The lichen genus *Ochrolechia* in Poland III with a key and notes on some taxa

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Abstract: KUKWA, M. 2009. The lichen genus *Ochrolechia* in Poland III with a key and notes on some taxa. – Herzogia **22**: 43–66.

Ochrolechia frigida, *O. pallescens*, *O. subviridis*, *O. szatalaensis*, *O. trochophora* s.str. and *O. upsaliensis* in Poland are revised and their distribution discussed. An identification key for all Polish *Ochrolechia* species is provided. Records of *O. parella* and *O. tartarea* from Poland were based on misidentifications. Taxonomic notes on several taxa are also provided. *Ochrolechia bahusiensis* is not conspecific with *O. subviridis*, but the oldest available name for *O. androgyna* C and *O. bahusiensis* applied to *O. androgyna* C here. New synonyms are reported for *O. bahusiensis* (*O. subviridis* f. *pulverulenta* and *Pertusaria subviridis* var. *lignaria*), *O. frigida* (*Lecanora inaequatula*, syn. *O. inaequatula*, *O. groenlandica* and *Roccella grayi*), *O. trochophora* s.str. (*O. harmandii* f. *granulosa* and *O. pallescens* var. *krempelhuberi*) and *O. szatalaensis* (*O. tenuissima*). *O. harmandii* f. *pustulata* is tentatively placed in synonymy of *O. trochophora*, and *Lecanora subtartarea* (= *O. subtartarea*) and *L. subtartarea* f. *leprosa* most probably belong to *O. frigida*. Lectotypes are selected for *Lecanora inaequatula*, *Ochrolechia bahusiensis*, *O. frigida* (also epitype) and *O. tenuissima*. *Lecanora gyalectina* (= *O. gyalectina*) does not belong to the genus *Ochrolechia* and its identity remains unknown. *Ochrolechia szatalaensis* var. *macrospora* is considered as a long-spored form of *O. szatalaensis*. *Ochrolechia trochophora* is reported for the first time from Europe (Germany, Poland, Romania and Ukraine) and western Asia (Turkey). *Ochrolechia szatalaensis* is new to Macedonia and Poland, *O. pallescens* for Macedonia and *O. bahusiensis* for Croatia, Czech Republic, France, Great Britain (England and Scotland), Luxembourg and Russia. European records of *O. subathallina* are misidentifications and belong to *O. szatalaensis*.

Zusammenfassung: KUKWA, M. 2009. Die Flechtengattung *Ochrolechia* in Polen III mit einem Schlüssel und Bemerkungen zu einigen Taxa. – Herzogia **22**: 43–66.

Die Arten *Ochrolechia frigida*, *O. pallescens*, *O. subviridis*, *O. szatalaensis*, *O. trochophora* s.str. und *O. upsaliensis* in Polen werden revidiert und ihre Verbreitung diskutiert. Für alle polnischen *Ochrolechia*-Arten wird ein Bestimmungsschlüssel vorgelegt, für mehrere auch taxonomische Bemerkungen angefügt. Meldungen von *O. parella* und *O. tartarea* aus Polen basieren auf Fehlbestimmungen. *Ochrolechia bahusiensis* ist nicht identisch mit *O. subviridis* sondern der älteste verfügbare Name für *O. androgyna* C. Neue Synonyme werden gelistet für *O. bahusiensis* (*O. subviridis* f. *pulverulenta* und *Pertusaria subviridis* var. *lignaria*), *O. frigida* (*Lecanora inaequatula*, syn. *O. inaequatula*, *O. groenlandica* und *Roccella grayi*), *O. trochophora* s.str. (*O. harmandii* f. *granulosa* und *O. pallescens* var. *krempelhuberi*) und *O. szatalaensis* (*O. tenuissima*). *Ochrolechia harmandii* f. *pustulata* wird vorläufig als Synonym von *O. trochophora* geführt. *Lecanora subtartarea* (= *O. subtartarea*) und *L. subtartarea* f. *leprosa* gehören sehr wahrscheinlich zu *O. frigida*. Lectotypen wurden ausgewählt für *Lecanora inaequatula*, *Ochrolechia bahusiensis*, *O. frigida* (auch der Epitypus) und *O. tenuissima*. *Lecanora gyalectina* (= *O. gyalectina*) gehört nicht zur Gattung *Ochrolechia*, ihre systematische Stellung bleibt offen. *Ochrolechia szatalaensis* var. *macrospora* wird als eine langsporige Form von *O. szatalaensis* aufgefasst. *Ochrolechia trochophora* wird erstmals für Europa (Deutschland, Polen, Rumänien und Ukraine) und das westliche Asien (Türkei) nachgewiesen. *Ochrolechia szatalaensis* ist neu für Makedonien und Polen, *O. pallescens* für Makedonien und *O. bahusiensis* für Kroatien, Tschechien, Frankreich, Großbritannien (England und Schottland), Luxemburg und Russland. Die europäischen Funde von *O. subathallina* beruhen auf Fehlbestimmungen und gehören zu *O. szatalaensis*.

Key words: Lichen taxonomy, chemotaxonomy, Ochrolechiaceae, Pertusariales, lichenized Ascomycota.

Introduction

The genus *Ochrolechia* A.Massal. (Ochrolechiaceae, Pertusariales, Ascomycota; see Schmitt & Lumbsch 2004, Schmitt et al. 2006, Lumbsch et al. 2007) includes conspicuous crustose lichens with diverse and taxonomically useful chemistry that has been widely employed in circumscription of species (Brodo 1988, 1991, Tønsberg 1992, Mesutti & Lumbsch 2000). As part of the author's revision of the genus in Europe, results of the studies on species in Poland are presented herewith. Previous papers on *Ochrolechia* in Poland include Jabłońska & Kukwa (2007) on *O. androgyna* s.l. and *O. arborea* (Kreyer) Almb., while Kukwa (2008) provides a revision of the sorediate species containing variolaric acid. In this paper, the remaining *Ochrolechia* species are revised.

Material and methods

Material from the following herbaria was studied: B, BG, BILAS, BM, BM-ACH, BP, BR, E, GB, GPN, GZU, H, H-ACH, H-NYL, KRA, KRAM, KTC, LBL, LINN, LOD, OLS, POZ, PRA, S, TRH, TRN, TSB, TU, UGDA, VBI, W, WA, WRSL and the private herbaria of Diederich, Kukwa, Schiefelbein and Seaward. Several specimens in BP annotated as 'fragm. typi' by K. Verseghy (see Verseghy 1964) are regarded as isotypes.

Morphology was studied with a stereomicroscope and anatomy was examined in hand-made sections mounted in water or KOH (deformed spores in old specimens). Chemical characters were studied by thin layer chromatography TLC (in solvents A, B or B' and C) following Orange et al. (2001) or by high performance thin layer chromatography HPTLC (in solvents A and B) following Arup et al. (1993). Spot-test reactions with C and KC were applied to different parts of the thallus and apothecia, including sections, to determine the location of gyrophoric, variolaric and alectoronic acids.

All Polish localities of studied specimen are arranged according to the ATPOL grid square system (see Cieśliński & Fałtynowicz 1993; see also Kukwa et al. 2002, Jabłońska & Kukwa 2007, Kukwa 2008). The general distribution of taxa is based on the material seen by the author, if not otherwise stated. The following abbreviations in the chapters with localities are used: fs – forest section(s); NP – National Park; NR – nature reserve.

During studies of material referred in this paper to *Ochrolechia frigida*, several sorediate specimens examined were annotated as *O. inaequatula*. According to the present concept of the species, all such material belongs to *O. frigida* (for more information see under that species). Numerous terricolous specimens with variolaric and gyrophoric acids were also annotated as *O. frigida*; only recently it has become clear that the material can be separated as distinct taxon.

Results

Six species are treated here: *O. frigida* (Sw.) Lynge, *O. pallescens* (L.) A.Massal., *O. subviridis* (Høeg) Erichsen, *O. szatalaensis* Verseghy, *O. trochophora* (Vain.) Oshio s.str. and *O. upsaliensis* (L.) A.Massal. *O. szatalaensis* and *O. trochophora* are new to Poland, the latter also new to Europe. Fałtynowicz (2003 and literature cited therein) reported also *O. parella* (L.) A.Massal. and *O. tartarea* (L.) A.Massal. from the country, but we could not confirm this. Specimens determined as *O. parella* belonged to the *Lecanora rupicola* group. Polish samples determined as *O. tartarea* belong to unidentified *Pertusaria* species or other *Ochrolechia* taxa. Nevertheless, the occurrence of both taxa is possible in Poland, therefore, they have been included in the key.

During these studies, the type material of *Lecanora gyalectina* Nyl. [*Ochrolechia gyalectina* (Nyl.) Zahlbr.] was also studied. Superficially it is similar to *O. frigida*, but contains a fatty acid and a possible trace of gyrophoric acid. Few apothecia are present, but the hymenium is disintegrated. The chemistry indicates that it does not belong to *Ochrolechia*.

Type material of *Lecanora gyalectina* **examined: U.S.A.** America Septentrionalis, Port Clarence, ad fretum Bering, 65°15'N/166°30'W, on ground, 21.–26.07.1879, E. Almquist Expeditio 'Vega' (S–L2015 – holotype, studied with TLC; H-NYL–24081 – isotype).

The species

Ochrolechia frigida (Sw.) Lynge

Sci. Results Norw. Exped. Novaya Zemlya **43**: 182 (1928). – *Lichen frigidus* Sw., Meth. musc.: 36 (1781). – *Ochrolechia tartarea* var. *frigida* (Sw.) Körb., Parerg. Lich.: 92 (1859).

Type: 'In Alpibus Lapponis' (in SWARTZ 1789, Methodus muscorum illustrata, Tab. 2, Fig. 4 – lectotype, selected here). Finland, Lapponia enontekiensis, Enontekiö, Toskalharji, 800 m, in reg. alpina, ad terram muscorum, 06.08.1947, A. J. Huuskonen, Räsänen, Lichenoth. Fenn. 315 (S–F98600 – epitype, selected here; B–32062, H – duplicates of epitype).

= ?*Lecanora subtartarea* Nyl., Flora **55**: 550 (1872). – *Ochrolechia subtartarea* (Nyl.) A.Massal., Atti Reale Ist. Veneto Sci. Lett. Arti. **5**: 254 (1860). – *Ochrolechia tartarea* f. *subtartarea* (Nyl.) Vain., Meddeland. Soc. Fauna Fl. Fenn. 6: 174 (1881).

Type: Russia, Kola Peninsula, Ponoi, 1863, N. I. Fellman (H-NYL–24062 – syntype; see HANKO et al. 1986: 174).

= ?*Lecanora subtartarea* f. *leprosa* Nyl., in Cromb., J. Bot. **20**: 274 (1882). – *Lecanora pallescens* f. *leprosa* (Nyl.) Nyl., Not. Sällsk. Fauna Fl. Fenn. Forh. **5**: 135 (1886). – *Ochrolechia subtartarea* f. *leprosa* (Nyl.) Jatta, Fl. Crypt. Ital. **3**: 335 (1909). – *Ochrolechia androgyna* f. *leprosa* (Nyl.) Verseghy, Ann. Hist.-nat. Mus. Nat. Hung. **7**: 292 (1956).

