apothecial disc (as was actually noted by Fröberg), but also its amphithecial cortex is only apparently cellular, its paraphyses are expanded at the tips but not submoniliform, and above all it contains vinetorin. The presence of the lichen product makes the species most related to *L. semipallida*, and I consider *L. dispersa* var. *coniotropa* conspecific with *L. invadens* H. Magn. For further discussion, see under the species.

NOMENCLATURAL NOTES. In his 1989 paper, Fröberg stated that he was not validly describing the species as this would be dealt with in a later paper, but he did provide the Latin diagnosis and designated the type specimen. Since Santesson (1993: 103) and subsequently Poelt *et al*. (1995: 322) and Fröberg (1997: 33) himself considered the description legitimate, I follow their intention and accept the name as validly published in 1989 by Fröberg.

SPECIMENS EXAMINED. U.S.A. IOWA. Fayette Co., Apr. 1894, *Fink s.n*. (MIN).

Lecanora cf. *perpruinosa*: U.S.A. MONTANA. Flathead Co., Whitefish Range, Trail Creek, near caves close to confluence of Thoma Creek, 17 Oct. 1999, *Spribille 9436* (herb. Spribille) – the specimen lacks distinct pruina on the apothecial disc, but other characters agree with the species characteristics.

Specimen has also been seen from Sweden (LD: 'Öland: Vickleby par., 1.1 km WNW of Trindkärr, the great karst of Vickleby. On limestone. 56°34′N 16°30′E. RUBIN 4G411329. Alt. 0–50 m, 1988-08-8, *Lars Fröberg L863*' – PARATYPE).

Fig. 54. Known North American distribution of *Lecanora perpruinosa* Fröberg.

Lecanora persimilis (Th. Fr.) Nyl.

Figs 55 & 56

Flora **59**: 577. 1876. – *Lecanora hagenii* [subsp.] *persimilis* Th. Fr., Lichenogr. Scand. **1**: 251–252. 1871. – LECTOTYPE (designated here): [Sweden] 'Westrogothie, Kållandsö, på ask, 1861, *F. Graewe*' [the specimen in left, lower corner] (UPS!).

Thallus within the substratum, immersed and not apparent (endophloedal), very rarely superficial, inconspicuous, membranaceous. Apothecia often clustered in groups of 2–3 or occurring singly, widely attached to the substratum, flat when mature, 0.4–0.6 mm diam.; disc plane, smooth, pale brown to chocolate brown, never pruinose, often ±glossary; margin prominent or level with the disc, smooth, entire or slightly crenate, even, uniform, epruinose or rarely slightly pruinose, concolorous with the disc or almost so, often of biatorine appearance. Amphithecium 80–90 µm thick, corticate, algae sparse or concentrated in to the lower part of margin (close to the base) and absent on top; cortex distinctly delimited or continuous with parathecium, differentiated in thickness (15–20 µm thick laterally and 20–60 µm thick at the base), composed of adglutinated hyphae or distinctly prosoplectenchymatic (external hyphae enlarged and blue-green coloured), with sparse granules throughout or granules in outer part of cortex (pol+, partly soluble in K, soluble in N); parathecium distinct; epithecium in shades of brown or olive, indistinctly granular, granules superficial (pol±, partly soluble in K and soluble in N), epipsamma absent; hymenium hyaline, 45–50 µm high; subhymenium hyaline, indistinct; hypothecium hyaline, 40–50 µm high, composed of adglutinated hyphae or prosoplectenchymatic, without granules. Paraphyses slender, simple or slightly branched, slightly expanded, brown pigmented, ± coherent in K. Asci clavate, (4-)8-spored; ascospores hyaline, simple, ellipsoid (broadly ellipsoid to ellipsoid), 9–[9.9]–13 × 4–[5.3]–6 µm, Q = 1.5–[1.9]–2.3. Pycnidia not seen.

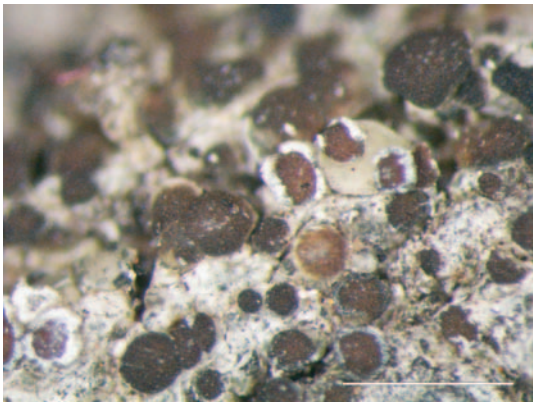


Fig. 55. *Lecanora persimilis* (Th. Fr.) Nyl. (*McCune 26547*, OSC). Scale bar = 1 mm.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. On bark of deciduous trees, most often on branches and twigs.

DISTRIBUTION. Known from Europe and North America, where it was recognized from several scattered localities; probably more frequent but overlooked. It is perhaps a boreal to mainly temperate element.

DISCUSSION. The species is most similar to *L. sambuci*. *Lecanora sambuci* is easily distinguished, however, by having 12 or more spored asci. Moreover, the apothecia of *L. sambuci* are smaller and slightly immersed in the substratum. *Lecanora persimilis* is also likely to be mistaken with slightly pruinose or epruinose forms of *L. hagenii*. However, the apothecia of *L. hagenii* are scattered, occurring singly, not clustered in groups of 2–3 as most often the apothecia of *L. persimilis* are. The apothecial margin is always white and lecanorine in *L. hagenii*, whereas it may be brownish and biatorine in *L. persimilis*.

NOMENCLATURAL NOTES. There are five collections quoted in the species protologue: 'in Suecia ad Glanshammar Nericiæ (P. J. Hellbom) et Kållandsö Westrogothiæ (F. Græwe); in Norvegia ad Christianiam (N. G. Moe) et Tromsöe (ipse); in Fennia ad Asikkala (J. P. Norrlin)'. The following three syntypes were located in the Fries herbarium in UPS: [Sweden] 'Nerike, Glanshammar, Skala gruva, på *Salix caprea*, 1866, *P. J. Hellbom*';

[Sweden] 'Westrogothie, Kållandsö, på ask, 1861, *F. Graewe*'; and [Norway, Akershus] 'Christiania [Oslo]: Skjöen, soc. *Caloplaca cerina*, 18.4.1867, *N. G. Moe No. 107*'. The most appropriate one is selected here for the species lectotypification (see above).

REMARKS. The species was first reported for North America from British Columbia (Liard River Basin: Wakkpash Lake) by Brodo *et al.* (1987: 103).

EXSICCATE SEEN. Malme, *Lich. Suecici Exsicc.* 643 (as *L. hagenii*) (MIN, WIS).

SPECIMENS SEEN. CANADA. ALBERTA. Crowsnest Pass, flat E of Summit Lake, S of Hwy 3, 3 Mar. 2001, *Spribille 10296* (herb. Spribille). BRITISH COLUMBIA. Rocky Mountains, upper White River drainage, E of Canal Flats, near W edge of Height of the Rockies Provincial Park, 28 July 2004, *Spribille 14936*, *14950* (herb. Spribille). – U.S.A. OREGON. Lake Co., Hart Mountain National Antelope Refuge, N end of Hotsprings Campground, June 2002, *McCune 26547* (KRAM, OSC). WASHINGTON. Whatcom Co., Chowder Ridge, NW of Mt. Baker: 19 Sep. 1982, *Ryan 8350* (ASU), NE part, 19 Sep. 1982, *Ryan 7655* (ASU), SW part, 19 Sep. 1982, *Ryan 8134* (ASU). Note: not all North American material was investigated.

Lecanora cf. *persimilis*: U.S.A.. MONTANA, Lincoln Co., Turtle Lake, N Salish Mountains near Eureka, 15 May 1996, *Spribille 4847* (herb. Spribille).

Specimens have also been seen from Luxembourg (herb. Diederich), Poland (KRAM), Sweden (ASU), and UK (NY).

Fig. 56. Known North American distribution of *Lecanora persimilis* (Th. Fr.) Nyl.

Lecanora salina H. Magn. Figs 57 & 58

Bot. Not. (1926): 229. 1926. – LECTOTYPE (selected by S. Ekman in 1990 and formalized here): [Sweden] 'Bohuslän, par. Lycke, Elgön, on maritime rocks, 0.5–1 m, in sheltered sit., 29.5.1921, *coll. A. H. Magnusson*' (UPS!).

Thallus scarcely visible, thin, or thick, of dispersed or rarely contiguous, more or less convex granules or dispersed areolate, most abundant in close vicinity of apothecia, edge definite and slightly crenulate, yellowish grey to greenish grey, or light brownish. Apothecia clustered in groups, sessile, or constricted at the base, flat when mature or irregular in outline to flexuose, 0.3–0.7 mm diam.; disc plane, smooth, pale brown, epruinose; margin prominent, or level with the disc, smooth to waxy in appearance, entire or slightly crenulate, even, uniform, epruinose, concolorous with thallus, paler than disc. Amphithecium 70–160 μm thick, corticate, algae fill the area below the cortex, algal layer continuous below hypothecium; cortex distinctly delimited, brownish, more or less uniform in thickness, 25–30 μm thick laterally and 25–30 μm thick at the base, amorphous (cell walls and lumina indistinct), gelatinous, obscured by two kinds of granules (pol+): coarse, interfering also into parathecium and medullar tissue (soluble in K and insoluble in N) and fine (insoluble in K and insoluble in N); parathecium well delimited, distinct, thin, 15–20 μm; epithecium shades of yellow or brown, granular (pol+), granules superficial and between paraphyses tips, or inspersed in the whole hymenium, fine (insoluble in K and insoluble in N), unchanged in N, epipsamma

Fig. 57. *Lecanora salina* H. Magn. (*Degelius s.n.*, MIN). Scale bar = 1 mm.

absent; hymenium hyaline, 50–60 μm high; subhymenium indistinct; hypothecium hyaline or almost so, 70–80 μm high, composed of prosoplectenchyma (adglutinated hyphae), clear, without granules, confluent with parathecium, similar in colour. Paraphyses slender (averaging less than 2 μm wide), somewhat branched throughout, with few anastomoses, expanded or not and sometimes brownish pigmented, coherent in K. Asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (broadly ellipsoid to ellipsoid), 10.5–[10.8]–12 × 5–[5.9]–7.0 μm, Q = 1.5–[1.9]–2.1. Pycnidia-like structures were rarely observed.

CHEMISTRY. Thallus and apothecial margin K–, C– or C+ pink, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. Lichen products: ± gyrophoric acid and lichenxanthone detected by TLC.

HABITAT. Exclusively on siliceous seashore rocks.

DISTRIBUTION. The species is known from Europe and the east coast of North America. It represents a maritime element.

DISCUSSION. The species occupies the same habitats as *L. fugiens* and *L. andrewii*. The taxa may appear similar in morphology, especially by the presence of a superficial (sometimes scarcely visible) thallus. *Lecanora fugiens* and *L. andrewii* differ from it in having usually pruinose apothecia, as well as in some details of apothecial anatomy (e.g., properties of epithecial and cortical granules) and chemical content (see under the species). Due to the presence of the thallus and *dispersa*-like epithecial granules, *L. salina* seems closely allied to *L. albescens*. In *L. salina* the thallus is much less developed and is granular-areolate rather than distinctly areolate to lobate at the margin. Moreover, the apothecia of *L. salina* are smaller and always bare, and the hymenium is lower. The presence of gyrophoric acid is also very distinctive for the species, as it is not produced by any other member of the *L. dispersa* complex. The chemistry and the somewhat different granulation of the apothecial cortex (the presence of K-soluble and N-insoluble cortical granules) suggest that the relation of the species to the complex is a matter for future debate.

NOMENCLATURAL NOTES. There were three syntypes quoted in the protologue of the species: 'Bohuslän: par. Lycke, Elgön, 1921; par. Långelanda, Svanesund, 1924; par. Torslanda, Flygfältet, 1925'. The first one was selected as lectotype by S. Ekman in 1990 (according to the label information) but this lectotypification was never published.

REMARKS. The species was first reported from North America from Maine (Prince's Point) by Degelius (1940: 42). The chemistry of the species was previously investigated by U. Arup and S. Ekman (label information). They noted that lecanoric acid and a lichexanthone were detected by TLC. However, due to the faint pink (soon disappearing) rather than carmine red reaction with C indicated on the thallus, gyrophoric acid is more likely. TLC analysis and comparison with the standardized spot originating from *Umbilicaria muhlenbergii* confirmed the determination of the lichen product. Gyrophoric acid was reported from *L. salina* previously by Leuckert *et al*. (1990).

EXSICCATE SEEN. Magnusson, *Lich. Selecti Scand. Exsicc*. 24 (as *L. salina*) (KRAM).

SPECIMENS EXAMINED. CANADA. NEWFOUNDLAND. Island of Newfoundland, Bay of Islands, Coal River, 18 Sep. 1896, *Waghorne 415* (BM). – U.S.A.

Fig. 58. Known North American distribution of *Lecanora salina* H. Magn.

MAINE. Hancock Co., Salisbury Cove, 29 July 1922, *Plitt 125a*, *125b* (US); *s.loc*., *s.d.* Degelius *s.n.* (MIN).