Type: homotypic with *Lecanora subtartarea* Nyl., Flora **55**: 550 (1872); see HANKO et al. (1986: 174).

= *Roccella grayi* Stirt., Trans. & Proc. Bot. Soc. Edinburgh **14**: 358 (1883).

Type: Canada, Newfoundland, rock near Brigus, on rock, 08.1878, A. Gray (BM – isotype).

= *Lecanora inaequatula* Nyl., Flora **68**: 603 (1885). – *Ochrolechia inaequatula* (Nyl.) Zahlbr., Cat. Lich. **5**: 681 (1928).

Type: Alaska, Bering Strait, Port Clarence, on mosses, 21.–26.07.1879, E. Almquist, Expeditio 'Vega' (S–F93773 – lectotype, selected here; S–F93759 & F93779, H-Nyl–24083, 24082 & 24086 – isolectotypes).

= *Ochrolechia tartarea* var. *lapuensis* Vain., in Räsänen, Meddeland. Soc. Fauna Fl. Fenn. **46**: 163 (1921). – *Ochrolechia lapuensis* (Vain.) Räsänen, Ann. Acad. Sci. Fenn., Ser. A, **34**: 93 (1931). – *O. frigida* f. *lapuensis* (Vain.) Coppins, in Corner, Trans. Bot. Soc. Edinb. **43**: 312 (1981).

Type: Finland, Ostrobottnia australis, Lapua Huhdanneva Mahkalla, 10.1920, V. Räsänen (H – holotype).

= *Ochrolechia elisabethae-kolae* ('*elisabethii kolii*') Verseghy, Ann. Hist.-nat. Mus. Nat. Hung. **50**: 75 (1958).

Type: Alaska, Atka Island, on ground, 01.07.1932, W. J. Eyerdam (H – holotype, lost? – see below; BP–19923 – isotype).

= *Ochrolechia groenlandica* Verseghy, Beih. Nova Hedwigia **1**: 105 (1962).

Type: Greenland, no exact locality, on mosses, 1845, Kümmer, (M – holotype, not seen; see VERSEGHY 1962: 105; BP–19951 – isotype).

= *Ochrolechia gyalectina* auct., non (Nyl.) Zahlbr.

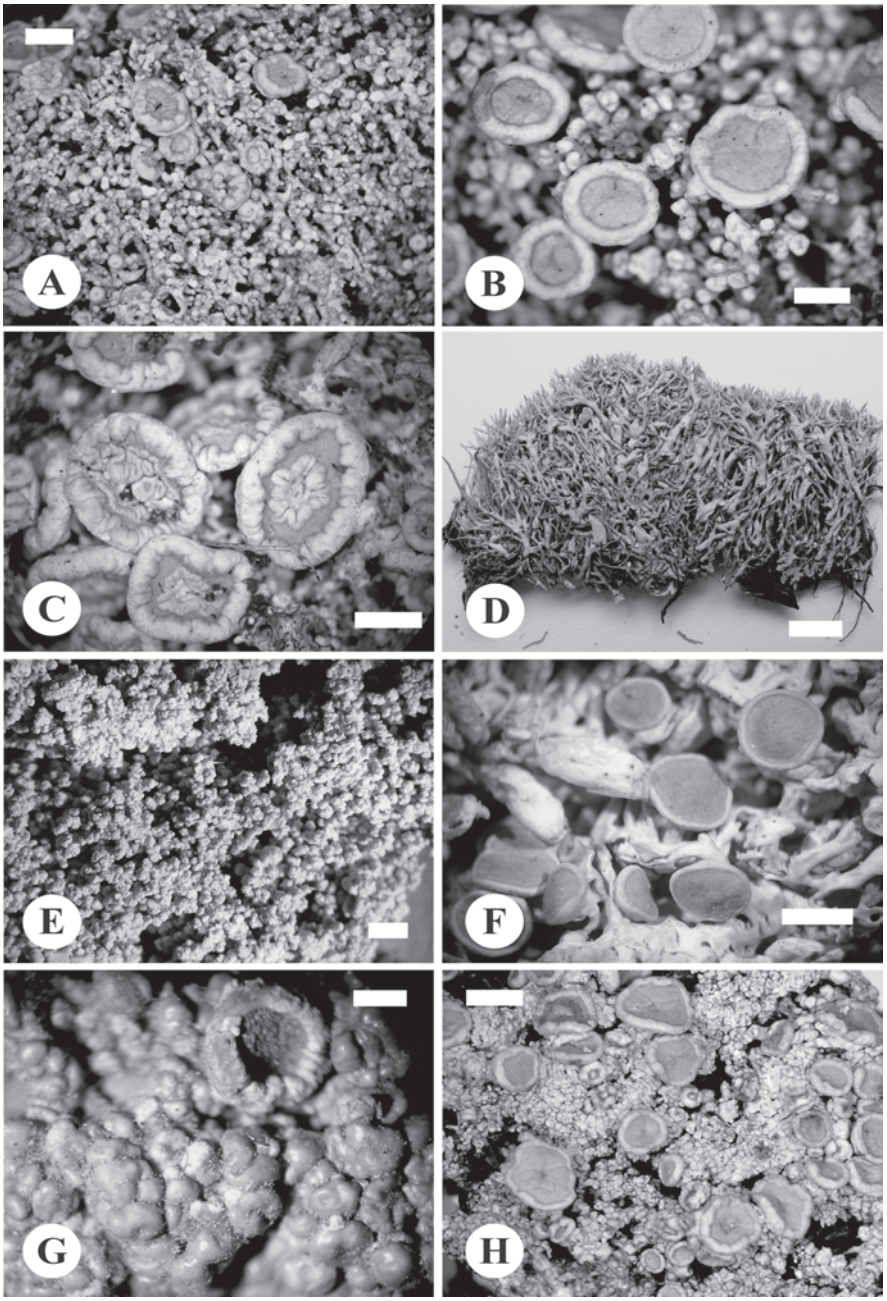

Fig. 1: Morphological variation of *Ochrolechia frigida*. **A, B** – form with branched and separated areoles, fertile (**A** – Finland, 30.07.1967, Helske, H, **B** – Finland, 1867, Norrlin, H); **C** – apothecia with secondary sterile thallus elements in the disc (Finland, 1911, Lång, H); **D** – fruticose thallus of long spines, partly covered with secondary thallus tissues (Behring Sea, St. Paul Island, 1897, Macoun, W–18990000787); **E** – thallus of small, granular and scabrous areoles, with very few small spines (Sweden, Strimasund, 24.07.1926, Magnusson, S); **F** – thallus of flat elements branching over the substrate, fertile (Scotland, Braeriach, 1822, Greville, E); **G** – brown, shiny form used to called *O. elisabethae-kolae* (Norway, Lorentz, WRSL); **H** – form with partly swollen, constricted and crowded areoles, fertile (Russia, Kärkkainen 49, H). Scale bars: A, C, F, H = 2 mm; B, E, G = 1 mm; D = 5 mm.

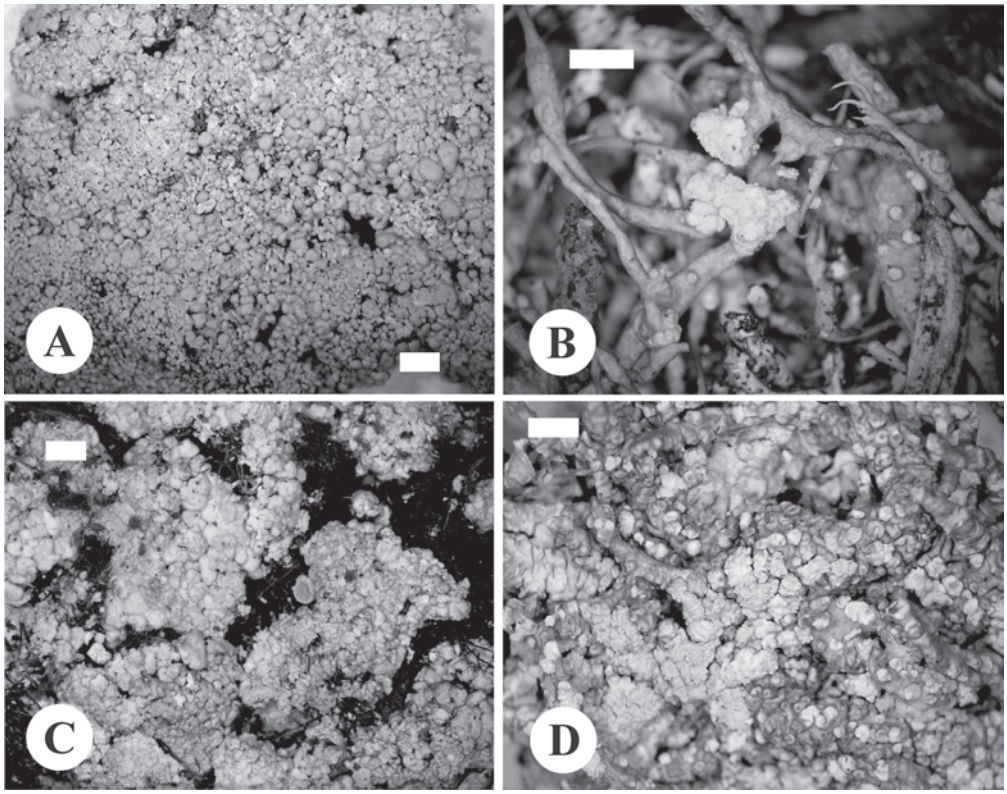

Fig. 2: Morphological variation of *Ochrolechia frigida*. **A** – convex, partly bullate or swollen areoles, developed over eroded whiter thallus, sterile (Finland, Kääntönen 154/92, H); **B** – thallus with long and branched spines, soredia developed on spines (sub *O. lapuensis*, Finland, 1908, Lång, H); **C** – thallus of bullate, white, delicate areoles with granular soredia and very few apothecia (Slovakia, Vězda, H); **D** – folded thallus with shiny cortex and whitish soralia, sterile (Finland, Ahti 20970, H). Scale bars: A, B = 1 mm; C, D = 2 mm.

Description: Thallus variable (Figs 1, 2), thin, medium thick to very thick, with or without spines, membrane-like and almost invisible, but with small or large, dispersed or crowded papillate, subglobose to elongate areoles, or thallus more or less continuous with or without areoles, or thallus areolate, consisting of well developed, separated to crowded, subglobose, elongated or coralloid and branched areoles, sometimes with scabrid surface, or of elongated areoles, forming a subfruticose thallus, or thallus of more or less swollen, soft and often fragile areoles, commonly dissolving into ± granular soredia or breaking into coarsely coralloid granules, with many intermediate forms; swollen areoles whitish-grey or brownish-grey, covered with thin, usually ± mat cortex (Fig. 2C); not swollen (coralloid to elongated) areoles grey, beige or grey-brown, sometimes only top has brown tinge, covered with mat to shiny cortex with epinecral layer (Figs 1A, B, D), or cortex covered with thick epinecral layer, distinctly shiny and brown (Fig. 1G); spines short or long, in extreme forms up to 2 cm in length, simple or branched, sometimes covered partly with thallus areoles or soralia; when spines long, sometimes surrounded by the thallus tissues and resembling stems of *Usnea*; prothallus usually not evident, visible only in corticolous material as a white zone around thallus; soredia farinose or granular, forming ± discrete soralia on the continuous thallus, or on the top of areoles, or rarely formed at the base of spines, or areoles completely dissolving into soredia, or coarsely coralloid granules areoles forming at the top of areoles, or areoles completely dissolving into few such granules; in several specimens areoles dissolving into soredia, crowded and forming sorediate crust; apothecia frequent, up to

c. 4 mm in diam., with well developed or rarely almost excluded thalline margin, in several specimens with prominent salmon discoid tissue (excipulum proprium), visible as a well defined excipular ring around the disc or spreading over the thalline margin, brownish; thalline margin rather thin, usually concolorous with the thallus, smooth, entire, or crenulate, with thalline areoles, with or without spines, non-sorediate or ± sorediate; disc flat to concave, usually not pruinose, or sometimes with white farinose pruina, often with fissures radiating from the centre, commonly with secondary thalline areoles developing along the fissures (Fig. 1C), or disc ± rosulate; margin cortex well developed c. 50–75 µm wide; algal layer differently developed, present in excipulum and/or below hypothecium; hypothecium yellowish; hymenium c. 170–250(–300) µm; asci (4–)6–8(–12)-spored; spores variable in size and shape, even in one ascus or section, ellipsoid, broadly ellipsoid, pyriform and sometimes constricted in 1/3rd of length (in Argentinean material), ovoid, rarely globose or subglobose, (10–)20–50(–67) × (6–)12–30(–42) µm. The above description is based mostly on European material (including very few Polish samples).

Chemistry: Gyrophoric (major) and lecanoric (trace to minor) acids (sometimes with traces of additional unidentified substances), usually accompanied by the same pigments as described in *O. androgyna* s.l. and *O. arborea* by Jabłońska & Kukwa (2007). One fatty acid (in one instance, three fatty acids) of murolic acid complex were detected in most sorediate specimens from Poland and Scotland (form often named *O. inaequatula*), and more rarely from other regions. Sometimes, it was also found in esorediate specimens. Since, no correlation between morphology and chemistry has been found, those fatty acids are not treated as a taxonomically important character in this species. In several other specimens, some unknown fatty acids were detected in small quantities.

Thalline and apothecial cortex, epihymenium, spines and soredia were C+ red. Sometimes the reaction of the cortex was obscured by the thick necrotic layer present over the cortex. Thalline and apothecial medulla were always C– and KC–.

Hanko et al. (1986) reported a chemotype of *O. frigida* with additional variolaric acid, but that belongs to a separate taxon (Kukwa, unpubl. results).

Notes: *Ochrolechia frigida* is morphologically the most variable species of the genus (Figs 1, 2). The size and shape of the ascospores are also variable, even in one ascus or apothecial section. The remarkable morphological variation (see Figs 1, 2) led previous authors to describe several species or infraspecific taxa (Verseghy 1962, Howard 1970); these are treated here as synonyms of *O. frigida* (mostly new synonyms listed in this paper; for more synonyms see Hanko et al. 1986). Extreme forms are rather easy to separate, such as: *O. elisabethae-kolae* (thallus distinctly brown, shiny, without spines, Fig. 1G), *O. frigida* (areoles separated, globose to elongated, frequently with spines, Figs 1A, B, D, H), *O. gyalectina* auct. (thallus consisting mostly of coarse granules, Fig. 1E), *O. inaequatula* (thallus of ± bullate areoles, with granular soredia, Fig. 2C; almost all Polish specimens had such morphology), *O. lapuensis* (similar to *O. frigida*, but with soredia, Fig. 2B), However, these extreme forms are connected by intermediate specimens and there are no constant discriminating characters for the distinction of these taxa based on extensive studies of European material (Kukwa, in prep.). This is also in agreement Messuti & Lumbsch (2000) who studied South American material. According to the present circumscription, this species is morphologically quite polymorphic, and since it is very widespread, different evolutionary lineages can be involved in that taxon; but this needs confirmation with molecular studies.

According to Howard (1970), the type of *Lichen frigidus* should be in S (also an illustration of it is provided in her work); however, no such specimen was found there and is thus considered as lost. The illustration in Swartz (1781) is here selected as lectotype, with appropriate epitype.

New synonyms listed here are *Ochrolechia groenlandica*, *O. inaequatula* (syn. *Lecanora inaequatula*) and *Roccella grayi*; the first two are sorediate morphs lacking spinules, but intermediate forms between those and the typical *O. frigida* were found. The type of *R. grayi* consists of material with very long spines.

Although Hanko et al. (1986: 177) regarded the type of *O. tartarea* var. *lapuensis* in H as the syntype, there is no material in TUR-V (see Alava 1988: 310) and hence the H collection represents the holotype.

Lecanora subtartarea and *L. subtartarea* f. *leprosa*, were treated by VERSEGHY (1962) as two separate taxa, but both are homotypic and were listed as synomyms of *O. androgyna* (see HANKO et al. 1986). The only material is represented by small pieces of thallus consisting of two apothecia and thallus almost completely covered with quite farinose soredia and in the opinion of the author it is quite similar to *O. frigida*. However, only the discovery of richer material will allow the proper identification. HANKO et al. (1986) listed also three synonyms, which types contained variolaric acid: *O. frigida* f. *alaskana* Verseghy, *O. frigida* f. *solida* Verseghy and *O. tartarea* var. *effigurata* Verseghy. These names represent one distinct taxon (see also note under chemistry), which will be treated elsewhere.

HANKO et al. (1986) listed *O. elisabethae-kolae* Verseghy and *O. frigida* f. *alaskana* as being homotypic. Examination of the type collection in BP revealed that two different samples (isotypes) exist for both names. The specimen of *O. elisabethae-kolae* contains gyrophoric and lecanoric acids and belongs to *O. frigida*, whereas the isotype of *O. frigida* f. *alaskana* has additionally variolaric acid and belong to different species (see above). That specimen is identical in morphology and chemistry to the original material in H, therefore that sample in H represents holotype of *O. frigida* f. *alaskana*, not *O. elisabethae-kolae*. The holotype of *O. elisabethae-kolae* has not been traced so far in H, and is perhaps lost.

Several species can be mistaken for *O. frigida*, including *O. grimmiae* Lynge, an Arctic to subarctic taxon that agrees in chemistry, apothecial morphology and a muscicolous habitat, but is readily distinguished by having an endosubstratal thallus without sterile granules, but with numerous areole-like, immature apothecia intermixed with mature fruit bodies (LYNGE 1928).

Some sorediate morphs of *O. frigida* lacking spines can be confused with species of the *O. androgyna* complex, especially *O. androgyna* A sensu TØNSBERG (1992) containing only gyrophoric acid and *O. bahusiensis* H.Magn. (= *O. androgyna* C) with the murolic acid complex and gyrophoric acid. TØNSBERG (1992) noted that some forms of *O. androgyna* A may be sorediate espinulose forms of *O. frigida*. However, it seems that both taxa differ in their apothecia: *O. frigida* has a well developed thalline margin, whereas the thalline margin is almost excluded in *O. androgyna* A. Additionally, *O. androgyna* A grows on bark or wood and usually has a much thinner thallus and ± regular soralia. *O. bahusiensis* differs from *O. frigida* in more farinose soredia, a thinner thallus with smaller and more delicate areoles, and the corticolous habitat (*O. frigida* is rarely found on bark); it also produces constantly 2–3 fatty acids of murolic acid complex (in *O. frigida* usually 1, but once 3 substances found). *O. androgyna* B contains unknown substances 'androgyna B unknowns 1–3' (TØNSBERG 1992, JABŁOŃSKA & KUKWA 2007).

Material of *O. frigida* without spines was often labeled as *O. tartarea*. Both taxa differ mainly in the chemistry as *O. tartarea* contains 'androgyna B unknowns 1–3' (Kukwa, unpubl.), substances not known from *O. frigida*.

Habitat: *O. frigida* is found on detritus, soil, amongst or partly on bryophytes, always in open areas. MESSUTI & LUMBSCH (2000), SANTESSON et al. (2004) and TØNSBERG (1992) also reported corticolous samples; these were not found in Poland.

Distribution: *O. frigida* in Poland is known only from the Karkonosze Mts and the Western Carpathians (FAŁTYNOWICZ 2003, KOSSOWSKA 2006, FLAKUS 2007); its occurrence there is confirmed.

O. frigida is bipolar. In the Northern Hemisphere, where it is mostly known from Arctic-boreal and alpine regions, it rarely extends beyond this, e.g. in Denmark or northern Germany (VERSEGHY 1962, SØCHTING & ALSTRUP 2002). The date, the author has examined European material from Austria, Denmark, Estonia, Finland, Germany, Great Britain, Iceland, Italy, Norway, arctic Russia, Slovakia, Spitsbergen and Sweden. It has also been reported from Czech Republic (only old records; VĚZDA & LIŠKA 1999), France (VERSEGHY 1969a, sub *O. inaequatula*), Slovenia (SUPPAN et al. 2000) and Switzerland (VERSEGHY 1969a, sub *O. inaequatula*).

Extra-European material of *O. frigida* was studied from Canada, Greenland, USA, Mongolia and several regions of the Russian Arctic in Asia. In the Southern Hemisphere it was confirmed from Antarctica, Argentina, Chile, New Zealand and Tasmania.

Number of specimens examined – 21

Selected specimens examined: [Ea–78] – Karkonosze Mts, Karkonoski NP, Szrenica Mt., Końskie Łby rocks, 08.2007, M. Kossowska (WRSL); **[Gd–26] –** Babia Góra Mts, Kościółki, 1600 m, 05.09.1967, J. Nowak (KRAM-L–1288); **[Gd–59] –** Tatry Zachodnie, Tatra NP., Czerwone Wierchy Mts, N slope of Małołączniak Mt, 1910 m, 18–19.09.1975, M. Olech (KRA, two specimens); Kopa Kondracka Mt., part close to Dolina Kondracka valley, 1710 m, 03.09.1975, M. Olech (KRA); environs of Czerwony Żleb gully, 49°13'51"N/19°54'15"E, 24.06.1971, M. Olech (KRA); **[Ge–50] –** Tatry Wschodnie Mts, Tatra NP., Dolina Waksmudzka valley, NE slope of edge between Mt. Wołoszyn and Mt. Koszysta, 2067 m, 49°13'46"N/20°03'01"E, 19.08.2005, B. Cykowska 8264a (UGDA-L–14382); Tatry Zachodnie Mts, Tatra NP, Kopa Magury Mt., 1690 m, 14.09.1964, M. Olech (KRA); Kopa Magury, 1964, J. Nowak (KRAM-L–3880, 3892 & 3974); **[Ge– 60] –** Tatry Wschodnie Mts, Tatra NP, Ciemnosmreczyńska Przełączka, 49°11'21"N/20°02'59"E, 2115 m, 08.2007, A. Flakus 9991 (UGDA-L–14232); Szpiglasowa Przełęcz pass, 49°11'53"N/20°02'34"E, 2107 m, 17.07.2004, A. Flakus 2335, 2446 & 2469 (KRAM-L–52143, 52152 & 52153).