Specimens have also been seen from Denmark (ASU) and Sweden (MIN).

Lecanora sambuci (Pers.) Nyl. Figs 59 & 60

Lich. Scand.: 168. 1861. – *Lichen sambuci* Pers., Neue Ann. Bot. **1** [Ann. Bot. **7**]: 26. 1794. – NEOTYPE (designated here): [Germany] 'An Zweigen von *Sambucus nigra* am Waldrande zwischen Neuried und Planegg bei München. Septbr. 1888. *Boll*.' [Arnold, *Lich. Exsicc*. 300d, as *L. sambuci*] (M! 139484; KRAM!, MIN! – NEOTYPE DUPLICATES).

Thallus within the substratum, immersed and not apparent (endophloedal). Apothecia occurring singly or clustered in groups, when young slightly immersed in the substratum, later sessile, flat when mature, 0.3–0.6 mm diam.; disc plane, smooth, brown, epruinose; margin prominent or level with the disc, thin, smooth, entire, even, uniform, epruinose or pruinose, paler than the disc or most often white. Amphithecium ±80 µm thick, corticate, algae more or less densely fill the area below the cortex, algal layer continuous below the hypothecium; cortex distinctly delimited, differentiated in thickness (20–30 µm thick laterally and 30–60 µm thick at the base), composed of adglutinated, gelatinous hyphae, with sparse granules, more abundant only on top of margin (pol+, insoluble in K, soluble in N); parathecium indistinct; epithecium in shades of brown, mostly not at all granular or indistinctly granular, granules superficial, coarse (pol±, insoluble in K and soluble in N), epipsamma absent; hymenium hyaline, 45–60 µm high; subhymenium hyaline, indistinct; hypothecium hyaline or almost so, 20–50 µm high, composed of adglutinated hyphae, without granules. Paraphyses simple, thick, slightly expanded or capitate, brown pigmented at tips, usually free in K; asci clavate, 16(–32) spored. Ascospores hyaline, simple, broadly ellipsoid (broadly ellipsoid to ellipsoid), 7.5–[9.6]–12 × 4–[5.8]–7.5 µm, Q = 1.5–[1.7]–1.9. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. On bark of deciduous trees especially *Populus* spp., *Fraxinus*, *Acer*; most often on branches and twigs.

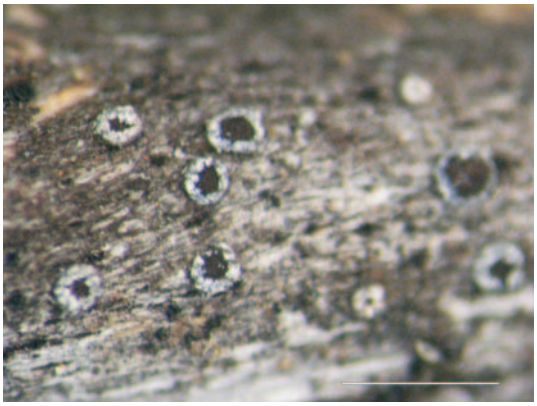


Fig. 59. *Lecanora sambuci* (Pers.) Nyl. (*Ryan 24979b*, ASU). Scale bar = 0.5 mm.

DISTRIBUTION. The species is known from Europe and several scattered localities in North America; perhaps more frequent but overlooked. It is probably a boreal to temperate element with the main distribution area in temperate regions.

DISCUSSION. *Lecanora sambuci* is differentiated by having small apothecia with a thin, regular thalline margin and a brown disc, and by growing predominantly on branches and twigs of deciduous trees, preferring *Sambucus*. The following anatomical characters distinguish the species: (i) asci more than 8-spored, (ii) an epithecium not at all granular, and (iii) the absence of lichen products. The two most similar species are *L. hagenii* and *L. persimilis*. However, the number of spores is diagnostic, since *L. sambuci* is the only species of the complex having multispored asci. Additionally, *L. hagenii* has an often pruinose apothecial disc, and *L. persimilis* usually has a darker apothecial margin (often biatorine), sometimes concolorous with the disc.

NOMENCLATURAL NOTES. It is the oldest species in the complex besides *L. dispersa*. No material of *Lecanora sambuci* was found in the Persoon herbarium at Leiden (Gerard Thijsse, in letter), and the original collection must be regarded as lost. Therefore a neotype has been chosen. The selection was made based on an exsiccate collection seen, as was done for typification of other members of the complex.

REMARKS. The multispored species of *Lecanora* s.str. were studied in detail by Guderley and Lumbsch (1999). The authors concluded that the number of ascospores is of minor taxonomic significance in the genus *sensu stricto*. Assessment of the significance of the character within the *L. dispersa* complex requires study of more material from Europe.

EXSICCATES SEEN. Arnold, *Lich. Exsicc.* 300d (as *L. sambuci*) (KRAM, M, MIN; types); Arnold, *Lich. Monac. Exsicc.* 512 (as *L. sambuci*) (MIN); Malme, *Lich. Suec. Exsicc.* 609 (as *L. sambuci*) (MIN).

SPECIMENS EXAMINED. CANADA. ONTARIO. Slate Islands, Patterson Island Camp, 12 July 1977, *Wetmore 28545b* (MIN). – U.S.A. CALIFORNIA. Siskiyou Co., Klamath National Forest, Gold Flat, on road 7F01, about 6 mi. SW of Scott Bar, 20 Aug 1989, *Ryan 24979b* (ASU). MICHIGAN. Leelanau Co., Sleeping Bear Dunes National Lake-shore: Sleeping Bear Dune, 1 July 1987, *Wetmore 58180* (MIN), Good Harbor Bay, Good Harbor CR, 7 July 1987, *Wetmore 58645b* (MIN). MINNESOTA. Clay Co., Hawley, 8 mi. NW, 11 July 1978, *Wetmore 35999* (MIN); Clearwater Co., Itasca SP, Headwaters area, 2 Aug 1976, *Wetmore 26159*, *26187* (MIN); Lake of the Woods Co., Clementson at Rapid River, 18 Aug 1994, *Wetmore 74848* (MIN); Pine Co., Pine City, 5.5 mi. W, 26 July 1983, *Schuster 1250* (MIN). SOUTH DAKOTA. Lawrence Co., Black Hills, Buskala Burn, 11 mi. SW of Lead, 1 Aug 1961, *Wetmore 12545* (MIN), Pennington Co., Black Hills, Matt Burn, 2 mi. SE of Deerfield, 1 July 1961, *Wetmore 12530* (MIN). WISCONSIN. Ashland Co., Apostle Island NL, Long Island, Jack Pine Ridge, 15 Aug 1995, *Wetmore 75651* (MIN). Note: not all North American material was investigated.

Specimens have also been seen from Austria (MIN), Sweden (MIN), and Ukraine (KRAM).

Fig. 60. Known North American distribution of *Lecanora sambuci* (Pers.) Nyl.

Lecanora semipallida H. Magn. Figs 61 & 62

Lichens from Central Asia I, in S. Hedin (ed.), Reports Scientific Exped. North-west. provinces of China (the Sino-Swedish expedition). 13, XI. Botany, **1**. Aktiebolaget, Thule & Stockholm: 89. 1940. – HOLOTYPE: 'China occidentalis: prov. Kansu. Wai-chüan-ku, E of Yeh-ma-ta-chüan, *ca* 3000 m.s.m., 13.12.1931, *Birger Bohlin 42d*' (S!).

= *L. xanthostoma* Wedd. ex Cl. Roux, Bull. Mus. Hist. Nat. Marseille **36**: 24. 1976. – HOLOTYPE: [France] 'Poitiers' [parasitic on *Verrucaria nigrescens* Pers.], *Weddell* (PC).

= *L. xanthostoma* Cl. Roux ex Fröberg, Symb. Bot. Ups. **32**(1): 33. 1997; *nom. illeg*. (Art. 53.1).

= *L. flotoviana* auct. (non Spreng.). For an overview of the taxon see Ryan *et al*. 2004: 218. Widely distributed reference collection: Rabenhorst, *Lich. Eur*. 747, *L. flotowiana* (for saxicolous specimens) and Körber, *Lich. Select. German*. 338, *L. flotoviana* (for corticolous specimens).

Thallus within the substratum, immersed and not apparent, or crustose, indistinct to clearly visible, thin, edge indefinite, ±smooth or rimose, pale grey, or yellowish grey to greenish grey, often with distinct bluish pigment. Apothecia occurring singly, or clustered in groups, sessile, or constricted at the base to almost raised, flat when mature or flexuose, 0.4–1.3(–1.4) mm diam.; disc plane, smooth, yellow, pale greenish yellow, or yellow-orange to pale brown, epruinose, or slightly pruinose; margin prominent or level with the disc, often considerably thick, smooth or rough, entire or distinctly crenate, even, uniform, epruinose or pruinose, paler than thallus and paler than disc, often with bluish pigment. Amphithecium 70–170(–270) µm thick, corticate, algae densely filling the area below the cortex; cortex usually distinctly delimited, rarely not distinctly delimited, uniform, or slightly thicker at the base than at the sides, 30–50 µm thick laterally and 50–70 µm thick at the base, composed of adglutinated hyphae to prosoplectenchymatous, obscured by granules occasionally interfering into the area below the cortex (pol+, insoluble in K, soluble in N); parathecium usually distinct, prosoplectenchymatous, 10–30 µm wide; epithecium hyaline or shades of yellow or brown, granular (pol+!), granules

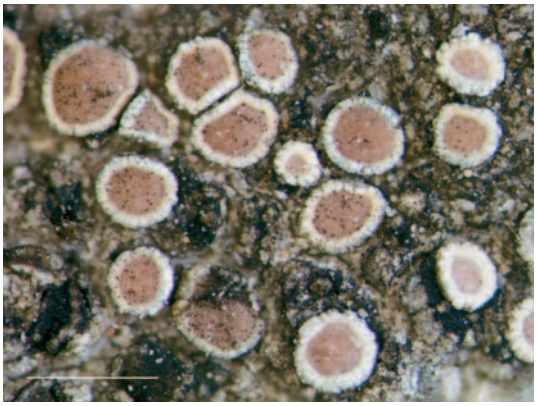


Fig. 61. *Lecanora semipallida* H. Magn. (*Wetmore 13052*, KRAM). Scale bar = 1 mm.

superficial and between paraphyses tips, fine to coarse, soluble in K and insoluble in N, sometimes with an epipsamma (insoluble in K, soluble in N); hymenium hyaline, 50–90 µm high; subhymenium indistinct; hypothecium hyaline or distinctly yellow to orange (becoming more intense in K), composed of prosoplectenchyma, clear, without granules, confluent with parathecium and similar in colour, 50–160 µm high. Paraphyses simple or dichotomously branched at tips, slender or thickened, not expanded, or slightly expanded apically, usually not pigmented, free in K. Asci clavate to broadly clavate, 4–8-spored; ascospores hyaline, simple, broadly ellipsoid (broadly ellipsoid to narrowly ellipsoid), 7.5–[10.8]–13 × 4.5–[6.0]–7.5 µm, Q = 1.2–[1.8]–2.6. Pycnidia rare, black, inconspicuous; conidia falcate – consistently filiform and characteristically curved, 10–17(–18) × 1 µm.

CHEMISTRY. Apothecial margin K+ yellow, C– or C+ yellow, KC+ yellow, PD–; disc K+ yellow or orange, C+ yellow or orange, PD–; apothecia UV+ yellow-orange. Lichen products: vinetorin (5-chloro-3-*O*-methylnorlichexanthone) detected by TLC.

HABITAT. Directly on calcareous rock (limestone, calcium-rich sandstone) and concrete or overgrowing or commensally on other lichens, e.g., *Aspicilia calcarea* (L.) Mudd, *Caloplaca* spp., *Lecanora* spp., *Physcia* spp., *Phaeophyscia*

nigricans (Flörke) Moberg, *Verrucaria* spp.; occasionally on bark, bryophytes and plant debris, also on metal.

DISTRIBUTION. It is a widespread species in Europe and North America. It is also known from Asia, Australia and New Zeland. In North America it occurs in the Arctic, alpine, boreal and temperate regions with the main distribution in temperate areas.

DISCUSSION. *Lecanora semipallida* is one of the more distinct species of the *L. dispersa* complex. A key character distinguishing *L. semipallida* is the presence of epithecial granules that are soluble in K. The presence of vinetorin, resulting in positive spot tests and UV reactions of the apothecial disc, is also diagnostic. Especially interesting was the discovery of elongate, curved conidia produced by the species. Morphologically, *L. semipallida* is a highly variable species. The size, shape and colouration of the apothecia may vary significantly. The species is consistent in regard to anatomy (properties of epithecial granules) and chemistry (vinetorin always present). A closely related species is *L. invadens* H. Magn, which differs in having a more distinct thallus than *L. semipallida*, a dark brown to blackish, epruinose or heavily pruinose apothecial disc, and a bluish-green epithecium. For comparison with *L. dispersa*, see discussion under the species.

NOMENCLATURAL NOTES. *Lecanora semipallida* H. Magn. was shown to be the correct name for the common, widespread member of the *L. dispersa* complex hitherto known as *L. flotoviana* (auct. non Spreng.). Further, *L. xanthostoma* Cl. Roux was shown to be conspecific with *L. semipallida* and therefore was relegated to synonymy (Śliwa 2007). Full details on the status and application of the names are provided in the publication.