Exsiccates examined: Anonymous, Rel. Tuckermanianae 115 (sub *Ochrolechia tartarea* var. *frigida*, POZ). Anzi, Lich. Rar. Langob. Exs. 101 (sub *O. tartarea* f. *frigida* S, W–20080000578). Bartling & Hampe, Veget. Cell. Germ. Ser. C 38 (sub *Parmelia tartarea*, BP–19952, S). Crombie, Lich. Brit. Exs. 70 (sub *Lecanora tartarea* var. *frigida*, E). Fries, T., Lich. Scand. Rar. Critic. Exs. 61 (sub *O. tartarea* var. *frigida* f. *microcarpa*, S, syntype?). Hakulinen, Lichenoth. Fenn. 1183 (sub *O. frigida* f. *thelephoroides* B–32071, BP–77268, H, S). Hansen & Christensen, Lich. Dan. Exs. 181 (H, KRAM-L–46553, UGDA). Hansen, Lich. Groenl. Exs. 24 (B–32066, S, WA–46). Hansen, Lich. Groenl. Exs. 500 (sub *O. tartarea*, B–97881, BP–89637, GZU, WA–149). Hansen, Lich. Groenl. Exs. 513 (WA–48). Hansen, Lich. Groenl. Exs. 644 (B–32067, BP–77655, KRAM-L–29877, WA–47). Hansen, Lich. Groenl. Exs. 833 (B, H, S–L45625). Hansen, Lich. Groenl. Exs. 846 (B, H). Hansen, Lich. Groenl. Exs. 900 (S–L59933). Hansen, Lich. Groenl. Exs. 964 (B, S–L65944, W–20060001271). Hansen, Lich. Groenl. Exs. 1017 (sub. *O. tartarea*, BM). Kurokawa, Kashiwadani, Lichenes Rariores et Critici Exsiccati 675 (B–57227, H, S, W–19870003835). Magnusson, Lich. Sel. Scand. 180 (sub *O. inaequatula*, B–92578, BG L–76395, BM, S, W–19350001064). Magnusson, Lich. Sel. Scand. 358 (sub *O. frigida* f. *microcarpa*, B–32068 & 92756, H, W–19500000256). Malme, Lich. Suec. Exs. 336 (pro parte, sub *O. tartarea*, W–19130013196). Malme, Lich. Suec. Exs. 756 (sub *O. tartarea* f. *gonatodes*, B–92044, S). Räsänen, Lichenoth. Fenn. 315 (B–32062, H, S). Räsänen, Lichenoth. Fenn. 772 (sub *O. upsaliensis*, B–31579). Savicz, Lichenoth. Ross. 137 (S, H, BP–77605/9, KRAM-L–25588). Vězda, Lich. Bohemoslov. Exs. 106 (sub *O. inaequatula*, W–19590016142). Vězda, Lich. Sel. Exs. 217 (sub *O. inaequatula*, BM, BP–50889, H, S). Vězda, Lich. Sel. Exs. 1750 (B–75373, E, H, S). Zahlbruckner, Krypt. Exs. 2069 (sub *O. inaequatula*, B–32087, BG L–79345, BM – two specimens, BP–19953 & 82894, BR-LICH, S, W–19120006821). Zahlbruckner, Krypt. Exs. 2460 (sub *O. tartarea* var. *frigida*, B–31494 & 31493, BP–19925 & 82887, S, W–19210000233 – pro parte).

Ochrolechia pallescens (L.) A.Massal.

Nuov. Annal. Sc. Nat. Bologna **7**: 212 (1853). – *Lichen pallescens* L., Sp. plant. **2**: 1142 (1753). – *Ochrolechia parella* var. *pallescens* (L.) Rabenh., Kryptog.-Flora von Sachsen, 2. Abth.: 213 (1870). – *Ochrolechia parella* subsp. *pallescens* (L.) Clauzade & Cl.Roux, Liken. Okciden. Eŭr.: 531 (1985).

Type: Sweden, Härjedalen, Ramundberget, slope NE of Kvarbäckstjärn, c. 800 m, 27.06.1973, corticolous, R. Santesson 24384 (UPS – conserved type, not seen; selected by JØRGENSEN et al. 1994: 378).

Description: Thallus medium to very thick, folded, rugulose, areolate (Fig. 3A) or rarely tuberculate; areoles dispersed or crowded, brownish, light brown, yellow-grey, grey or grey-white, often areole tops or folded parts more greyish; prothallus indistinct; apothecia up to 2.5 mm in diam., sessile, to partly immersed, rounded or irregular in shape, first ± concave, later with ± flat or sometimes convex disc; thalline margin well developed, usually raised above the disc, even or flexuose, smooth, rarely rough, shiny, glabrous or matt, concolorous with the thallus, or more yellowish (especially if thallus in shades of grey) at least in young apothecia; cortex of the margin well developed, in upper part up to 70 µm, ± expanded at the base and 80–100 µm; margin medulla well differentiated; excipular ring and discoid tissue not visible, present as a ring around the disc or spreading over the closest part of thalline margin; disc ± plane, slightly concave or slightly convex, flesh coloured, usually heavily pruinose, but in several specimens almost epruinose, sometimes scabrose; pruina thin, medium or very thick, sometimes almost absent, finely or coarsely granular, or scabrid, snowy white, greyish-white, yellow-grey or brownish-grey; algal layer well developed as a continuous layer or as groups of algal cells in either excipulum and below hypothecium; excipulum proprium well visible in section, superficially often forming a ring around disc; hypothecium yellowish; hymenium 250–300 µm; asci (4–)6–8-spored; spores often rather variable in size in one section, widely ellipsoid or ellipsoid, rarely subglobose, (35–)45–70(–75) × (12–)25–40 µm. The above description is based on both Polish and foreign material.

Chemistry: Variolaric (cortex of thallus and thalline margin), gyrophoric and lecanoric acids (epihymenium, in one specimen also in upper part of excipulum proprium) are always present. Accessory compounds include alectoronic acid, murolic acid complex (sometimes with or replaced by other fatty acid), pigments associated with gyrophoric acid and 'microstictoides unknowns'.

The thalline and apothecial margin cortex always react C+ yellow due to the presence of variolaric acid, whereas the epihymenium is C+ red (gyrophoric acid). In almost all cases the medulla margin was C–, but in two specimens in the basal part of the medulla layer small spots were C+ red. The medulla reacted entirely or partly KC+ red due to the presence of alectoronic acid. The presence and distribution of alectoronic acid differed in one specimen or even in one apothecium (two sides of margin had medulla reacting differently with KC). The disc pruina reacted C+ yellow (variolaric acid), but only a part gave the reaction (sometimes only few granules) or it did not react at all.

BOQUERAS et al. (1999) also found unidentified xanthones in the material from Canary Islands. No such substances were observed in the material studied here.

Notes: *O. pallescens* is traditionally used for corticolous specimens of *O. parella* group with pruinose disc, gyrophoric acid in epiphymenium and variolaric acid in the cortex (CLAUZADE & ROUX 1985, HANKO et al. 1986, BRODO 1991, JØRGENSEN et al. 1994). It was often treated as an intraspecific taxon of a saxicolous *O. parella* or only as a synonym of the latter (e.g. CLAUZADE & ROUX 1985, COPPINS 2002); however, in a phylogenetic study by SCHMITT et al. (2006), specimens of both taxa were genetically distinct.

The author was unable to find characters that would discriminate between *O. pallescens* and *O. parella*, as both taxa shows similar variation in morphological characters, such as thallus colour and thickness, and chemistry. However, two different types of pruina were found in each species: one is white, usually farinose and does not react with C (colour picture of this type in SIPMAN 2007), and the second is yellowish or brownish and gives a yellow reaction with C (colour picture of this type in WIRTH 1995). Unfortunately, sometimes the pruina are almost absent, and the type of pruina is hardly detectable. This character is potentially taxonomically important and should be considered in future studies on the delimitation of both taxa, including molecular analyses of several samples.

Several intraspecific taxa were described in *O. pallescens* (VERSEGHY 1962), but since the discrimination from *O. parella* is unclear, they are not listed here.

O. pallescens can be confused in Poland with only two corticolous taxa having pruinose discs: sparingly or esorediate samples of *O. alboflavescens* (Wulfen) Zahlbr. and *O. szatalaensis*. However, they can be easily separated based on the chemistry: *O. alboflavescens* produces lichesterinic and protolichesterinic acids (HANKO et al. 1986, TØNSBERG 1992, KUKWA 2008), whereas *O. szatalaensis* lacks gyrophoric acid (HANKO et al. 1986, BRODO 1991).

According to BRODO (1991), *O. pallescens* is absent from North America, while three morphologically similar species replace the taxon there (*O. juvenalis* Brodo, *O. pseudopallescens* Brodo and *O. subathallina* H.Magn.). They differ in having lichesterinic acid and other characters discussed by BRODO (1991).

Habitat requirements: The species prefers deciduous trees in Poland, and most commonly it is found on *Fagus sylvatica* (11). Very rarely is it found on other trees: *Abies alba* (1), *Acer pseudoplatanus* (1), *Alnus* cf. *incana* (1), *A. glutinosa* (1), *Carpinus betulus* (1), *Fraxinus excelsior* (1), *Populus tremula* (1) and *Tilia cordata* (1). *Ochrolechia pallescens* seems to prefer forest conditions.

Distribution: *O. pallescens* occurs in only a few localities in Poland, scattered over the whole country, but it appears to be more common in the south. FAŁTYNOWICZ (2003) reported it from more localities, e.g. from north-western Poland, but no reference material was found. According to CIEŚLIŃSKI et al. (2006), *O. pallescens* is a critically endangered lichen (category CR) in Poland.

Ochrolechia pallescens is known mainly from Europe; the author has examined material from Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Finland, France, Georgia, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Macedonia (new for the country), Montenegro, Norway, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden and Switzerland. Its occurrence has also been confirmed in the Canary Islands, Cyprus, Georgia, Syria and Turkey. It has also been reported from Belgium and Luxembourg (DIEDERICH & SÉRUSIAUX 2000), Czech Republic (VĚZDA & LIŠKA 1999), Denmark

(Søchting & Alstrup 2002), Lithuania (Motiejūnaitė 1999), Ukraine (Kondratyuk et al. 2003) and Israel (Galun & Mukhta 1996), but the Indian record (see Awasthi 2000) perhaps needs verification.

The North American records of *O. pallescens* were misidentifications (Brodo 1991), as probably were records from Greenland (Kristinsson et al. 2006). Records from South America (Messuti & Lumbsch 2000) and Australia (McCarthy 2008) are dubious and require further studies.

Number of specimens examined – 19

Selected specimens examined: [Cg–64] – Białowieża Forest, vicinity of Hajnówka village, fs 518C/542A, on *Fraxinus excelsior*, 1982, S. Cieśliński, Z. Tobolewski (KTC); **[Da–97]** – Żagań town (orig. Sagan), on *Tilia cordata*, 19th century, Evertken? (WRSL); **[De–09]** – Dębina nature reserve, near Warszawa, on *Carpinus betulus*, 1957, J. Zielińska (WA–134); **[Fc–06]** – Environs of Opole town (poorly localized specimen, approximately in that ATPOL grid square), on *Fagus sylvatica*, 20.07.1961, J. Nowak (KRAM-L–18254); **[Gd–59]** – Tatry Zachodnie Mts, Dolina Białego valley, by Potok Biały stream, 960 m, on *Acer pseudoplatanus*, 29.08.1956, Z. Tobolewski (POZ); **[Ge–33]** – Pieniny Mts, Pieninki range, Białe Skały rocks, c. 700 m, on *Populus tremula*, 19.09.1957, Z. Tobolewski (POZ); **[Gf–57]** – Bieszczady Zachodnie Mts, S slope of Łopiennik Mt., 900 m, on *Fagus sylvatica*, 30.07.1958, K. Glanc (KRAM-L–35853); NE slope of Falowa Mt., 49°13'21"N/22°23'26"E, 900 m, on *Abies alba*, 31.07.1958, K. Glanc (KRAM-L–35852); **[Gf–59]** – Bieszczady Zachodnie Mts, SW slope of Stuposiańska Magura Mt., 950 m, on *Fagus sylvatica*, 23.09.1958, K. Glanc (KRAM-L–35831); **[Gf–68]** – Bieszczady Zachodnie Mts, Puszcza Bukowa forest, SW slope of Dział Mt., c. 750 m, on *Fagus sylvatica*, 19.08.1958, Z. Tobolewski (POZ); **[Gf–69]** – Bieszczady Zachodnie Mts, by the road from Berechy Górne to Ustrzyki Górne, by Rzeczyca, 680 m, on *Alnus* cf. *incana*, 07.07.1959, K. Glanc (KRAM-L–35851); NE slope o Połonina Caryńska, 800 m, on *Fagus sylvatica*, 24.09.1958, K. Glanc (KRAM-L–35802).

Additional selected specimen examined (in total 190 specimens examined)**: Macedonia**. Galičia, N-exponierte Hänge S der Passstraße mit Buchenwald, on bark, 12.07.1977, J. Hafellner 3526 (GZU).

Exsiccates examined: Arnold, Lich. Monac. Exs. 275 (B–32120, BP–82887, W–20080000570). Arnold, Lich. Monac. Exs. 342 (BP–82886). Baglietto, Cesati & Notaris, Erb. Critt. Ital. Ser. I 384 (S). Barth, Herb. Transsylv. Flechten 40 (BP–19989). Harmand, Lich. Gall. Rar. Exs. 549 (sub *Lecanora* (*Ochrolechia*) *parella* f. *corticola*, B–32225, W–19140003396). John, Lich. Anatol. Exs. 52 (sub *O. szatalaensis*, GZU, H, W–20000000154). John, Lich. Anatol. Exs. 159 (sub *O. szatalaensis*, GZU, H, W–20030000109). Koerber, Lich. Sel. Germ. 275 (sub. *O. pallescens* var. *tumidula*, S, W–19100011787). Mougeot & Nestler, Stirp. Crypt. Vog.-Rhen. 1146 (sub *L. parella* var. *pallescens*, W–20080000598). Poelt, Pl. Graec. Lich. 213 (sub *O. balcanica*, B, BM, GZU, H, S, W–19810009877). Poelt, Pl. Graec. Lich. 541 (B–89371, S, W–19930000399). Rabenhorst, Lich. Europ. Exs. 639 (sub *L. pallescens* var. *tumidula*, BP–19984, W–19060010855 & 20080000602, WRSL). Räsänen, Lich. Fenn. Exs. 888 (sub *O. parella*, BP–20012, S). Räsänen, Lichenoth. Fenn. 176 (sub *O. parella* var. *tumidula*, B–32250, H, S). Schaerer, Lich. Helv. Exs. Ed. I 317 (sub *O. parella* var. *pallescens* f. *corticola*, BP–19988, S, WRSL). Tavares, Lich. Lusit. Sel. Exs. 193 (H). Verseghy, Lich. Exs. 73 (BP–75623, H, KRAM-L–23888, W–20080000569). Vězda, Lich. Sel. Exs. 242 (BP–50890, H, W–19640011135). Vězda, Lich. Sel. Exs. 1337 (sub *O. szatalaensis*, H S–F53323, W–19760008309). Vězda, Lich. Sel. Exs. 1791 (B–75374, H, S, W–19820006198). Wartmann & Schenk, Schweiz. Krypt. 64 (sub *O. pallescens* var. *tumidula*, WRSL). Welwitsch, Cryptoth. Lusit. 88 (sub *Parmelia pallescens*, BM).

Ochrolechia subviridis (Høeg) Erichsen

Verh. Bot. Vereins Prov. Brandenburg **72**: 2 (1930). – *Pertusaria subviridis* Høeg, Nyt Mag. Naturvidensk. **61**: 150–151 (1923).

Type: Norway, Vestfold, Larvik, Bøkeskogen, near Kilen, on *Fagus sylvatica*, 22.08.1922, O. Høeg (TRH L–35194 – lectotype; selected by Tønsberg 1992: 243).

= *Ochrolechia gallica* Verseghy, Ann. Hist.-nat. Mus. Nat. Hung. **50**: 76 (1958).

Type: France, Vère, on bark, s.coll. (M – holotype, not seen; see Verseghy 1958: 77; BP–19941 – isotype).

= *Ochrolechia yasudae* auct. brit. non Vain., Bot. Mag. (Tokyo) **32**: 155 (1918) (see Laundon 1963: 134–137, Brodo 1991: 768).

Description: Thallus thin or thick, rather variable in morphology, ± flat at the edge, in central parts ± even, folded, cracked, areolate with small and separated areoles or rarely tuberculate with swollen and constricted at the base areoles, whitish-grey, grey, rarely pale straw; prothallus often very well developed in many specimens, thick, radiating, zonate, sometimes fibrous, white at the border, whitish-pink to pinkish-brown in more central parts; isidia small, subglobose to elongated and cylindrical,

sometimes coralloid, separated or densely crowded and forming an isidiate crust in the central part of thallus, isidia of two types, (1) soft, resembling soredia, matt and with uneven surface, apparently with weakly corticated surface, white, whitish-grey or grey, brighter or concolorous with thallus, (2) true isidia, with shiny, corticate surface, grey or brownish-grey, concolorous or darker than the thallus, intermediate forms also exist; true soralia and soredia not developed, but isidia may form groups resembling soralia, especially when soft isidia are produced; apothecia very rare (found only in material from France and Great Britain), up to 3.5 mm in diam. (up to 5 mm according to VERSEGHY 1958, sub *O. gallica*), rounded or irregular, thalline margin well developed, even or rarely flexuose, sometimes with shallow, but well visible radiating fissures, matt, concolorous with the thallus, non-isidiate, with small papillae (place of future development of isidia) or sparingly to completely isidiate; cortex of the margin well developed in non isidiate parts, thick, margin medulla poorly differentiated; salmon discoid tissues (excipulum proprium) prominent, visible as a well defined ring around the margin or spreading over the thalline margin, white pruinose; disc flesh-coloured, plane to slightly concave, white pruinose, pruina ± farinose; algal layer below hypothecium absent in some specimens or present as more or less continuous layer; algal layer present in excipulum; hypothecium yellowish; hymenium up 200–300 µm high, hyaline; asci 4–8-spored; spores thin walled, in KOH 42–62 × 25–35 µm (in all examined specimens deformed and measured only in KOH). The above description is based on Polish and, especially in the case of apothecia, on foreign material.

Chemistry: *O. subviridis* produces gyrophoric (major) and lecanoric (trace to minor) acids, usually accompanied by the same pigments as described in *O. androgyna* s.l. and *O. arborea* by JABŁOŃSKA & KUKWA (2007).

The thalline cortex, apothecial margin cortex and isidia always react C+ red in examined specimens due to the presence of gyrophoric acid; the apothecial margin medulla never reacted with C nor KC. The medulla of thallus was usually C–, but in some specimens part or entire medulla reacts red. The disc pruina is C–, but the epihymenium gives a C+ red reaction as it contains gyrophoric and lecanoric acids.

BOQUERAS et al. (1999) also reported atranorin, a substance not found in examined specimens. Comparing the spot-test reactions, BOQUERAS et al. (1999) reported specimens with C+ red medulla to be more common than those with negative reaction. In samples examined for this study, specimens with C– medulla dominated. BOQUERAS et al. (1999) recorded material of *O. subviridis* with C– thallus cortex, but the reaction probably was obscured by a thick necrotic layer observed in some studied specimens. The same case was reported also for *O. androgyna* s.l. and *O. arborea* (see JABŁOŃSKA & KUKWA 2007).

Notes: *O. subviridis* is the only isidiate species of the genus in Europe. It is characterised by small, often soft, isidia (Fig. 3B) and the presence of gyrophoric acid as the major lichen substance. In Poland (and also other countries) it was often confused with *O. arborea*, *O. bahusiensis* (syn. *O. androgyna* C, see below and JABŁOŃSKA & KUKWA 2007) and *O. turneri* (Sm.) Hasselrot, three sorediate species, which may develop semi-isidioid densely packed (two first taxa) or granular soredia (all three species). However, they all differ chemically. Both, *O. bahusiensis* and *O. arborea*, produce gyrophoric acid in the thallus, the substance present also in *O. subviridis*, but *O. arborea* also contains lichexanthone and *O. bahusiensis* has fatty acids of the murolic acid complex (see TØNSBERG 1992, JABŁOŃSKA & KUKWA 2007). *O. turneri* produces variolaric acid (soralia C+ yellow) (TØNSBERG 1992, KUKWA 2008), which is absent in *O. subviridis*.

LAUNDON (1963) considered *O. subviridis* to be a synonym of *O. yasudae* (see also BRODO 1991). Several specimens of the latter were studied for comparison. Both species are chemically identical and contain gyrophoric acid as a major lichen substance; however, *O. subviridis* has smaller, often soft isidia forming a granulose crust, and usually produce very distinct and thick radiating prothallus. The apothecia are smaller, with pruinose disc and highly visible salmon discoid tissues (excipulum proprium) spreading over the thalline margin. *Ochrolechia yasudae* develops thick and long (even over 1 mm) isidia, which never form a granular crust (as illustrated in BRODO et al. 2001). The disc is epruinose, with a margin which does not possess discoid tissues and the thallus usually lacks a distinct radiating prothallus. Both species also differ in their distribution: *O. subviridis* is confirmed only from

Europe and Tunisia in Africa (see Hanko et al. 1986), whereas *O. yasudae* grows in North America and East Asia (see Brodo 1991).

Almborn (1952) considered *Ochrolechia bahusiensis* as a synonym of *O. subviridis* 'at least pro p.', but Jabłońska & Kukwa (2007) noted that at least some original specimens (distributed as Magnusson, Lich. Sel. Scand. no 4) belonged to *O. androgyna* C sensu Tønsberg (1992). Recently, original collection from GB was studied, and the two existing specimens appeared to belong to *O. androgyna* C. Therefore, *O. bahusiensis* is proposed here to replace *O. androgyna* C (see appendix).

Verseghy (1962) did not accept *O. subviridis*, and instead used *O. gallica* described a few years earlier (Verseghy 1958), but later considered both names to be conspecific (Verseghy 1969b).

Habitat requirements: *O. subviridis* is found in Poland only on the bark of *Fagus sylvatica* (11 records) and *Quercus* spp. (4 records). It appears to prefer mostly forest conditions, but only in 8 cases notes on the environment were provided on the labels.