EXSICCATES SEEN. Arnold, *Lich. Monac. Exsicc.* 206 (as *L. dispersa*) (M); *Flora Hung. Exsicc.* 812 (as *L. dispersa*) (FH, KRAM, WIS); Körber, *Lich. Select. German.* 338 (as *L. flotoviana*, lignicolous) (GOET, L, M); *Lich. Danici Exsicc.* 276 (as *L.* cf. *xanthostoma*) (KRAM); Malme, *Lich. Suecici Exsicc.* 544 (as *L. dispersa*) (MIN, WIS); Rabenhorst, *Lich. Eur.* 747 (as *L. flotowiana*) (FH, GOET, L, M, WIS); Verseghy, Lich. Exsicc. 61 (as *L. dispersa*) (KRAM); Wartmann & Schenk, *Schweiz. Kryptog.* 469 (as *L. caesioalba*) (MIN).

SPECIMENS EXAMINED. CANADA. ALBERTA. E side of Alberta Hwy 6, 25 km N of Twin Buttes, 27 July 1985, *Ryan 13964* (ASU); Banff National Park, Canyon of Johnson Creek, SE of Mt. Eisenhower, 25 July 1959, *Weber S23549* (COLO). MANITOBA. W of Hudson Bay, Fort Churchill, 11 Aug. 1950, *Thomson 3836* (CANL). NEW BRUNSWICK. Albert Co., Fundy National Park, Point Wolfe, 19 June 1980, *Gowan 2438*, *Gowan 2457* (CANL). NORTHWEST TERRITORIES. unnamed tributary of the Arctic Red River, entering from the E side, 3 Aug. 1978, *Bird & Thomson 19828*, *19865* (WIS); Banks Island, near Mercy Bay, 22 July 1979, *Scotter 30519* (CANL); Bathurst Island, Polar Bear Pass area, 20 July 1973, *Brodo 19302a* (CANL, WIS), *Brodo 19302c*, *19310a* (CANL); Bluenose Lake – Hornaday River, 26 July 1990, *Scotter s.n.* (WIS); Central Ellesmere Island, Central Sverdrup Pass, 14 July 1986, *Fahselt 410* (CANL), 19 July 1986, *Maycock & Fahselt s.n.* (CANL), 25 July 1986, *Maycock s.n.* (CANL); Devon Island, Truelove lowland, 15 July 1971, *Richardson 50*, *51* (CANL); Mackenzie Mt., Keele River region, 8 July 1971, *Scotter s.n.* (WIS). ONTARIO. Algoma Co., Pancake Bay, W side of Hwy 17, 27 July 1983, *Ford L252* (MICH); Bruce Co.: Georgian Bay Islands National Park, Flowerpot Island, 28 July 1976, *Wong 2084*, *2087*, *2097*, *2090* (CANL), Russell Island, Tobermory, 11 July 1965, *Krug 211* (CANL); Frontenac Co.: Eastview Park, 29 May 1967, *Brodo 9667* (CANL), Kingstone, 29 May 1967, *Wong 266* (CANL, with conidia); Lake Huron, Leask Point, South Bay, Manitoulin Island, *s.d.*, *Grassl 1817* (MICH); Slate Islands, Petterson Island, 20 July 1977, *Wetmore 29022a* (CANL, MIN); QUEBEC. Comte de Jacques Cartier, N edge of Isle Bizard, 15 mi. W of Montreal, 15 July 1970, *Brodo 16780* (CANL); Gaspé-Est Co., Gaspe Peninsula, Forillon National Park: near Cap Bon-Ami, 10 Aug. 1971, *Brodo 18622* (CANL), Mt. Ste. Anne, W of Perce, 14 Aug. 1959, *Shushan S23096* (COLO); Rimouski Co., St-Simon, 29 Aug. 1967, *Lepage 15903* (CANL). – U.S.A. ALASKA. Anaktuvuk Pass, Brooks Range, 1 July 1976, *Nash 14824* (ASU), Atqasuk, on bank of Meade River, 13 July 2001, *Fryday 8130* (MSC, assoc. with other lichens), along the Kaolak River, S of Wainwright, 9–18 July 1958, *Shushan & Maher s.n.* (H, WIS, US), *Maher s.n.* (WIS); along the Pitmegea River, 15 mi. upstream from Cape Sabine, 10–17 July 1958, *Thomson 10650* (WIS). ARIZONA. Apache Co., Pastora Peak, 14 July 1974, *Marsh & Rankert 368* (ASU); Cochise

Co.: Chiricahua Mts., 0.5 mi. above XX Martyr Dam, 22 May 1973, *Nash 6955* (ASU), Huachuca Mts., N side of Carr Peak, 14 Sep. 1976, *Nash 14556* (ASU); Coconino Co., Grand Canyon National Park: S rim, Bright Angel Trail, 12 Oct. 1974, *Nash 9574* (ASU), Grandview Trail, 30 June 1991, *Nash 30877* (ASU), top of Grandview Trail, 30 June 1991, *Nash 31020* (ASU), top of Hermit Trail, 11 July 1994, *Nash 35473* (ASU); 4 mi. N of Kaibab Lodge, 17 Aug. 1974, *Nash 9432* (ASU), N Kaibab Trailhead, 13 Aug. 1991, *Boykin 2287* (ASU), 2 km SSE of E rim Viewpoint, 9 Oct. 1994, *Nash 34680*, *34681* (ASU); Coconino Co.: Coconino National Forest, upper end of the W fork of Oak Creek Canyon, 23 km SW of Flagstaff, 11 June 1998, *Nash 42045* (ASU), Grand Canyon S rim, E of Pima Point, 18 Nov. 1992, *Sharnoff & Sharnoff 97222* (herb. Brodo), edge of Gray Mesa, 19 mi. SE of Page, 22 Apr. 1973, *Nash 6494* (ASU), Oak Creek Canyon, 10 mi. S of Flagstaff, 15 June 1974, *Brodo 20340* (CANL), W fork of Oak Creek Canyon, 1 Mar. 1972, *Letho s.n.* (ASU), 18 Nov. 1973, *Nash 8349* (ASU), W side of San Francisco Peaks, near road to Snow Bowl, 14 July 1973, *Nash 7493* (ASU); Gila Co., Workman Creek, from upper campground to Workman Falls, 28 Apr. 1990, *Nash 28422* (ASU). CALIFORNIA. Siskiyon Co., near the Ash Creek Bridge, along S shore of Kalamath River, N of Yrek, 26 Aug. 1989, *Ryan 25626* (ASU). COLORADO. Archuleta Co., Simms ranch, 2 mi. N of Chromo, 14 June 1955, *Shushan S9897* (COLO); Baca Co., Canyonside, vicinity of Dodge Ranch, SW of Utleyville, 4 Sep. 1955, *Shushan S8195* (COLO); La Plata Co., Mesa Verde National Park, Spruce Canyon Trail, 6 Aug. 1974, *Marsh 315* (ASU); Las Animas Co., W bank of Trinchera Creek, 25 mi. E of Trinidad, 4 July 1957, *Shushan S11486* (COLO); San Juan Co., Mesa Verde National Park: E side of Navajo Canyon, 27 May 1980, *Nash 18021* (CANL, MIN, MSC, NY), lower Fewkes Canyon, 27 May 1980, *Nash 17782* (ASU, MIN), Soda Canyon and Battleship Rock area, 29 May 1980, *Nash 18089* (ASU). IDAHO. Twin Falls Co., Hagerman Fossil Beds National Monument, 0.5–1 km E of S end of 500 E road, 10 Sep. 1998, *Ryan 32902* (ASU). IOWA. Fayette Co.: Echo Valley State Park, E of West Union, 30 Oct. 1965, *Wetmore 13635* (CANL: with *L. invadens*, MIN), Fayette, Apr. 1894, *Fink s.n.* (FH, MICH, MIN, NY, WIS), 1895, *Fink s.n.* (CANL, MICH, MIN, NY), 6 Aug. 1895, *Fink s.n.* (WIS), 28 Oct. 1895, *Fink s.n.* (MICH), 16 July 1905, *Fink s.n.* (FH, H, US), near Fayette, 16 July 1903, *Fink s.n.* (CANL, MIN, MSC). KANSAS. Anderson Co., 1.5 mi. S of Garnett, 12 June 1950, *Kramer 158* (NY); Riley Co., Manhattan, 14 July 1893, *Reed s.n.* (NY). MICHIGEN. Emmet Co.: 0.2 mi. E of Lone Rock Rd., on Robinson Road, 15 July 1969, *Pfister s.n.* (MICH), Wangbshance Pt., 16 July 1952, *Fulford s.n.* (MICH); Keweenaw Co., Isle Royale Natinal Park, N of Conglomerate Bay, 25 July 1983, *Wetmore 49483* (MIN), Heron Island in Rock Harbor, 26 July 1983, *Wetmore 49618* (CANL, MIN, US); Mackinac Co.: Bush Bay, 28 July 1979, *Tan 306* (CANL), 9 July 1983, *Fischlin 157* (CANL), shore of Lake Huron at Bush Bay, 13 Aug. 1974, *Harris 9466* (MICH), W of Hessel on Mich. Hwy 134, 20 Sep. 1966, *Harris 1081b*, *Harris 1083b* (NY); Presque Isle Co.: Ocqueoc Falls, NE of Onaway, 18 July 1974, *Harris 9066* (MICH, MSC), *Buck s.n.* (NY), Posen, 3 Aug. 1968, *Hinds s.n.* (MICH). MINNESOTA. Blue Earth Co., Mankato, 24 June 1899, *Fink s.n.* (MIN), *Gardener s.n.* (NY); Cook Co., Sugar Loaf Preserve, 10 mi. SW of Tofte, 11 July 1995, *Wetmore 75351* (KRAM, MIN); Goodhue Co., 3 mi. E of Red Wing along U.S. 61, 18 May 1975, *Wetmore 24067* (MIN); Hennepin Co., Minneapolis, 1896, *Fink s.n.* (MICH, MIN), *Fink s.n.* (MIN), 24 June 1896, *Fink 2* (MIN); Lake Co., shore of Lake Superior, Pork Bay, 28 Aug. 1902, *Fink s.n.* (MICH,

Fig. 62. Known North American distribution of *Lecanora semipallida* H. Magn.