Distribution: *O. subviridis* has been recorded in Poland from many regions of the country (see Fałtynowicz 2003 and literature cited therein). After the revision of all available material it appeared that most of the material was misidentified. At present *O. subviridis* is known only from a few localities in north-western Poland and can be considered as a rare Atlantic lichen. Perhaps the species is in danger of extinction, as most of the specimens originate from 1951–1977.

According to Purvis (1992), *O. subviridis* is an oceanic and suboceanic lichen. The presented here distribution (based on revised specimens) confirms that. So far the author examined specimens from Belgium, Denmark, France, Germany, Great Britain, Greece, Luxembourg, Ireland, Italy, the Netherlands, Norway, Portugal and Sweden. It has also been reported from Albania (Hafellner & Kashta 2003), Croatia (Hanko et al. 1986), Spain (Hanko et al. 1986, Boqueras et al. 1999), Switzerland (Hanko et al. 1986) and Tunisia (Hanko et al. 1986). Records of *O. subviridis* from the Czech Republic (Vězda & Liška 1999), Estonia (Thor & Nordin 1998, Randlane & Saag 1999) and Finland (Santesson et al. 2004) are doubtful; all examined specimens belonged to other species. Almborn (1948) reported *O. subviridis* from Lithuania, Hanko et al. (1986) from Russia (Sambia, former East Prussia), Pišút (2002) from Slovakia, and Kondratyuk & Coppins (2000) from Ukraine, but no specimens have been seen so far by the author from those countries. In terms of the known distribution of the species, it is highly probable that it does not occur in those regions. North American records of *O. subviridis* by Howard (1970) were also considered as doubtful (Brodo 1991).

Number of specimens examined – 14

Specimens examined: [Ab–98] – c. 3 km SW of Janiewice village, by Janiewice gamekeeper's cottage, on *Quercus* sp., 24.08.1951, Z. Tobolewski (POZ); **[Ac–35] –** Szklana Huta village, on *Fagus sylvatica*, 13.09.1957, T. Sulma (UGDA-L–14561); **[Ac–37] –** W of Karwia village, 54°50'N/18°13'E on *Quercus* sp., 12.08.1966, T. Sulma (UGDA-L–9330 & 13996); **[Ac–42] –** Grabowo forest division, on *Fagus sylvatica*, 29.03.1977, Z. Tobolewski (POZ); Słowiński NP, Kluki forest division, fs No. 77, on *Quercus* sp., 17.05.1968 Z. Tobolewski (POZ); **[Ac–45] –** 1.5 km NW of Choczewo village, on *Fagus sylvatica*, 23.06.1987, W. Fałtynowicz (UGDA-L–3270); **[Ac–64] –** Lębork forest division, Dąbrowa village (poorly localized specimen, approximately in that ATPOL grid square), on *Fagus sylvatica*, 12.06.1964, T. Sulma (UGDA-L–13980); **[Ac–66] –** 2 km S of Bożepole Wielkie village, on *Fagus sylvatica*, 21.09.1973, Z. Tobolewski (POZ); **[Ac–86] –**Mirachowo village, on bark, 1936, F. Krawiec (literature record, see Hanko et al. 1986: 189); **[Ac–97] –** Zamkowa Góra NR near Kartuzy town, c. 0.5 km NW of Ciche lake, 54°19'04"N/18°10'2"E, on *Fagus sylvatica*, 13.08.1974, Z. Tobolewski (POZ); **[Bb–01]** – Kołobrzeg town, Podczele railway station, 54°11'20"N/15°39'09"E, on *Fagus sylvatica*, 11.06.1955, Z. Tobolewski (POZ); **[Bc–12] –** Bukowa Góra hill, vicinity of Sierzno village, 54°07'04"N/17°28'17"E, on *Fagus sylvatica*, 29.08.1951, Z. Tobolewski (POZ); **[Bc–16] –** Czapliniec w Wierzysku NR, by Wierzysko lake, on *Fagus sylvatica*, 16.05.1972, Z. Tobolewski (POZ). Poorly localized specimen: Słupsk district, Dolina Zgnilna NR, by lake, on *Fagus sylvatica*, 08.1951, Z. Tobolewski (POZ).

Exsiccates examined: Abbayes, Lich. Gall. Exs. 37 (sub *Pertusaria subviridis*, B–32237, BM, BP–33160, S). Magnusson, Lich. Sel. Scand. 4 (pro parte sub *Ochrolechia bahusiensis*, BP–43574, GB–92816, GZU, S). Magnusson, Lich. Sel. Scand. 60 (sub *P. subviridis*, B–92458, BM, BP–42197 & 50404, KRAM–L23052, S, GB–92829, GB, non-numbered specimen). Zahlbruckner, Krypt. Exs. 2277 (sub *P. velata*, later re-determined as *P. subviridis*, W–19150012102).

Ochrolechia szatalaensis Verseghy

Ann. Hist.-nat. Mus. Nat. Hung. **50**: 80 (1958).

Type: Bulgaria, Cepelarska planina, in monte "Karlak dag" pr. Pasmakli, 1700–2100 m, *Picea abies*, 07.–08.06.1929, Ö. Szatala (BP–20057 – holotype; BP–20058 – isotype).

= *Ochrolechia szatalaensis* var. *macrospora* Verseghy, Ann. Hist.-nat. Mus. Nat. Hung. **50**: 81 (1958).

Type: Germany, Partenkirchen, on bark, 11.01.1957, A. von Krempelhuber? (M – holotype, not seen; see VERSEGHY 1958: 81; BP–20060 & 20055 – isotypes).

= *Ochrolechia tenuissima* Verseghy, Nova Hedwigia **1**: 77 (1962).

Type: Slovenia (not Slovakia as in the description), Kranjska region (orig. Krain), Veliki Pišenza (orig. Gross Pischenza), by Kranjska Gora (orig. Kronau), on *Picea abies*, 1908, K. von Keissler (W–19080009172 – non-sorediate fragments with apothecia of *O. szatalaensis* – lectotype, selected here; BP–19942 – isolectotype).

= *Ochrolechia pallescens* f. *cinerea* Verseghy, nom. nud.

Type: Sweden, Västergötland, Hässyda, near the church, on *Populus tremula*, 18.05.1929, A. H. Magnusson (BP–20004).

Description: (Fig. 3C) Thallus thin, flat in most places and at least partly endosubstratal, or medium to very thick, folded, rugulose, areolate or very rarely tuberculate, with intermediate forms between extremes, brownish, light brown, yellow-grey, grey or rarely whitish-grey; soralia not observed in European material; prothallus indistinct; apothecia always present, up to 2.5 mm in diam., sessile, rounded or irregular in shape, ± flat; thalline margin well developed, even, smooth or rough, or rarely flexuose, shiny, glabrous or matt, concolorous with the thallus, or more yellowish than the thallus; cortex of the margin well developed, laterally thinner, white in section, and up to 70 µm thick, expanded at the base, glassy, but opaque (best visible in sectioned apothecia under the stereomicroscope), up to c. 170 µm thick [according to BRODO (1991) over 200 µm]; margin medulla well differentiated; excipular ring or discoid like tissue not observed; disc ± plane to slightly concave, flesh coloured, always pruinose, and invisible if heavily pruinose, pruina very thick, coarsely granular or scabrose, never farinose, yellowish-grey, yellow, brownish-grey or distinctly brown-grey with yellow tinge; algal layer variously developed even in one specimen, continuous, of scattered groups or completely absent in margin and/or below hypothecium, but at least in one structure algae present; excipulum proprium highly visible in section; hypothecium yellowish; hymenium (160–)220–300 µm; asci (4–)6–8-spored; spores often deformed, widely ellipsoid or ellipsoid, rather variable in size even in one section, 30–75(–80) × (15–)20–43 µm, but in terms of length, usually with tendency to a certain partition, e.g. 45–50 µm, 55–65 µm or 60–72 µm, but also 40–75 µm long. The above description is based on Polish and foreign, mostly European, material.

Chemistry: *O. szatalaensis* always produces variolaric acid, which is often accompanied by both 'microstictoides unknowns', rarely only one is present, or both are absent. Alectoronic acid (sometimes with unidentified accessory spots detectable in solvent B) was detected in c. 60 % of specimens tested by TLC, and murolic acid complex with 1–3 fatty acids was found in c. 80 % of the examined samples. Few specimens were tested twice, and sometimes those substances were detected only once (only variolaric acid constant). Unknown xanthone 'Ofr-1' (see BRODO 1991 for details) was detected in a few specimens from Scotland, and in four Scottish samples an additional fatty acid in Rf classes A2, B1–2 and C1 was detected.

The outer part of the apothecial margin cortex, disc pruina and cortex of thick and yellowish thalli always react C+ yellow due to the presence of variolaric acid. The medulla and epihymenium is C– and KC–. The entire or fragments of the inner part of the apothecial cortex margin (but only in the not expanded upper part) reacts KC+ red and C– due to the presence of alectoronic acid. To date, alectoronic acid has only been found in the apothecial cortex of *O. turneri* (Sm.) Hasselrot (KUKWA 2008). In specimens with 'Ofr-1', the apothecial disc gave a UV-orange reaction, but for one thallus some apothecia were UV+, and some UV–.

Notes: *O. szatalaensis* is characterized mainly by the presence of variolaric acid and commonly alectoronic acid (in Europe only), absence of gyrophoric acid, strongly pruinose apothecial disc, distinctly expanded and glassy, but opaque cortex at the base of apothecial margin, and the corticolous habitat. *O. upsaliensis* is the most morphologically and chemically similar species, but differs predominantly by the terricolous habit, permanently lacks alectoronic acid, and the margin cortex is entirely white and only slightly expanded at the base. The difference in the last character was observed for the first time during this study, and confirms the separation of both taxa; before, mostly the habitat and sometimes thallus thickness were used as the discriminating feature (e.g. Brodo 1991, Purvis et al. 1994a).

Morphologically *O. szatalaensis* also resembles *O. pallescens*, but that species contains gyrophoric acid in the epihymenium (Hanko et al. 1986, Boqueras et al. 1999), and, when present, alectoronic acid in the margin medulla (see also under that species).

Verseghy (1958) distinguished two varieties of *O. szatalaensis*, the typical one characterized by the relatively short spores (42–57 × 26–32 µm) and *O. szatalaensis* var. *macrospora* with longer spores (66.6–74 × 30–37 µm). Both forms were rarely distinguished, and considered as synonymous by Hanko et al. (1986) and Hafellner & Türk (2001). That view is supported by the author's study as several samples were found with spores almost exactly intermediate as well such with spores 40–75 µm long.

O. tenuissima was described as another member of the *upsaliensis*-group, and Verseghy (1962) distinguished it from *O. szatalaensis* by the presence of soralia. The holotype of *O. tenuissima* in W consists of two different lichens, a long-spored form of *O. szatalaensis* and an unidentified sorediate taxon, probably *Loxospora elatina* (Ach.) A.Massal. This was also detected and annotated by J. Poelt, but as far as it is known, never published. As the material is heterogeneous, according to the Art. 9.9 and 9.12 of ICBN (see McNeill et al. 2006), one element corresponding most nearly with the original description has to be selected as a lectotype. Therefore it is here proposed to lectotypify the name with the fertile part in order to keep it in the genus *Ochrolechia*. *O. tenuissima* becomes the later synonym of *O. szatalaensis*.