MIN); Le Sueur Co., 1.5 mi. SW of Kasota, 17 July 1999, *Wheeler 20114* (MIN); Otter Tail Co., Battle Lake, 20 June 1900, *Fink 109* (MIN, with conidia); Wabasha Co.: Handshaw Coulee, 11 July 1979, *Brako 1678* (MIN), Millville, 14 mi. SW of Wabasha, 26 June 1979, *Brako 1485* (MIN); Winona Co.: 0.5 mi. SW of Bear Creek, 10 mi. NW of Winona, 17 June 1979, *Brako 921* (MIN), John Latsch State Park, 12 mi. NW of Winona, near Mississippi River, 7 June 1975, *Wetmore 24110* (MIN), 17 June 1979, *Brako 943* (MIN), Whitewater Wildlife Management Area, 2 mi. W of Elba, 25 mi. NW of Winona, 13 Oct. 1979, *Brako 2424* (MIN). MONTANA. Gallatin Co., Gallatin National Forest: Bozeman Pass, 7 mi. E of Bozeman, 30 July 1998, *Wetmore 81495* (MIN), 'M' hill, 4 mi. NE of Bozeman, 31 July 1998, *Wetmore 81521* (MIN); Gallatin Co., W-side of Hwy 191, 87.5 km S of Bozeman, 1 Aug. 1985, *Ryan 20943* (ASU); Lake Co., E side of National Bison Range, S end of Mission Valley, 8 km SE of Moiese, *May 1976*, *McCune 6628* (KRAM, OSC); Park Co., Silver Gate, along trail to Silver Creek Falls, 22 Aug. 1973, *Weber L57511* (COLO, MIN); Sanders Co., Cabinet Mountains, summit of St. Paul Peak. 14 Aug. 2004, *Spribille & Wagner 15733* (herb. Spribille); Stillwater Co., 8.5 mi. SW of Columbus, 23 Aug. 1978, *Trana 6140*, *6179* (MIN). NEBRASKA. Dawes Co., Chardon State Park, 9 mi. S of Chardon off U.S. Route 385, 25 May 2000, *Morgen & Egan 442* (OMA). NEVADA. Pershing Co., 6 mi. E of Oreana off Interstate 80, 20 mi. NE of Lovelock, 14 Aug. 1975, *Wetmore 24357* (MIN); Washoe Co., E-side of Pyramid Lake, 25 Jun. 1985, *Ryan 22096* (ASU). NEW MEXICO. Bernalillo Co., Sandia Cresta, summit of Sandia Mts., 26 Mar. 1956, *Shushan & Weber S6589* (COLO); San Juan Co., S side of Chaco Wash, across from Casa Chiquita ruins, 7 Aug. 1979, *Nash 16252* (ASU); San Miguel Co., Hot Springs in Lower Gallinas Canyon, 16 Sep. 1973, *Weber et al. L57802*, *L57803* (COLO), Santa Fe National Forest, El Porvenir Campground, 22 Apr. 1970, *Egan 5095* (MIN). NEW YORK. Niagara Co, Goat Island, Niagara Falls, W end of Luna Island, 1 Nov. 1988, *Harris 22858* (NY). SOUTH DAKOTA. Custer Co., Black Hills: along Antelope Ridge Road, N of Custer-Limestone Road, 16 mi. WNW of Custer, 9 July 1960, *Wetmore 7115*, *7116* (MSC), 3.6 mi. S of U.S. 16, on Fourmile Creek Road, 2 July 1960, *Wetmore 6723a* (MSC), S of Jewel Cave National Monument, 0.8 mi. S of U.S. 16, in Hell Canyon, 6 July 1960, *Wetmore 6917* (H, MSC), *Wetmore 6884b* (MSC), S of Jewel Cave National Monument, 6 July 1960, *Wetmore 6879* (MSC); Lawrence Co., Black Hills: along Boulder Creek, 1 mi. S of U.S. 14A, 6 mi. E of Deadwood, 10 Aug. 1960, *Wetmore 9187* (MSC), Hanna Creek Campground, 6 Aug. 1983, *Nash 22023* (ASU), Icebox Gulch, 13 Aug. 1960, *Wetmore 9441* (CANL, MSC), Little Elk Creek Canyon, 3 mi. W of Piedmont, 10 Aug. 1960, *Wetmore 9197* (MSC), Spearfish Canyon, S of Bridal Veil Falls, 28 July 1961, *Wetmore 11111* (MSC); Pennington Co., Black Hills: Ditch Creek Campground, 5 Aug. 1983, *Nash 21967* (ASU, NY), 18 July 1960, *Wetmore 7658* (MSC), 5 Aug. 1983, *Wetmore 50014*, *50041* (MIN), 3 mi. WSW of Rapid City, S of Rapid Creek, 6 June 1960, *Anderson S20526* (COLO, MSC, with conidia), on road to Rhodes Ranch, 21 mi. NE of Newcastle, 20 July 1960, *Wetmore 7842* (MSC); Roberts Co., shore of Big Stone Lake, NE South Dakota, 31 Aug. 1929, *Kienholz 95* (FH, MICH). UTAH. Carbon Co., N side of Consumer Road, between towns of Helper and Price, 14 Aug. 1985, *Ryan 18101a*, *18101b* (ASU); Grand Co., Arches National Monument near campground at Devils Garden Trail, 10 June 1967, *Wetmore 16485b* (MIN); Kane Co.: about 10 mi. E of Kanab, along U.S. Hwy 89, *s.d.*, *Nebecker 1558* (ASU), Tibbets Canyon, Kaiparowitz Plateau, 22 Dec. 1971, *Nash 3590* (ASU); San Juan Co.: Devil's Canyon, 16 mi. S of Monticello, 30 Apr. 1976, *Nash 14951* (ASU), 35 mi. S of Moab, *s.d.*, *Nebecker 2781* (ASU), road between La Sal and Bedrock (Colorado), 18.5 mi. just W of Colorado state line, 26 Oct. 1988, *Timdal et al.* L83576 (COLO); Sevier Co.: 1.5 km W of Rte 72 on S side of I-70, 1 Aug. 1984, *Nash 22967* (ASU), along Hwy 4, 16 km E of Interstate Hwy 15, 1 Aug. 1985, *Ryan 17401* (ASU), S side of Interstate Hwy 70, 1 Aug. 1984, *Ryan s.n.* (ASU); Washington Co., Zion National Park, Refrigerator Canyon, in narrow Navajo sandstone gorge, 19 May 1979, *Nash 15603* (ASU); Wayne Co., Capital Reef National Monument: along Grand Wash, *s.d.*, *Nebecker 2413* (ASU), E side of the Park, *s.d.*, *Nebecker 2354* (ASU). VERMONT. Rutland Co., Rutland, July 1911, *Kirk s.n.* (MIN). WISCONSIN. Door Co., below Potawatomi Bluffs, 1 Sep. 1971, *Petersen 136* (WIS); Grant Co., on bridge across the Grant River, 26 Sep. 1964, *Thomson 11634* (WIS); Iowa Co., T7N R4E S.1, 19 July 1960, *Foote 60400a* (WIS); Sauk Co., Spring Green Reserve St. Nat. Area, Baraboo Hills, off Jones road, 4 Sep. 1988, *Harris 42177* (NY), *Buck 34506* (NY); Vernon Co., T12N R3E S.7, 28 July 1960, *Foote 60748a* (WIS). WYOMING. Crook Co., Black Hills, 3.5 mi. N of Moskee, 14 Aug. 1960, *Wetmore 9593* (MIN, MSC); Niobrara Co., 39 mi. S of Mule Creek junction, junction of U.S. 85 & U.S. 8, 3 Aug. 1965, *Wetmore 13052* (KRAM, MIN); Park Co., Yellowstone National Park: Pebble Creek Campground, 25 July 1998, *Wetmore 81255* (KRAM, MIN),

W end of Lamar Canyon, 25 July 1998, *Wetmore 81197* (MIN); Weston Co., along U.S. 85 at Soldier Creek, 20 mi. NNW of Newcastle, 12 Aug. 1961, *Wetmore 11271b* (MSC).

Lecanora cf. *semipallida*: CANADA. MANITOBA. W of Hudson Bay, The Pass, 19 Aug. 1950, *Thomson 3743* (CANL, US).

Specimens have also been seen from Australia (FH), Austria (ASU, GZU, KRAM), Belgium (FH), Czech Republic (NY, US), Denmark (KRAM), Germany (ASU, GOET, L, M), Hungary (FH, KRAM, WIS), Italy (MSC), Mongolia (KRAM, LE), New Zealand (ASU; MSC: Campbell Island), Norway (GOET, NY), Poland (KRAM), Russia (WIS), Sweden (FH, L, LD, MIN, NY, WIS), Switzerland (GOET, NY), UK (H, MSC, NY), and Ukraine (KRAM).

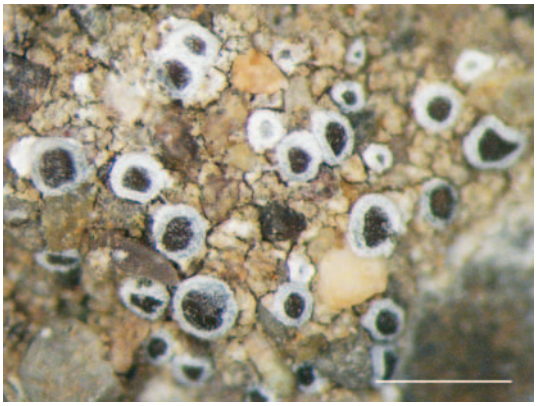


Fig. 63. *Lecanora torrida* Vain. (*McCune 18047*, KRAM). Scale bar = 1 mm.

Lecanora torrida Vain. Figs 63 & 64

[Wainio] Arkiv Bot. **8**(4): 45. 1909. – HOLOTYPE: [Russia] 'Sibiria Septentronalis: Peninsula Jinretlen, 67º lat. bor., 174º long. occid. (Greenw.), IX. 1878 – VII. 1879, *leg. Ernst Almquist*' (S!).

Thallus clearly visible, dispersed areolate, present only under apothecia or restricted to their close vicinity, rarely wider than apothecia and forming areoles, white. Apothecia occurring singly, or clustered in groups of 2–3, widely sessile on single areole of thallus, sometimes slightly immersed in the areole (areoles often very small, create stalk-like structure under apothecia), flat when mature, 0.3–1.0(–1.3) mm diam.; disc plane to convex, smooth, dark brown, or black or almost black, epruinose; margin prominent, or level with the disc, smooth, entire, even, uniform, epruinose, concolorous with thallus or darkened, paler than disc, or the same colour as the disc, or sometimes thalline margin excluded and then dark true exciple usually distinct. Amphithecium 80–190 µm thick, corticate, algae not abundant in the area below the cortex, algal layer discontinuous below hypothecium; cortex indistinctly delimited, or distinctly delimited, more or less uniform in thickness, 30–40 µm thick, prosoplectenchymatous, gelatinous, filled by abundant or sparse granules (pol+, insoluble in K, soluble in N); parathecium distinct, thick, up to 50 µm, granular, bluish on top, often higher than disc and overlapping margin; epithecium shades of brown, or shades of olive, green or blue (becoming more intensely green with K and turning pink or red in N), not granular or granules sparce, but fine granules (pol+) inspersed in the whole hymenium (insoluble in K and insoluble in N), epipsamma absent; hymenium hyaline, 45–60 µm high; subhymenium indistinct; hypothecium hyaline or almost so, 30–40 µm high, composed of thick adglutinated hyphae, clear, without granules. Paraphyses slender, or thick, somewhat branched throughout, with few anastomoses, slightly expanded to capitate, pigmented, with pigment sharply delimited as a cap, coherent in K. Asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (broadly ellipsoid to narrowly ellipsoid), 9–[10.9]–11 × 4.5–[5.4]–6 µm, Q = 1.5–[2.0]–2.6. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD– or PD+ orange; disc K–, C–, KC–, PD–; apothecia UV-negative. Lichen products: 2,7-dichlorlichexanthone, ± pannarin; or no lichen products detected by TLC.

HABITAT. Growing directly on calcareous rock.

DISTRIBUTION. The species occurs in Europe, North America, New Zealand and Antarctica. In North America *L. torrida* is an arctic-alpine to boreal species.

DISCUSSION. The chemistry and granulation of the apothecial tissues indicate the close relation of

this species to *L. dispersa* and *L. albescens*. Unlike the dispersed areolate thallus of *L. torrida*, *L. dispersa* has a thallus immersed within the substratum and not apparent, and *L. albescens* has a much more abundant thallus, often forming conspicuous rosettes which are indistinctly lobate at the margins. Additionally, the thallus of *L. albescens* bears numerous apothecia, whereas the apothecia of *L. torrida* are clustered in groups of 2–3 per thallus areole. Moreover, both *L. albescens* and *L. dispersa* have a distinctly granular epithecium which is tinged yellow or brown (unlike the dark and often not at all granular epithecium of *L. torrida*), and both are more widely distributed than *L. torrida*.

REMARKS. The species was known to occur in the Arctic but has recently been reported also from the Antarctic (Śliwa & Olech 2002), indicating a bipolar range.

Fig. 64. Known North American distribution of *Lecanora torrida* Vain.

SPECIMENS EXAMINED. CANADA. MANITOBA. Churchill, IGY # 2, 25 June 1989, *Brodo 27537* (CANL). NORTHWEST TERRITORIES. Axel Heiberg Island, E side, 19 July 1980, *Scotter s.n.* (WIS); Banks Island: at confluence of Muskox and Thomson Rivers, 20 July 1990, *Gould 934b* (MIN), close to confluence of Muskox and Thomson Rivers, 18–24 July 1989, *Harmsen s.n.* (CANL), Thomson River, 17 July 1990, *Gould 916* (MIN); Bathurst Island: Bracebridge Inlet, 23 July 1992, *Scotter s.n.* (WIS), Polar Bear Pass Area, Antler Hill, on W bank of Goodsir River, 2 mi. N of N.M.N.S. Station, 20 July 1973, *Brodo 19305* (CANL, H, WIS), Polar Bear Pass Area, Eastwind Point, 4 mi. W of Goodsir Inlet, 23 July 1973, *Brodo 19424* (CANL); Cornwallis Island, Resolute Bay, E hill, 2 Sep. 1947, *Innes-Taylor 128* (CANL); Central Ellesmere Island, central Sverdrup Pass, 18 July 1986, *Maycock & Fahselt s.n.* (CANL); Ellesmere Island: vicinity of Eureka 16–17 July 1980, *Scotter s.n.* (WIS), Fosheim Peninsula, Hot Weather Creek, 2 July 1990, *Brodo s.n.* (CANL); Prince Patrick Island, vicinity of Mould Bay, 29 May 1968, *Kuc s.n.* (CANL). – U.S.A. ALASKA. Glacier Bay, 11 June 1899, *Trelease & Saunders s.n.* (NY); Kuskokwin River near Georgetown, 21 July 1980, *Hoare 706* (WIS); along Pitmegea River, 15 mi. upstream from Cape Sabine, 10–17 July 1958, *Thomson 10572*, *10574*, *10575* (WIS). MINNESOTA. Cook Co.: Grand Portage National Monument, Mt. Rose above Grand Portage, 12 Aug. 1991, *Wetmore 67905* (MIN), Sugar Loaf Preserve along shore of Lake Superior, 12 July 1995, *Wetmore 75508* (MIN). VERMONT. Brigle, *s.d.*, *Pringle s.n.* (NY). OREGON. Benton Co., NE of Coevallis Willamette Valley, Oct. 1989, *McCune 18047* (KRAM, OSC).

Lecanora cf. *torrida*: CANADA. NEW BRUNSWICK. Albert Co., Fundy National Park, Point Wolfe Beach, 5 Sep. 1981, *Gowan 4708* (CANL). NEWFOUNDLAND. Island of Newfoundland, Cape Norman, at N tip of the Northern Peninsula, off of Rt. 435 going towards Cook's Harbor, 26 July 1993, *LaGreca 1492* (BM, CANL, KRAM).

Specimens have also been seen from Antarctica (Śliwa & Olech 2002), Austria (GZU), New Zealand (MSC: Campbell Island), Norway (FH), and Sweden (MIN).

Lecanora wetmorei Śliwa Figs 65 & 66

in Nash *et al*. (eds), Lich. Fl. Sonoran **2**: 283. 2004. – HOLOTYPE: [U.S.A.] 'UTAH. Salt Lake Co., E of Salt Lake City, along Big Cottonwood Canyon, on road to Brighton, on oak, elev. 5800 ft., 11 June 1967, *coll. Clifford M. Wetmore 16568*' (MIN!; KRAM! – ISOTYPE).

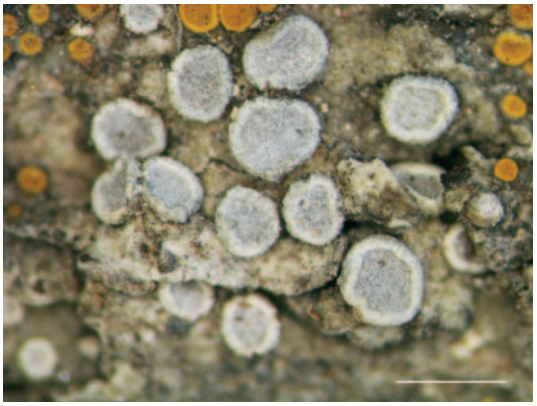


Fig. 65. *Lecanora wetmorei* Śliwa (*Wetmore 16568*, KRAM – isotype). Scale bar = 1 mm.

Thallus within the substratum, immersed and not apparent (endophloedal). Apothecia sessile and flat when occurring singly, flexuose when mature or crowded, 0.4–1.2(–1.5) mm diam.; disc pale brown to black, heavily pruinose, (therefore disc apparently bluish), smooth; margin prominent or level with the disc, entire, smooth, uniform, pruinose, paler than disc to white. Amphithecium 80–190 µm thick, corticate, algae fill the area below the cortex, algal layer continuous below hypothecium; cortex distinctly delimited, strongly expanded at the base, 16–20 µm thick laterally and 60–100 µm thick at the base, composed of adglutinated hyphae or gelatinous, cortical granules sparse, more abundant at top of margin (pol+, insoluble in K, soluble in N); parathecium indistinct; epithecium in shades of yellow or brown, granular, granules superficial (pol±, insoluble in K, soluble in N), in some specimens additional coarse granules present (pol+, soluble in K, insoluble in N) [those granules are easier to observe in thick cross sections], epipsamma absent or present (insoluble in K and soluble in N); hymenium hyaline, 50–65 µm high; subhymenium distinct, granular; hypothecium hyaline, 40–50 µm high, composed of adglutinated hyphae. Paraphyses simple, rarely branched, slightly expanded or capitate and not pigmented or pale brown, ± free in K. Asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (ellipsoid to narrowly ellipsoid), 9–[11.9]–13 × 4.5–[5.1]–6 µm, Q = 2.0–[2.4]–2.7. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. Lichen products: sometimes traces of unknown lichen product detected by TLC (Rf A5, ice blue substance visible in 366 UV before charring).

HABITAT. Inhabits tree bark of *Juniperus*, *Populus*, *Pseudotsuga*, *Quercus*, *Salix*, *Thuja* and wood; occurs mostly at higher elevations (600 m to 3150 m).

DISTRIBUTION. The species is so far known only from the western part of North America, where it represents a western temperate to western montane element.

DISCUSSION. Although *L. wetmorei* is a distinctive western North American species, it was

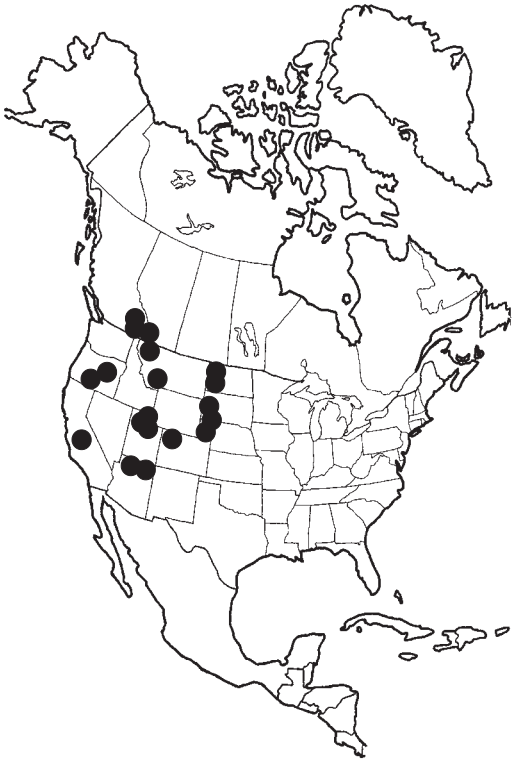


Fig. 66. Known North American distribution of *Lecanora wetmorei* Śliwa.

previously identified by most collectors as *L. hagenii* due to its heavily pruinose apothecial disc. *Lecanora wetmorei* is distinguished by its considerably larger apothecia, 0.4–1.2(–1.5) mm diam. The apothecia are sessile or constricted at the base, flat to flexuose, with an entire thalline margin and a yellowish, pale brown to black disc. The amphithecial cortex of the species is considerably thickened at the base (60–100 μm). *Lecanora hagenii* has widely sessile, smaller apothecia, 0.3–0.9 mm diam., with a usually incised apothecial margin and a pale to distinctly brown disc, often tinted orange. The amphithecial cortex of the species is of more or less uniform thickness or at most thickened up to 60 μm at the base. Moreover, *L. wetmorei* occurs only at higher elevations, mostly over 600 m, whereas *L. hagenii* is a widespread species.

EXSICCATE SEEN. Nash, *Lich. Exsicc. ASU* 115 (as *L. populicola*) (KRAM).

SPECIMENS EXAMINED. CANADA. ALBERTA. Rocky Mountains, Crowsnest Pass, in SW Alberta, on BC/Alberta border, 3 Mar. 2001, *Spribille 10293* (herb. Spribille). BRITISH COLUMBIA. East Kootenay region, west of Invermere, Toby Creek canyon, 20 July 2004, *Spribille & Goward 15306*, *15319* (herb. Spribille); Rocky Mountains, upper White River drainage, E of Canal Flats, near western edge of Height of the Rockies Provincial Park, 28 July 2004, *Spribille 14927* (herb. Spribille). – U.S.A. ARIZONA. Apache Co., Carrizo Mountains, canyon E of Pastora Peak, 4 July 1974, *Nash 9093* (ASU); Coconino Co.: Grand Canyon National Park, N Kaibab Trail, 1 Aug. 1991, *Boykin 2313* (ASU), Kaibab National Forest, secondary road adjacent to Fire Point and at boundary to Grand Canyon National Park, 8 Oct. 1994, *Nash 34641* (ASU). CALIFORNIA. Solano Co., W of town of Winters, Stebbins Cold Creek Canyon, 2 Mar. 2006, *Toby Spribille 18386* with *Wagner & Rejmánek* (herb. Spribille). MONTANA. Gallatin Co., Yellowstone National Park, Black Butte Trail to Big Horn Peak, near trail junction, 16 July 1998, *Wetmore 80629* (ASU, MIN); Flathead Co.: vicinity of Columbia Mountain trailhead, *ca* 7.5 km E of Columbia Falls, 15 Feb. 1999, *Spribille 8834*, *8829* (herb. Spribille), Salish Mountains Sunday Creek Road, between Stryker and Sunday Lake, 9 Mar. 2001, *Spribille 10303b* (herb. Spribille), SW of Trego, along Lime Creek, Pom and Rita Collins' Ranch, 23 June 2004, *Spribille 14194* (herb. Spribille); Lincoln Co., S of Trego, Brimstone Creek, 17 June 2004, *Spribille 14082*, *15199* (herb. Spribille). NEBRASKA. Scotts Bluff Co., Scotts Bluff National Monument, N side of S Bluff, SW of Coyote Pass, 1 July 1997, *Wetmore 77497* (MIN). NORTH DAKOTA. McKenzie Co., Theodore Roosevelt National Park, N Unit, along Little Missouri River, near Squaw Creek Campground (15 mi S of Watford City), 21 July 1982, *Wetmore 44855* (MIN); Billings Co., Theodore Roosevelt National Park, S. Unit, NE of Cottonwood camping ground (2.5 mi. N of Medora), 31 July 1982, *Wetmore 45638* (MIN). OREGON. Grant Co., near Long Creek, June 1987, *McCune 16412* (OSC). SOUTH DAKOTA. Pennington Co., Ditch Creek Campground, 5 Aug. 1983, *Wetmore 49995* (MIN); Shannon Co., Badlands National Park, along highway 2, at S edge of park, 5 mi. W of White River, 11 July 1997, *Wetmore 78026* (MIN). UTAH. Rich Co., Bear Lake, Lakota, 16 Aug. 1952, *Flowers 613* (COLO, KRAM, NY); Wasatch Co., Uinta National Forest, 10.4 mi. E of Springville in Hobble Creek Canyon, 10 June 1967, *Wetmore 16542* (MIN). WYOMING. Park Co., Yellowstone National Park, Lamar Valley Picnic Area, between Tower and Pebble Creek, 26 July 1998, *Wetmore 81295* (MIN).

Lecanora zosterae (Ach.) Nyl. var. ***zosterae***

Figs 67 & 68

Flora **59**: 577. 1876. – *Lecanora subfusca* [var.] *zosterae* Ach., Syn. Meth. Lich.: 158. 1814. – LECTOTYPE (designated by Brodo & Vitikainen, Mycotaxon **21**: 296. 1984): [Sweden] 'Suecia' (H-ACH 1147A).

Thallus within the substratum, immersed and not apparent (endophloedal), or evanescent, indistinct, thin of edge indefinite, whitish or greyish brown. Apothecia scattered to clustered, evenly distributed (not crowded), constricted at the base, orbicular at first, flat, later peltate (apparently adnate, nevertheless, narrowly attached at the base and thus regarded as constricted), 0.6–1.6(–3.5) mm diam.; disc plane and smooth initially, becoming concave and sinuous, orange brown, reddish, to lead brown or brown to almost black, epruinose or slightly pruinose; margin prominent (may sometimes be raised and involute above the disc), or level with the disc, rarely becoming excluded, relatively thin, smooth, entire, even or flexuose, uniform, concolorous with thallus or differentiated, concolorous with thallus below but often whitish and apparently pruinose on top.

Fig. 67. *Lecanora zosterae* (Ach.) Nyl. (*Brodo 12111*, CANL). Scale bar = 1 mm.

Amphithecium 60–140 μm thick, corticate, algae not abundant in the area below the cortex, algal layer continuous below hypothecium; cortex distinctly delimited, differentiated, indistinct or thin (30–40 μm) laterally and clearly expanded at the base (up to 40–80 μm), composed of adglutinated hyphae to apparently paraplectenchymatous, or gelatinous, cortical granules absent or sparse (pol+, insoluble in K, soluble in N); parathecium indistinct, thin, *ca* 10 μm wide; epithecium shades of yellow, deep orange to brown or reddish (more intense to red in N), not at all granular or rarely with sparse granules (pol+), granules superficial and between paraphyses tips (soluble in K and insoluble in N), epipsamma absent; hymenium hyaline, 45–60 μm high; subhymenium hyaline, indistinct; hypothecium hyaline or yellowish, 60–65 μm high, composed of adglutinated hyphae or prosoplectenchymatous, clear, without granules. Paraphyses slender, simple to sparsely branched, slightly expanded to capitate (up to 3 μm) apically and usually pigmented, adglutinated, coherent or free in K. Asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (ellipsoid to narrowly ellipsoid), 9–[11.0]–13(–16) × 4–[4.8]–6 μm, Q = 2.1–[2.3]–2.7. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. On wood, detritus, other organic substrata; described and often quoted as occurring on the eelgrass *Zostera*.

DISTRIBUTION. It is a widespread taxon of heterogenic distribution pattern, known from Europe, Asia and North America, including Greenland.

DISCUSSION. *Lecanora zosterae* is most closely related to *L. hagenii*. The latter differs in having small, sessile apothecia up to 0.8 mm diam., with a plane disc which is usually pruinose. Laundon (2003) provided an unambiguous and precise circumscription of *Lecanora zosterae*. The species as defined by the author is morphologically, anatomically and chemically uniform, and Laundon's concept of the species is accepted here. It is recognized by its characteristic peltate apothecia, with a brown or, more usually, orange-brown to reddish and epruinose disc which becomes sinuous and concave when old, and with a whitish or grey involute margin. It has an amphithecial cortex which is distinctly delimited and clearly thickened at the base, and an epithecium which is not at all granular. The species lacks any lichen products. While studying collections of the species from the Arctic region, however, it became very difficult to keep to such a clear species concept, because of the considerable morphological variability of the species. To cover this variability, which is most likely due to extreme environmental conditions in the Arctic region and does not influence the anatomy, it seems reasonable to delimit infraspecific taxa, as proposed below.