Verseghy (1962) reported *O. subathallina* H.Magn. from Europe (Sweden). Santesson et al. (2004), however, questioned its occurrence and attributed these records with a question mark to *O. pallescens*. Specimens cited by Verseghy (1962) as *O. subathallina* have been recently located in W; both belong to *O. szatalaensis*. Therefore, *O. subathallina* can certainly be excluded from the European lichen biota.

Habitat requirements: In Poland *O. szatalaensis* has been found only once on each of the following: *Acer pseudoplatanus*, *Alnus incana*, *Fagus sylvatica*, *Sorbus aucuparia* and an unidentified deciduous tree.

Distribution: *O. szatalaensis* is reported here as new to Poland. It was found only in a few localities in the western Polish Carpathians, and its known distribution suggests that it is a mountain species in Poland and since most of the records come from the middle of the last century, it seems that it is an endangered lichen species in the country.

O. szatalaensis is quite widely, but rather unevenly distributed in Europe, and in many areas appears to be uncommon. To date, the author has examined material from Austria, Bosnia and Herzegovina, Bulgaria, Estonia, France, Germany, Great Britain, Greece, Ireland, Italy, Montenegro, Norway, Portugal, European part of Russia, Slovenia, Spain, Sweden and Ukraine, and outside Europe from the Canary Islands, Canada, USA, as well as Argentina and Chile, where according to Messuti & Lumbsch (2000) it is common in andino-patagonic forest. It has also been reported from the Azores (Purvis et al. 1994b), Croatia (Boqueras et al. 1999, Verseghy 1962), Madeira (Hafellner 2002), Switzerland (Hanko et al. 1986) and Papua New Guinea (Aptroot 1998). It appears not to have been reported previously from Macedonia (see additional specimen examined).

Number of specimens examined – 5

Specimens examined: [Gd–25] – Beskid Żywiecki Mts, Dolina Stare Pole, 900 m (placement in that ATPOL grid square approximate), on *Fagus sylvatica*, 10.07.1966, J. Nowak (KRAM-L–17036); **[Gd–59]** – Tatry Zachodnie Mts, Dolina Białego valley, 960 m, on *Acer pseudoplatanus*, 16.06.1998, U. Bielczyk (KRAM-L–44411); S slope of Łysanki Mt., on deciduous tree, 06.06.1967, J. Motyka (LBL); **[Ge–51]** – Rów Podtatrzański, Łysa Polana settlement, by Biała Woda stream, on *Alnus incana*, 16.05.1965, J. Bystrek (LBL); by the road to Wodogrzmoty Mickiewicza waterfalls, on *Sorbus aucuparia*, 16.06.1965, J. Bystrek (LBL).

Additional selected specimen examined: Macedonia. Montes Galičica, secus via inter Trpejca et Otešovo, 1550 m, *Quercus* sp., 11.07.1975, A. Vězda (BM, in specimen of *O. balcanica*).

Exsiccates examined: Almborn, Lichenes Africanici 133 (sub *O. pallescens*, B – two specimens, VBI – two specimens). Anonymous, Lich. Exs. Arizona State Univ. 379 (B, S–F59352). Anzi, Lich. Exs. Minus Rari Ital. Super. 165 (sub *Lecanora parella* var. *pallescens*, BP 19998). Arnold, Lich. Exs. 1807 (sub *O. upsaliensis*, B 31569, S, W– 19140009641). Baglietto, Cesati & Notaris, Erb. Critt. Ital. (Ser. II?) 381 (1381) (sub *O. pallescens*, WRSL). Follmann, Lich. Exs. 130 (B – two specimens, GZU – two specimens). Fries, Lich. Exs. Suec. 103 (sub *L. pallescens*, S–F53287). Malme, Lich. Suec. Exs. 659 (sub *O. pallescens*, B–91947, S–F52695, W–19180000637). Poelt, Lich. Alp. 193 (sub *O. szatalaensis* var. *macrospora*, B, BP–53373, KRAM-L–23739, LBL-L, W–19640003200). Verseghy, Lich. Exs. 75 (BP–75620, H, KRAM-L–23890, W–20080000597), Vězda, Lich. Sel. Exs. 842 (BP–75879, H, S–F53322).

Ochrolechia trochophora (Vain.) Oshio **var**. ***trochophora***

J. Sci. Hiroshima Univ., Ser. B, Div. **2**(12): 145 (1968). – *Pertusaria trochophora* Vain., Bot. Mag. (Tokyo) **32**: 155 (1918).

Type: Japan, Prov. Kozuke, Mt. Akagi. Ad corticem arboris, Yasuda 53 (TUR-V–7255 – holotype, not seen; see BRODO 1991: 762; TI – isotype, not seen; see OSHIO 1968: 145).

= *Ochrolechia pallescens* var. *krempelhuberi* Verseghy, Ann. Hist.-nat. Mus. Nat. Hung. **50**: 78 (1958).

Type: Germany, Bayern, Seinsberg bei Mittenwald, on *Fagus sylvatica*, 1850, s.coll. (M – holotype, not seen; see VERSEGHY 1958: 78; BP–19997 – isotype).

= *Ochrolechia harmandii* f. *granulosa* Verseghy, Beih. Nova Hedwigia **1**: 108 (1962).

Type: China, Yunnan, Yangtze watershed, Prefectural District of Likiang, eastern slopes of Likiang Snow Range, on bark, 05.10.1922, J. F. Rock 11758 (W–19270000274 – holotype; BP–19955, isotype).

= ?*Ochrolechia harmandii* f. *pustulata* Verseghy, Beih. Nova Hedwigia **1**: 110 (1962).

Type: China, Prov. Setschwan austro-occid., in regionis siccae subtropicae convallis fluminis Yalong ad septentriones oppid Yenyüen infra castellum Kwapi, silva supra vic. Helngö, on *Boehmeria macrophylla*, 21.05.1914, H. F. v. Handel-Mazzetti 475 (W–19270013764 – holotype).

Description: Thallus thin, with ± dispersed pustulate areoles or very rarely areoles absent (in one poorly developed specimen) or thick, folded-areolate, shades of brown, but the top of areoles more or less whitish; prothallus not evident; apothecia crowded or dispersed, rounded to irregular, up to 3 mm in diam., thalline margin well developed, brown, pinkish-brown, ± shiny or matt, not pruinose, with few to many pustulate areoles, sometimes covering the whole margin or very rarely areoles absent (in one poorly developed specimen), areoles on the margin as on the thallus, often with white upper part; cortex of the margin well developed, laterally c. 50–75 µm, expanded at the base; excipular ring of salmon disk-like tissue not visible; disc flesh-coloured, flat, concave or wavy, matt, scabrose, but not pruinose, sometimes slightly rosulate, with weakly developed radiating bands of sterile tissue (only in Turkish specimen); algal layer of continuous layer or as scattered groups of cells, algae absent below hypothecium or rarely present in groups or more or less continuous layer; hymenium 180–320 µm; asci (3–)6–8-spored; spores ellipsoid to subglobose (even within the same apothecium), (20–)30–62 × (15–)20–35 µm. The above description is based on European (Fig. 3D & E) and Turkish specimens only, as they differed in apothecial morphology from most collections of *O. trochophora* from Asia and North America, in which the apothecial margin is usually not brown to pink-brown and does not possess pustulate areoles (see also BRODO 1991).

Chemistry: *O. trochophora* produces gyrophoric (major) and lecanoric (trace to minor) acids, usually with unidentified pigments (see JABŁOŃSKA & KUKWA 2007). Atranorin (trace) was detected in one specimen from China (G. & S. Miehe 14996, GZU). Sometimes traces or minor amounts of fatty acids were also detected; however, these might have been artefacts or contaminations since they were usually hardly detectable.

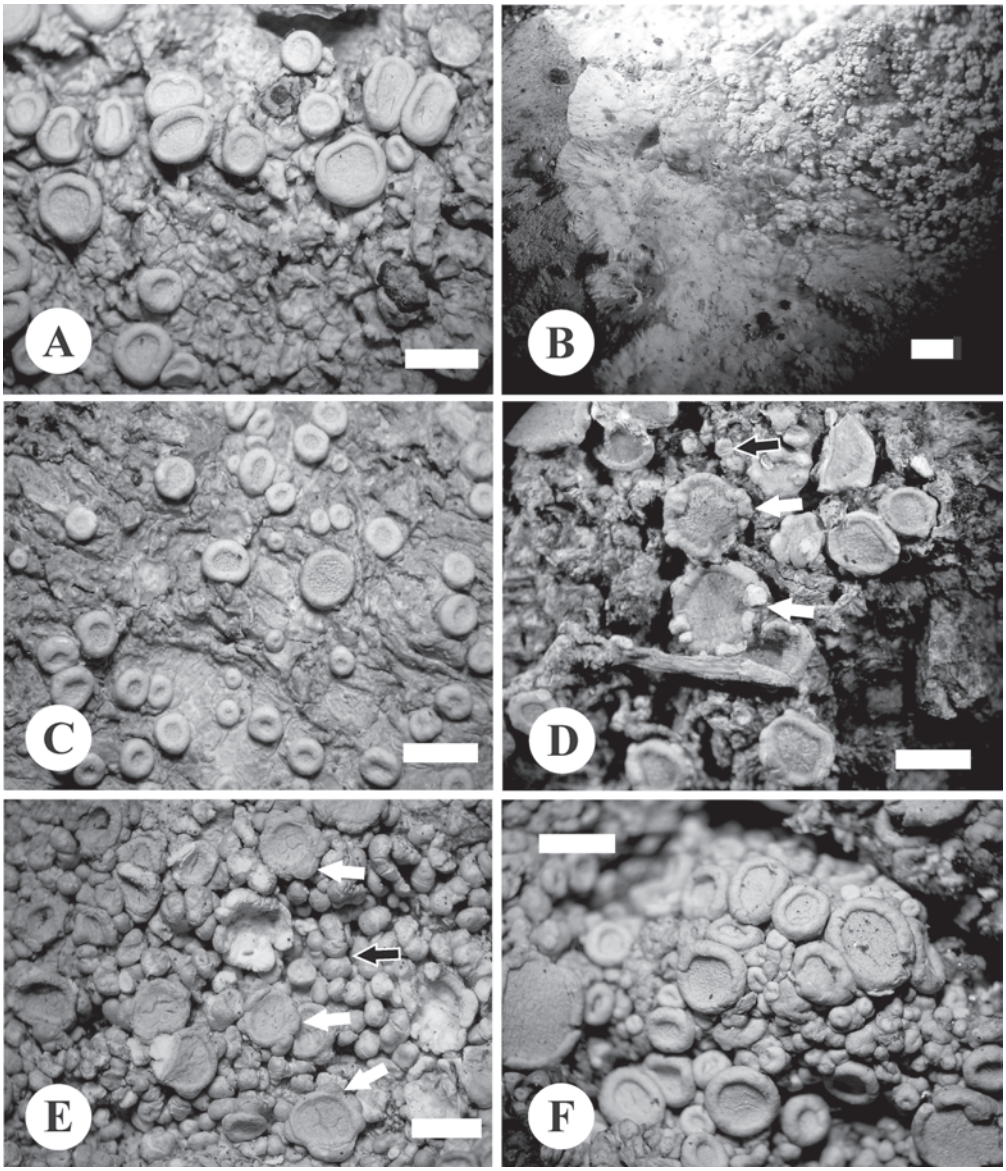

Fig. 3: Morphology of *Ochrolechia* species. **A** – *O. pallescens* (Montenegro, Mayrhofer 16077, GZU); **B** – *O. subviridis* with well developed prothallus (England, Essex, Harrold 823, E); **C** – *O. szatalaensis* (Austria, Obermayer 2999, GZU); **D** – *O. trochophora* s.str. from Europe with weakly developed thallus; white arrows – pustulate areoles on margin, black arrow – pustulate areoles over thallus (Germany, isotype of *O. pallescens* var. *krempelhuberi*, BP–19997); **E** – *O. trochophora* s.str. from USA.; white arrows – pustulate areoles on margin, black arrow – pustulate areoles over thallus (Hale, Poelt 8122, GZU); **F** – *O. upsaliensis* (Austria, Obermayer, Dupla Graec. Lich. 63, GZU). Scale bars: A, C, D, E, F = 2 mm; B = 1 mm.