NOMENCLATURAL NOTES. Brodo and co-authors considerably extended our knowledge of the species and related taxa (Brodo 1976; Brodo & Vitikainen 1984; Brodo *et al*. 2001). Based on examination of the type collections, Brodo (1976) maintained that the distinction between *L. palanderi* and *L. beringii* is not clear-cut. Brodo and Vitikainen (1984: 296) studied and lectotypified *L. zosterae*. In the same paper they regarded *L. palanderi* as conspecific with the former species and relegated it to synonymy (Brodo & Vitikainen 1984: 297). Brodo *et al*. (2001) again indicated the close relation of *L. zosterae* to *L. beringii*. In the present treatment a new

taxonomic status is proposed for both *L. palanderi* and *L. beringii* (see below).

EXSICCATE SEEN. *Lich. Danici Exsicc.* 65 (as *L. dispersa* s.lat.) (KRAM), with *L. semipallida*.

SPECIMENS EXAMINED. CANADA. ALBERTA. Aspen Parkland, 3 mi. SE of Mirror, C Bird farm, *s.d.*, *Bird 35171* (CANL). BRITISH COLUMBIA. Queen Charlotte Islands: Graham Island, 2 mi. W of Tow Hill (Yakan Poiny), 15 June 1967, *Brodo10018* (CANL), Moresby Island, Sandspit, 16 July 1971, *Brodo 18524A* (CANL), 2 mi. SE of Sandspit, 26 June 1971, *Brodo 17151* (CANL), Talunkwan Island, S of Louise Island, Thurston Harbour, 21 July 1967, *Brodo 12084B*, *12111* (CANL); Rocky Mountains, upper White River drainage, E of Canal Flats, near W edge of Height of the Rockies Provincial Park, 28 July 2004, *Spribille 14940* (herb. Spribille). NEWFOUNDLAND. Labrador, Foctear?, 23 Sep. 1894?, *Waghorne s.n.* (MICH, NY). NORTHWEST TERRITORIES. Bylot Island, 1982, *Scotter s.n.* (WIS); Richards Island, 23 July 1966, *Scotter 8504* (CANL). NOVA SCOTIA. Pictou Island, July 1880, *Farlow s.n.* (FH). QUEBEC. St. Lawrence River, 21 July 1880, *s.coll. s.n.* (FH). SASKATCHEWAN. about 30 mi. N of Swift Current, at the IBP Matador Research Station, 7 July 1969, *Jesberger 619b* (WIS). YUKON TERRITORIES. Herschel Island, tundra communities near settlement, 23 July 1972, *Scotter 19084*, *19095* (CANL). – U.S.A. CALIFORNIA. Humboldt Co., Samoa Peninsula, railroad bridge over Mad River Slough, 31 Oct. 1971, *Lindsay Jr. 245* (WIS); Santa Barbara Co., San Miguel Island, lower part of Willow Canyon, 17 Mar. 1998, *Nash 41287* (ASU). COLORADO. Boulder Co., Mt. Audubon, 4.5 mi. WNW of Ward, 20 Aug. 1968, *Egan 1168* (OMA). MICHIGAN. Shore Co., St. Lawrence, 21 July 1880, *s.coll. s.n.* (MSC). MONTANA. Granite Co., Grassland, 1 km E of Bear Creek mouth, 22 April 1976, *McCune 6553* (CANL); Morgan Lake, northern Salish Mts., S of Eureka, 15 May 1996, *Spribille 4856.1* (herb. Spribille), Murphy Lake, in Rocky Mountain Trench, S of Eureka, 1 Oct. 1996, *Spribille 6558* (herb. Spribille); Teton Co., E front of Rocky Mts., 2 km N of Headquarters Creek Pass, above Our Lake, 14 Aug. 1985, *McCune 15067* (KRAM, OSC). NEW MEXICO. Otero Co., Apache Indian Reservation, Sierra Blanca Peak, Sacramento Mts, 11 Aug. 1969, *Egan 1936* (OMA); Santa Fe Co., Lake Peak, 11 mi. NE of Santa Fe, 14 Aug. 1969, *Egan 1689* (OMA). WASHINGTON. Clallam Co., Elwha River Valley, 1 mi. S of Elwha, 21 Aug. 1969, *Brodo 15314* (CANL).

Specimens have also been seen from Greenland (NY, S), Mongolia (KRAM), Russia (FH: Novaya Zemlya, S: Siberia), and UK (KRAM).

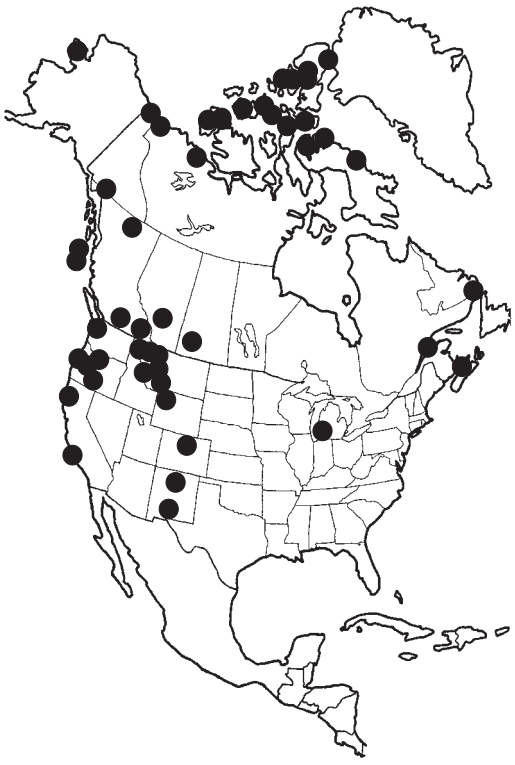


Fig. 68. Known North American distribution of *Lecanora zosterae* (Ach.) Nyl. [including var. *zosterae*, var. *beringii* (Nyl.) Śliwa and var. *palanderi* (Vain.) Śliwa].

Lecanora zosterae var. ***beringii*** (Nyl.) Śliwa, ***comb. nov.*** Fig. 69

BASIONYM: *Lecanora beringii* Nyl. [= '*Lecanora behringii* Nyl.'], Flora **68**: 439. 1885. – LECTOTYPE (selected by I. M. Brodo in 1993 and formalized here): [Russia] 'Ins. Behringii, *E. Almqvist* (Exped. Vega)' (H-Nyl 26134!).

= *Lecanora turbinata* Poelt & Leuckert, Biblioth. Lichenol. **58**: 327. 1995. – HOLOTYPE: [Austria] 'Dachstein-Gruppe, Steiermark / Ober-Österreich: Gipfel des Hohen Dachstein, Kalk, ±2290 m, 29.7.1990, *leg. J. Poelt*' (GZU!).

Thallus within the substratum, immersed and not apparent, endolithic or endophloedal or some distinct granules of thallus visible in close vicinity of the base of apothecia. Apothecia usually

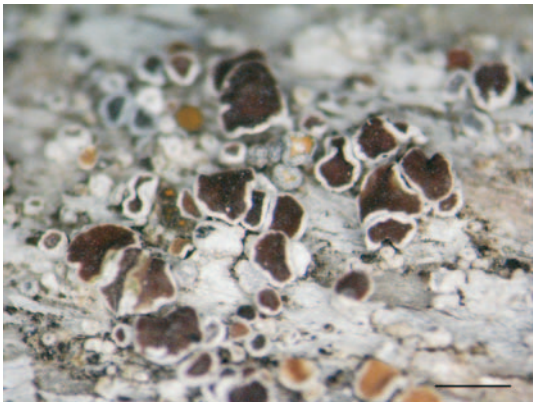


Fig. 69. *Lecanora zosterae* var. *beringii* (Nyl.) Śliwa (*Scotter 92755*, CANL). Scale bar = 1 mm.

clustered in groups of 2–3(–4), raised on a stalk or stipe, concave, cup-like, flat when young to flexuose when mature, 0.3–1.4 mm diam.; disc plane, smooth, reddish brown or dark brown, black or almost black, epruinose; margin prominent, occasionally becoming raised above the disc and involute, or partly excluded, entire or slightly crenate, flexuose, uniform, epruinose, paler than the disc, concolorous with thallus. Amphithecium 90–140 µm thick, corticate, algal layer very loose, algae sparse in the area below the cortex, more abundant at both sides of apothecia; cortex distinctly delimited, expanded at the base, 30–45 µm thick laterally and 45–70(–80) µm thick at base, gelatinous, or composed of adglutinated hyphae, cortical granules sparse or more abundant, in rows or located mostly on top of margin (pol+, insoluble in K, soluble in N); parathecium indistinct; epithecium shades of yellow or brown, reddish or shades of olive, green or blue, unchanged in N, or turning pink or red in N, not at all granular or very rarely granular (pol+), granules between paraphyses tips, coarse (soluble in K and insoluble in N), epipsamma absent or present, undefined (insoluble in K and soluble in N); hymenium hyaline, 40–60 µm high; subhymenium distinct, granular; hypothecium hyaline or almost so, 45–90(–120) µm high, composed of prosoplectenchyma, darkened by granules. Paraphyses thick (averaging more than 2 µm wide), simple, slightly expanded and usually pigmented, ± free in K. Asci clavate, 8-spored; ascospores hyaline, simple, narrowly ellipsoid (broadly ellipsoid to narrowly ellipsoid), 9–[12.0]–15(–18) × 4–[4.7]–6 µm, Q = 1.8–[2.6]–3.3. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C– or C+ yellow, KC– or KC+ yellowish, PD–; disc K–, C– or C+ yellow, KC– or KC+ yellowish, PD–; apothecia UV-negative or ± pale yellow. Lichen products: ± lichenxanthones; or no lichen products detected by TLC.

HABITAT. Growing directly on calcareous rock but preferentially on bones and caribou antlers.

DISTRIBUTION. The taxon occurs predominantly in the Arctic zone of North America but also in the alpine belt in the mountains. It is known also from Europe and represents an arctic-alpine element.

DISCUSSION. *Lecanora beringii* appeared to be conspecific with *L. zosterae* in many respects, and especially its apothecial anatomy. Morphologically the two taxa differ in some details, above all the raised apothecia of *L. beringii* which are often surrounded at the base by small areoles of thallus. Therefore, variety is considered the most appropriate taxonomic status for it.

NOMENCLATURAL NOTES. The lecotype of *L. beringii* was selected by I. M. Brodo in 1993 (according to the label information) but this lectotypification was never published.

Lecanora turbinata was described by Poelt *et al*. (1995). The author was hesitant to use a new name as marked on the label. At first he considered applying the name '*beringii*' for his original specimen. Finally he decided to use the new name for his collection. The species is very distinctive but perfectly matches the present understanding of *L. beringii*, and that name will have to replace *L. turbinata* along with its taxonomic rank.

REMARKS. In 2002 during revision of the herbarium material I labeled all these specimens '*L. turbinata* Poelt & Leuckert'.

SPECIMENS SEEN. CANADA. BRITISH COLUMBIA. Near Napier Lake on Rt. no. 5, 20.5 mi. S of junction of Rts. 1 & 5, 30 May 1966, *Brodo 7755* (CANL). NORTH-

WEST TERRITORIES. Axel Heiberg Island, E side of island, 19 July 1980, *Scotter s.n.* (CANL, WIS); Baffin Island: northern Baffin Island, Site C-4, 1982, *Scotter s.n.* (CANL), head of Clyde Fiord, 25 Aug. 1950, *Hale s.n.* (CANL, WIS); Banks Island: near Muskox River, 22 July 1979, *Scotter 30480*, *30482*, *30483*, *30487*, *30491* (CANL), at confluence of Muskox and Thomson Rivers, S of Muskox and W of Thomson, 20 July 1990, *Gould 1017* (MIN); horn of Barren Ground Caribou, 29 July 1914, *Johansen s.n.* (FH); Bathurst Island: vicinity of Bathurst Inlet, 29 July 1979, *Scotter s.n.* (CANL), Gregory Peninsula, 23 July 1992, *Scotter s.n.* (WIS); Bluenose Lake, Hornaday River, lower Brock Lagoon, 29 July 1990, *Scotter s.n.* (CANL); Bylot Island, Site B-5, 1982, *Scotter s.n.* (CANL); Cape Churchill, 1985, *Scotter s.n.* (WIS); Cape Parry Area, polar semi-desert near Pin Main Dewline station, 15 July 1978, *Scotter s.n.* (WIS); Ellesmere Island: Central Ellesmere Island, Central Sverdrup Pass, 14 July 1986, *Fahselt s.n.* (CANL), vicinity of Eureka, 20 July 1980, *Scotter s.n.* (WIS), 1.5 mi. SSW of PanArctic Fosheim N-27, 13 June 1971, *Johnson s.n.* (WIS); Richards Island, 23 July 1966, *Scotter 8444a*, *8445a*, *8447* (H), *Scotter 8444* (CANL). – U.S.A. ALASKA. Seaward Peninsula, Cape Prince of Wales, near Village Creek, 9 July 1980, *Flock 902* (COLO). OREGON. Klamath Co., Fremont National forest, 800 m W of Rd 335, across from Anderson Field, 9 July 1991, *Ryan 28292a* (ASU). WYOMING. Park Co., N of Clay Butte, near Beartooth Plateau, July 1992, *McCune 19770* (OSC).

Specimens have also been seen from Austria (GZU), Greenland (CANL, MIN, S) and Russia (CANL, S: Novaya Zemlya; S: Siberia).

Lecanora zosterae var. ***palanderi*** (Vain.) Śliwa, ***comb. nov.*** Fig. 70

BASIONYM: *Lecanora palanderi* Vain., Arkiv Bot. **8**(4): 48. 1909. – HOLOTYPE: [Russia, Siberia] 'Ad lignum in peninsula Jinretlen' (from the protologue), *Wainio* (TUR).

Thallus within the substratum, immersed and not apparent, or thin, continuous, whitish or grey. Apothecia scattered to clustered, evenly distributed (not crowded), constricted at the base, 0.6–1.6(–3.5) mm diam.; disc plane, smooth, reddish brown, lead brown or brown to almost black, slightly to moderately pruinose; margin prominent, or level with the disc, rarely becoming excluded, relatively thin, smooth, entire, even or flexuose, uniform, concolorous with thallus or

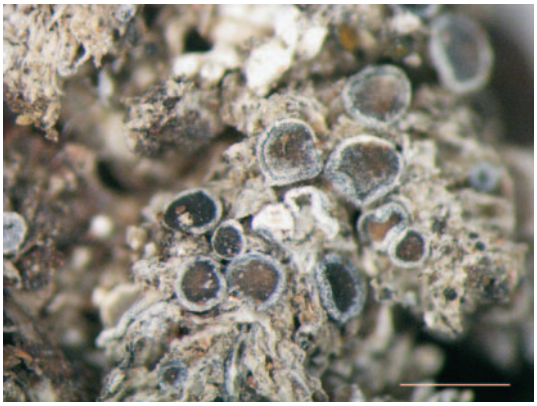


Fig. 70. *Lecanora zosterae* var. *palanderi* (Vain.) Śliwa (*Scotter 20242*, CANL). Scale bar = 1 mm.

distinctly white, pruinose. Amphithecium 60–140 μm thick, corticate, algae not abundant in the area below the cortex, algal layer continuous below hypothecium; cortex distinctly delimited, differentiated, indistinct or thin (30–40 μm) laterally and clearly expanded at the base (up to 40–80 μm), composed of adglutinated hyphae to apparently paraplectenchymatous, or gelatinous, cortical granules absent or sparse (pol+, insoluble in K, soluble in N); parathecium indistinct, thin, *ca* 10 μm wide; epithecium shades of yellow, deep orange to brown or pale reddish (more intense to red in N), not at all granular or rarely with sparse granules (pol+), granules superficial and between paraphyses tips (soluble in K and insoluble in N), epipsamma present (insoluble in K and soluble in N); hymenium hyaline, 45–60 μm high; subhymenium hyaline, indistinct; hypothecium hyaline or almost so, 60–65 μm high, composed of adglutinated hyphae, clear, without granules; paraphyses slender (1–1.5 μm wide), simple to sparsely branched, with clavate or slightly expanded to capitate (up to 3 μm) and usually pigmented tips, compact, coherent or free in K; asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid (ellipsoid to narrowly ellipsoid), 9–[11.0]–13(–16) × 4–[4.8]–6 μm, Q = 2.1–[2.3]–2.7. Pycnidia not seen.

CHEMISTRY. Apothecial margin K–, C–, KC–, PD–; disc K–, C–, KC–, PD–; apothecia UV-negative. No lichen products detected by TLC.

HABITAT. Predominantly on bryophytes and other organic substrata.

DISTRIBUTION. The taxon is known from the northern parts of Europe and North America. In North America it occurs also in the alpine belt in the mountains. It perhaps represents an arctic-alpine element.

DISCUSSION. *Lecanora palanderi* is anatomically conspecific with *L. zosterae*. However, the two taxa differ in some morphological details, above all by the moderately to heavily pruinose apothecial disc of *L. palanderi* which is also predominantly dark coloured. Therefore, variety is proposed as its taxonomic rank.

SPECIMENS SEEN. CANADA. BRITISH COLUMBIA. Northern Rocky Mountains, Liard River-Basin, Fairy Lake, 26 July 1977, *Brodo 21725* (CANL). NORTHWEST TERRITORIES. Banks Island: 20 July 1979, *Scotter 30017* (CANL), 22 July 1979, *Scotter 30225* (CANL), near Mercy Bay, 22 July 1979, *Scotter 30179* (CANL), near Muskox river, 22 July 1979, *Scotter 30495* (CANL); Bathurst Island: 2 June 1975, *Dickson 2293B* (CANL), slopes, ridges and valleys within 1.5 mi. of N.M.N.S. Station, E of Goodsir River, 18 July 1973, *Brodo 19248B* (CANL); Cornwallis Island, Resolute Bay, 13 Aug. 1959, *Seavile 4046*, (CANL); Devon Island, Truelove Lowlands, 1970, *G.M.C. 54* (CANL); Ellesmere Island: island in Disrraeli Fiord, 20 May 1969, *Brassard 4093B* (CANL), Marvin Penisula, lakes W of Rambow Hill, 17–19 May 1969, *Brassard 4066* (CANL); Northeastern Ellesmere Island, 1956, *Schuster 35904* (CANL); Hans Island, 18 July 1972, *MacDonald & MacDonald s.n.* (CANL). YUKON TERRITORIES. Herschel Island: tundra communities near settlement, 23 July 1972, *Scotter 19066*, *19092* (CANL), 18 Sep. 1977, *Cooper 7360* (CANL), 25 Sep. 1977, *Cooper 7412B* (CANL); Kluane National Park, Profile Mtn., alpine communities, 5 Aug. 1972, *Scotter 20242* (CANL). – U.S.A. MONTANA. Flathead Co., Glacier National Park, Ridge SW of Little Dog Mountain, 7 Aug. 1984, *McCune & DeBolt 14636* (OSC); Gallatin Co., bank of Missouri River, near Clarkston Access, 23 Aug. 1982, *McCune 12787* (OSC); Glacier Co., E side of Glacier National Park, near summit of Scenic Point, Aug. 1987, *McCune 16818* (OSC); Lincoln Co.: talus and outcrops along Kootenai River, just below Kootenai Falls, 10 km E of Troy, July 1977, *McCune 7795* (OSC), Ravalli Co., summit of Little St. Joseph peak, Bitterroot Range, 15 Aug. 1983, *McCune 12996a* (OSC); OREGON. Hood River Co., Mount Hood National Forest, Cascade Range ridge below Barrett Spur, N side of Mount Hood, 20 July 1994, *McCune 21678* (OSC); Lincoln Co., Rocky Creek State Park, within ocean spray zone, May 1987, *McCune 17356* (OSC); Linn Co., Horse Rock Ridge Research Natural Area, March 2001, *McCune et al. 25790* (OSC). WYOMING. Park Co., Beartooth Plateau, granitic bedrock outcrops and talus above Lower Twin Lake, July 1992, *McCune 19812* (OSC).

Specimen has also been seen from Russia (S).

EXCLUDED OR UNTREATED TAXA

Listed below are species not considered for one of the following reasons: (i) although preliminarily considered members, excluded from the *L. dispersa* complex based on the present study (*L. elenkinii*, *L. flotoviana*, *L. thallophila*, *L. utahensis*); (ii) they show some affinities to the complex but not enough material was examined to include them in the treatment (*L. actophila*, *L. populicola*); (iii) they belong to the *L. dispersa* complex but were not determined in North American material (*L. conferta*).

Lecanora actophila Wedd.

Memoir. Soc. Nation. Scienc. Natur. Cherb. **19**: 268. 1875.

This is a saxicolous species with unclear affinities. It has not traditionally been treated as related with *L. dispersa* complex, however, the species chemistry (the lichen xanthones produced) suggests that the relation of *L. actophila* to the former group of taxa requires further consideration.

SPECIMENS EXAMINED. CANADA. BRITISH COLUMBIA. Queen Charlotte Islands, Moresby Island, Takakia Lake, 6 July 1967, *Brodo & Shchepanek 11017* (MIN).

Specimens have also been seen from Finland (MIN) and Sweden (MIN).

Lecanora conferta (Fr.) Grognot

Plant. Crypt.-Cellul.: 61. 1863. – *Parmelia conferta* Fr., Lichenogr. Europ. Reform.: 155. 1831. – SYNTYPE: [France] 'Gallia occidentalis, in muris argillaceus, *Prevost*' (UPS!).

The species is similar to *L. fugiens* in its spot test reactions, pruinose apothecial disc and epithecial granule properties, but has much more abundant apothecia which often become angular by compression. *Lecanora conferta* also occupies a different habitat; it occurs on hard limestone. The species is reported from several European countries and it is likely to be found in North America.

Specimens have also been seen from Sweden (WIS) and Portugal (WIS).

Lecanora elenkinii Mereschk. Fig. 71

Lich. Ross. Occid. Exsicc. 31: 1913. – SYNTYPE: [Russia] 'Ad saxa calcarea in monasterio Sancti Georgi, prope Sebastopolin, in peninsula Taurica, 1910, *leg. et det. C. Mereschkowsky*', *Lich. Rossiae Exsicc.* 31 (LE!).

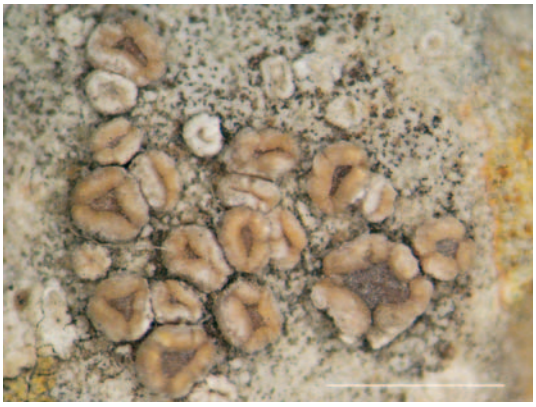


Fig. 71. *Lecanora elenkinii* Mereschk. (Mereschkowsky, *Lich. Ross. Exicc.* 31, LE – syntype). Scale bar = 1 mm.

This is a mysterious saxicolous species. It superficially resembles *L. crenulata* due to considerably thick and distincly crenate apothecial margin, however, the species produces isousnic acid and unknown pigment. *Lecanora elenkinii* is hitherto known exclusively from its *locus classicus*.

Lecanora flotoviana Spreng. Fig. 72

Neue Entd. **1**: 221. 1820. – LECTOTYPE (designated by Śliwa, Polish. Bot. J. **52**(1): 73. 2007): [Germany] 'Halle' [on sandstone, parasitic on *Phaeophyscia sciastra*] (GOET!).

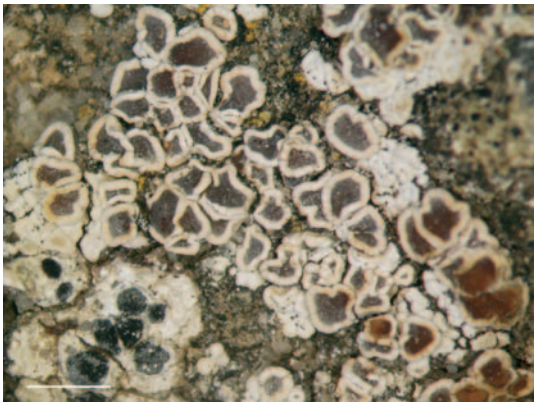


Fig. 72. *Lecanora flotoviana* Spreng. (*Sprengel*, B – topotype). Scale bar = 1 mm.

This saxicolous lichen is excluded from *L. dispersa* complex on account of its chemistry: usnic and ±psoromic acids were detected in original collection of the species (Śliwa 2007).

REMARKS. The species quotation in the Sonoran desert treatment (Ryan *et al*. 2004) as well as all specimens labeled by me as '*L. flotowiana* Spreng.' in 2002 refer to *L. semipallida* [= *L. flotoviana* auct. non Spreng.] (Śliwa 2007).

Specimens have been seen from Germany (B, GOET, L).

Lecanora populicola (DC.) Duby

Flore Franc. (ed. 3) **2**: 363. 1805. – *Patellaria populicola* DC., Botanic. Gallic. **2**: 664. 1830.

This corticolous lichen has not traditionally been treated as related with *L. dispersa* complex; however, the species chemistry (the lichen xanthones produced) indicate its affinity to this group of taxa. The inclusion if *L. populicola* into the latter is still an open question.

SPECIMENS EXAMINED. U.S.A. CALIFORNIA. Santa Clara Co., Base of Mt. Hamilton along San Felipe Creek, 29 Dec. 1954, *Weber & Rose S3519* (ASU, COLO). OREGON. Umatilla Co., Blue Mountains, lower North Fork Umatilla River, June 2004, *McCune 27443* (OSC).

Specimen has also been seen from Poland (KRAM).

Lecanora thallophila H. Magn. Fig. 73

Bot. Not. (1954): 196. 1954. – HOLOTYPE: [U.S.A.] 'UTAH, San Juan Co., Devil's Canyon, 6300 feet, on *Dermatocarpon miniatum*, on dry exposed sandstone, June 1952, *coll. Seville Flowers*' (UPS!).

This interesting lichenicolous species is characterized by yellowish, considerably large apothecia (up to 2.7 mm in diam.). Although considered as related with *L. dispersa* group, *L. thallophila* was found to produce isousnic acid and therefore was excluded from the complex. For detailed characteristics see Ryan *et al*. (2004).

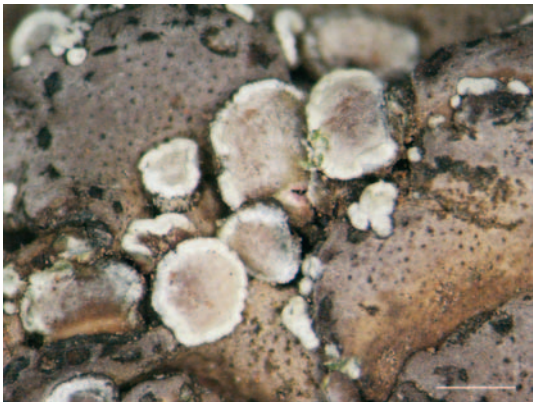


Fig. 73. *Lecanora thallophila* H. Magn. (*Nash 35479*, ASU). Scale bar = 1 mm.

SPECIMENS EXAMINED. U.S.A. ARIZONA. Coconino Co., Grand Canyon National Forest: top of Grandview Trail, 10 July 1994, *Nash 35579* (ASU), top of Hermit Trail, 11 July 1994, *Nash 35479* (ASU). COLORADO. San Juan Co., Mesa Verde National Park: upper Fewkes Canyon, 28 May 1980, *Nash 17858* (ASU), Spruce Tree Canyon, 28 May 1980, *Nash 17938* (ASU). MONTANA. Lake Co., E side of National Bison Range, S end of Mission Valley, 8 km SE of Moiese, May 1976, *McCune 6613* (OSC); Teton Co., hill on W side of Pine Butte Swamp, Aug. 1985, *McCune 15155* (OSC).

Lecanora utahensis H. Magn. Fig. 74

Acta Horti Gotob. **19**(2): 39. 1952. – HOLOTYPE: [U.S.A.] 'UTAH, Wayne Co., Ekker's Ranch, on dry exposed [red] sandstone, elev. 6000 feet, 20 May 1951, *coll. Dr. Seville Flowers 359*' (UPS!; MIN! – ISOTYPE).

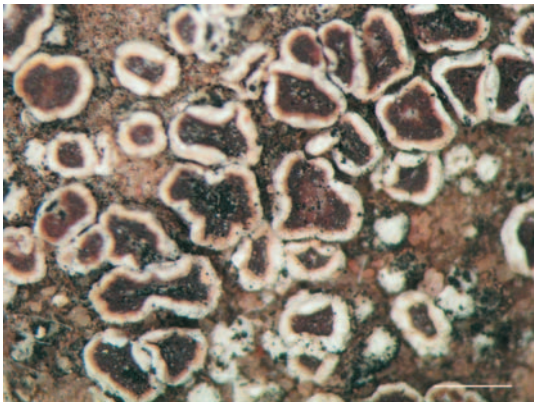


Fig. 74. *Lecanora utahensis* H. Magn. (*Nash 6523*, ASU). Scale bar = 1 mm.

This long forgotten saxicolous taxon was regarded as a member of the *L. dispersa* group in Ryan *et al.* (2004). However, the recent chemical study of the type material indicated that the species produces isousnic acid and therefore the appropriate usage of the name is in urgent need of reconsideration. Full account of the status and application of the name is being published separately.

SPECIMENS EXAMINED. U.S.A. ARIZONA. Coconino Co. Echo Cliffs, 10 mi. SSW of Page along U.S. 89, 23 Apr. 1973, *Nash 6523* (ASU). SOUTH DAKOTA. Custer Co. Black Hills, Schenk Canyon, 18 mi. WSW of Custer, 20 Aug. 1961, *Wetmore 11842* (MIN, MSC).

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also the contribution of all collectors who sent me their specimens, especially Irwin M. Brodo (Ottawa), Paul Diederich (Luxembourg), Lars Fröberg (Lund), Katherine Glew (Seattle), Bruce McCune (Corvallis), Robert Egan (Omaha) and Toby Spribille (Göttingen). The collections served as excellent reference material for me. My most sincere thanks are due to Irwin M. Brodo (Ottawa) for valuable comments, fruitful discussions and helpful support with the DELTA programme, all offered to me during a visit he made to the University of Minnesota lichen laboratory. I appreciate the constructive discussions and corrections I received from the authors of the *Lecanora* chapter of the Sonora treatment: H. Thorsten Lumbsch (Chicago), Tom H. Nash (Tempe), Christian Prinzen (Frankfurt), and the late Bruce D. Ryan (Tempe). I thank Paul Diederich for sharing his ideas and personal comments on the group, and the following for helpful discussion, commentary and criticism: David L. Hawksworth (Madrid and London), Jack R. Laundon (London), Orvo Vitikainen, and Dag Olav Øvstedal (Bergen). I am especially grateful to David L. Hawksworth who generously read the manuscript, made a number of valuable comments, and revised the English.

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SYNOPSIS OF EXSICCATES EXAMINED

Listed by author, exsiccate name, number, original label name and herbarium, and followed by accepted name in **bold**.

ANZI, *Lich. Rar. Veneti*: 34. *Lecanora agardhianoides* var. *cilophthalma* (MIN), ***L. agardhiana***; 35. *Lecanora agardhianoides* var. *pacnodes* (MIN), ***L. agardhiana***.

ARNOLD, *Lich. Exsicc.*: 93. *Lecanora agardhianoides* (M), ***L. agardhiana***; 300d. *Lecanora sambuci* (KRAM, M, MIN; types), ***L. sambuci***; 931a. *Lecanora crenulata* (M), ***L. crenulata*** 931b. *Lecanora crenulata* (M; types), ***L. crenulata***; 996b. *Lecanora hagenii* f. *umbrina* (M, MIN), ***L. hagenii***; 1225. *Lecanora agardhiana* var. *cilophthalma* (GZU, KRAM, M, MIN), ***L. agardhiana***; 1377c. *Lecanora hagenii* (KRAM, UPS), ***L. hagenii***; 1703. *Lecanora albescens*, lignicolous (M, MIN), ***L. dispersa***; 1808. *Lecanora crenulata* (M, MIN), ***L. crenulata***.

ARNOLD, *Lich. Monac. Exsicc.*: 29. *Lecanora albescens* (M), ***L. albescens***; 31. *Lecanora hagenii* (M, MIN, UPS; types), ***L. hagenii***; 142. *Lecanora albescens*, lignicolous (M), ***L. dispersa***; 205. *Lecanora hagenii*, saxicolous (M, UPS), ***L. hagenii***; 206. *Lecanora dispersa* (M), ***L. semipallida***; 212. *Lecanora albescens* (H, M, MIN; types), ***L. albescens***; 213. *Lecanora hagenii* f. *umbrina* (M, MIN, UPS), ***L. hagenii***; 232. *Lecanora dispersa* (M), ***L. dispersa***; 266a. *Lecanora hagenii*, saxicolous (M, MIN, UPS), ***L. hagenii***; 298. *Lecanora hagenii* f. *umbrina* (M, UPS), ***L. hagenii***; 346. *Lecanora hagenii* f. *umbrina* (M, MIN, UPS), ***L. hagenii***; 378. *Lecanora hagenii* (M, UPS), ***L. hagenii***; 432. *Lecanora albescens*, lignicolous (M), ***L. dispersa***; 433. *Lecanora dispersa* (M), ***L. dispersa***; 511. *Lecanora hagenii* (M, MIN, UPS), ***L. hagenii***; 512. *Lecanora sambuci* (MIN), ***L. sambuci***; 513. *Lecanora dispersa* (M, MIN), ***L. dispersa***.

CUMMINGS, *Decad. North Americ. Lich.*: 132. *Lecanora hagenii* (NY, WIS), ***L. hagenii***; 300. *Lecanora hagenii* (WIS), ***L. dispersa***.

CUMMINGS *ET AL.*, *Lich. Boreali-Americ.*: 50. *Lecanora hagenii* (COLO, FH, MICH), ***L. hagenii***; 249. *Lecanora hagenii* (COLO, FH, MICH), ***L. dispersa***.

Erbar. Crittogam. Ital. Ser. II: 615. *Lecanora flotowiana* (MIN), ***L. dispersa***.

FOLLMANN, *Lich. Exsicc. Selecti*: 387. *Lecanora albescens* (ASU, BM, COLO, MIN, WIS; types), ***L. dispersa***.

Flora Hung. Exsicc.: 812. *Lecanora dispersa* (FH, KRAM, WIS), ***L. semipallida***.

FLÖRKE, *Deutsche Lich.*: 89. *Lecanora angulosa* var. *galactina* (M), ***L. albescens***.

HASSE, *Lich. Exsicc.*: 240. *Lecanora hagenii* (FH), ***L. crenulata***; 240. *Lecanora hagenii* (COLO), ***L. dispersa***.

HEPP, *Lich. Helvet. Exsicc.*: 900. *Lecanora galactina* (NY), ***L. albescens***.

KÖRBER, *Lich. Select. German.*: 338. *Lecanora flotoviana*, lignicolous (GOET, L, M), ***L. semipallida***.

Lich. Danici Exsicc.: 65. *Lecanora dispersa* s.l. (KRAM), ***L. zosterae***, with *L. semipallida*; 276. *Lecanora* cf. *xanthostoma* (KRAM), ***L. semipallida***.

MACOUN, *Canad. Lich.*: 117. *Lecanora hagenii* (COLO, FH, MICH, UPS, WIS), ***L. hagenii***.

MAGNUSSON, *Lich. Selecti Scand. Exsicc.*: 24. *Lecanora salina* (KRAM), ***L. salina***.

MALME, *Lich. Suecici Exsicc.*: 434. *Lecanora hagenii* (MIN, UPS, WIS), ***L. hagenii***; 496. *Lecanora hagenii* (MIN, WIS), ***L. dispersa***; 544. *Lecanora*

dispersa (MIN, WIS), ***L. semipallida***; 609. *Lecanora sambuci* (MIN), ***L. sambuci***; 643. *Lecanora hagenii* (MIN, WIS), ***L. persimilis***; 869. *Lecanora galactina* (COLO, WIS), ***L. albescens***; 897. *Lecanora hagenii* (MIN, WIS), ***L. fugiens***.

MERESCHKOWSKY, *Lich. Rossiae Exsicc.*: 9. *Lecanora crenulata* (COLO), ***L. albescens***; 31. *Lecanora elenkinii* (LE), ***L. elenkinii***.

MERRIL, *Lich. Exsicc.*: 113. *Lecanora hagenii* (COLO, FH, MICH), ***L. dispersa***.

NASH, *Lich. Exs. ASU*: 115. *Lecanora populicola* (KRAM), ***L. wetmorei***.

NORRLIN, *Herb. Lich. Fenniae*: 144. *Lecanora dispersa* f. *atrynella* (COLO), ***L. fugiens***.

NOWAK, *Lich. Polon. Merid. Exsicc.*: 63. *Lecanora albescens* (COLO, KRAM, MIN), ***L. albescens***; 178. *Lecanora hagenii* (COLO, KRAM, MIN), ***L. hagenii***; 223. *Lecanora umbrina* (KRAM, MIN), ***L. dispersa***.

PIŠUT, *Lich. Slovakiae Exsicc.*: 290. *Lecanora albescens* (KRAM), ***L. crenulata***.

RABENHORST, *Lich. Eur.*: 205. *Lecanora hagenii* (KRAM), ***L. hagenii***; 486. *Lecanora umbrina* (MIN), ***L. hagenii***; 494. *Lecanora agardhiana* (COLO), ***L. agardhiana***; 596. *Lecanora albescens* f. *murorum* (COLO), ***L. albescens***; 624. *Lecanora hagenii* f. *lithophila* (KRAM), ***L. dispersa***; 747. *Lecanora flotowiana* (FH, GOET, L, M, WIS), ***L. semipallida***.

RÄSÄNEN, *Lichenoth. Fennica*: 15. *Lecanora crenulata* (MIN), ***L. fugiens***.

RÄSÄNEN, *Lich. Fenn. Exsicc.*: 743. *Lecanora hagenii* f. *coerulescens* (MIN, UPS), ***L. hagenii***.

TOBOLEWSKI, *Lichenoth. Polon.*: 187. *Lecanora crenulata* (COLO, KRAM, WIS), ***L. crenulata***.

VERSEGHY, *Lich. Exsicc.*: 61. *Lecanora dispersa* (KRAM), ***L. semipallida***.

VĚZDA, *Lich. Selecti Exsicc.*: 639. *Lecanora dispersa* f. *coniotropa* (COLO), ***L. invadens***.

WARTMANN & SCHENK, *Schweiz. Krypt.*: 157. *Lecanora hagenii* (MIN), ***L. hagenii***; 469. *Lecanora caesio-alba* (MIN), ***L. semipallida***.

INDEX OF NAMES

The index includes only lichen names that are mentioned in the text. Species epithets and taxa of lower rank refer to *Lecanora* unless stated otherwise, but combinations of other genera may also occur. Reference citation in **bold** refers to taxonomic treatment.