The thalline cortex, apothecial margin cortex and epihymenium always react C+ red due to the presence of gyrophoric acid. A thick necrotic layer present on some parts of the thallus does not react with C. The medulla of the thallus and margin is C–.

Notes: *O. trochophora* is distinguished by its usually thick, verruculose thallus, margin usually without pinkish tissue or excipular ring, algal layer confined to lateral parts of excipulum, and the presence of gyrophoric acid in epihymenium and cortex of thallus and apothecial margin (see BRODO 1991). It is rather variable in the development of thallus (thin to thick, with or without pustulate areoles, etc.) and apothecia (shape, disc rosulate or not, margin smooth or verrucose to verruculose). The morphological variation of the species is well illustrated by OSHIO (1971) and BRODO (1991). Two varieties are distinguished, *O. trochophora* var. *trochophora* with epruinose disc and only gyrophoric acid in the thallus cortex and epihymenium, and *O. trochophora* var. *pruinirosella* Brodo with pruinose disc and additional variolaric acid in the thallus cortex (see BRODO 1991). However, according to BRODO (1991) both varieties are not sharply delimited.

The variability of *O. trochophora* var. *trochophora* led to the description of many taxa, which were subsequently reduced to synonyms (see OSHIO 1971, BRODO 1991; also above). Here, three names are added: *O. harmandii* f. *granulosa* and *O. pallescens* var. *krempelhuberi* undoubtedly belong to *O. trochophora*, but in the case of *O. harmandii* f. *pustulata* this is not so clear cut, as the holotype is rather small and not well developed, and the identification was not certain. It seems, that the Asiatic material referable to *O. trochophora* is very variable and perhaps heterogeneous, thus, together with the type *O. harmandii* f. *pustulata*, it needs further study.

At the beginning of this revision of European material, only one specimen of *O. trochophora* var. *trochophora* from Romania came to my attention. It was rather typically developed, but as the species was not known from Europe, at first it was suspected that it was mislabelled. Later, specimens from Germany (type of *O. pallescens* var. *krempelhuberi*, Fig. 3D), then Poland and Ukraine were found, and these confirmed its presence in Europe. All this material seemed to be rather atypical, usually with a thin thallus, but commonly with well developed pustulate areoles (present also on thalline margin) and pinkish margin. It is similar to the illustration in BRODO et al. (2001) and falls well within the variation of that taxon.

In Poland, *O. trochophora* s.str. cannot be mistaken with any other corticolous species, but in other parts of Europe it can be confused with *O. balcanica* Verseghy, corticolous forms of *O. frigida* and *O. tartarea*, and *O. oregonensis* H.Magn., since all those taxa produce gyrophoric and lecanoric acids. *O. balcanica* can be distinguished by its large, apothecia with smooth margin lacking pustulate areoles, the constant presence of a continuous algal layer below the hypothecium, and its occurrence in the Mediterranean region. *O. frigida* often develops sterile thalli consisting of bullate and delicate, swollen or subglobose to coralloid areoles (never pustules), very often with spines, and it only grows on bark in open places in northern Europe. *O. tartarea* differs in the presence of 'androgyna B unknowns 1–3'. *O. oregonensis* is similar to the European material of *O. trochophora* in having a pinkish apothecial margin, but in the former it is due to the salmon discoid tissues (excipulum proprium), not the pigmentation as in the latter (Kukwa, unpubl.). In North America *O. oregonensis* usually produces fatty acids (see BRODO 1991), but the European sample lacked these (BRODO 1992).

Habitat requirements: Polish specimens of *O. trochophora* var. *trochophora* are found on the bark of *Alnus* cf. *incana* in forests along streams in mountains.

Distribution: To date, *O. trochophora* var. *trochophora* has been reported only from North America and eastern and southern Asia (e.g. OSHIO 1971, BRODO 1991, KUROKAWA 2003). Here it is reported for the first time from Europe, namely from Germany (type of *O. pallescens* var. *krempelhuberi*), Poland, Romania and Ukraine, where it only occurs in the mountains. It is also reported for the first time from Turkey, the most western Asiatic record of this taxon.

O. rosella, a synonym of *O. trochophora* (see above), was reported from Spain, but the material belongs to *O. balcanica* (see BOQUERAS et al. 1999).

O. trochophora is very rare in Poland: only four specimens exist, all from the 1950s; thus it should be considered as close to extinction or even extinct.

Number of specimens examined – 4

Specimens examined: [Gf–69] – Bieszczady Zachodnie, by the road from Berechy Górne to Ustrzyki Górne, by Rzeczyca, 700 m, black-alder forest, by river, on *Alnus* cf. *incana*, 27.09.1958, K. Glanc (KRAM-L–35848); ibidem, 680 m, on *Alnus* cf. *incana*, 07.07.1959, K. Glanc (KRAM-L–35851, in the specimen of *O. pallescens*); **[Gg–60] –** Bieszczady Zachodnie, Pszczeliny, 650 m, by the stream, on *Alnus* cf. *incana*, 25.08.1958, K. Glanc (KRAM-L–35801); SE of Pszczeliny village, 690 m, by the stream, on *Alnus* cf. *incana*, 29.07.1959, K. Glanc (KRAM-L–35849).

Additional selected specimens examined (22 specimens)**: Romania**. Transsilvania, no exact locality, on *Fagus* sp., 21.07.18??, s.coll. (WRSL). **Turkey**. Rize vilayet, Kaçkar Mts, village Ayder, 16 km SSE of Çamlıhemşin, S slope of Huser Mt. (2548 m), 40°57'45-50"N/41°07'20-25"E, 2000 m, on *Fagus orientalis*, 01.07.2001, A. Guttová, J. Halda, Z. Palice 8256, Ch. Printzen (PRA). **Ukraine**. Zakarpats'ka Oblast', Boržava, V. Ozenianec, on bark, 1932, J. Nadvornik (S–F93824).

Ochrolechia upsaliensis (L.) A.Massal.

Ricerch. Autin. Lich.: 31 (1852). – *Lichen upsaliensis* L., Species plantarum **2**: 1142 (1753). – *Ochrolechia pallescens* var. *tumidula* f. *upsaliensis* (L.) Körb., Syst. Lich. German.: 149 (1855). – *Ochrolechia pallescens* var. *upsaliensis* Rabenh., Flecht. Europ. **6**: 168 (1857). – *Ochrolechia parella* var. *upsaliensis* Rabenh., Kryptog.-Flora von Sachsen, 2. Abth.: 213 (1870).

Type: Unlocalized specimens, but according to the description 'Upsalia' (LINN–1273.44, upper right-hand specimen – lectotype; see JØRGENSEN et al. 1994: 382; LINN–1273.44 – two additional specimens, E – syntypes); Upsalia, W. Nylander (BR-LICH – possible topotype).

= *Ochrolechia upsaliensis* f. *continua* Verseghy, Beih. Nova Hedwigia **1**: 75 (1962).

Type: Slovakia, Tatra Mts, Zelezné vrata, (orig. Eisernes Thor prope Béla com. Szepes in Hung.), on plant remains, no date, H. Lojka (W–20080000593 – holotype).

Description: Thallus usually thick, areolate, usually with large, up to 0.7 mm wide, crowded and sometimes ± swollen areoles (Fig. 3F), rarely thin, flat in most places or folded, partly endosubstratal, but always with some, mostly separate and small, up to c. 0.4 mm wide areoles, white-grey, grey, yellow-grey or brownish-grey, sometimes pruinose; prothallus indistinct; apothecia almost always present (absent in only one specimen), up to 4 mm in diam., rounded or irregular, thalline margin well developed, even, flexuose, crenulate or areolate, concolorous with the thallus, but if the thallus white-grey or grey, than usually darker and brown or yellow-grey; cortex of the margin well developed, thick, entirely white, not expanded or partly expanded at the base (character not constant even in one apothecium), but never glassy and opaque; margin medulla well differentiated; salmon discoid tissues (excipulum proprium) not observed; disc ± plane to slightly concave, rough, always pruinose, pruina very thick, scabrose or coarsely granular, never farinose, yellow-grey, brownish-grey or distinctly brown-grey with yellow tinge; algal layer continuous in margin, but usually in groups below hypothecium, rarely in continuous layer or very rarely absent; hypothecium yellowish; hymenium c. 250 µm; asci 4–8(–10)-spored; spores very different in shape and size, even in one section, widely ellipsoid, ellipsoid, almost oblong, ± rounded or ovoid with the widest part in 1/3rd of the length, (19–)40–75(–80) × (17–)25–35 µm. The above description is based on both Polish and foreign material.

Chemistry: *O. upsaliensis* always produces variolaric acid, usually accompanied by detectable amounts of 'microstictoides unknowns' (see KUKWA 2008) and also commonly the murolic acid complex (usually with two, neodihyromurolic and murolic acids). In several specimens, two unknown fatty acids were also found; the first one has following Rf classes A1, B1? (difficult to separate from the second one), C1; and the second one has Rf classes: A1–2, B1?, C – not tested. The first unidentified fatty acids was found in several specimens; the second one was detected only in five specimens; twice both fatty acids were found in the same sample.

Notes: *O. upsaliensis* is well known and readily recognizable lichen species. It is characterized by its ± yellow and regular apothecia with thick pruina, the presence of variolaric acid as a major secondary substance, the absence of alectoronic acid, and a terricolous habitat. *O. szatalaensis* is the most similar species, but it grows on the bark of trees (very rarely on wood), has a distinctly expanded and glassy, but opaque basal margin cortex (not or partly expanded in *O. upsaliensis*), and, at least in Europe,

alectoronic acid is frequently produced (see also HANKO et al. 1986, BRODO 1991; see also under *O. szatalaensis*).

The holotype of *O. upsaliensis* f. *continua* (see VERSEGHY 1962) represents a form with a thick and folded thallus. The thickness of the thallus is not considered to be taxonomically important as several intermediate forms between thin and thick thallus exist.

Habitat requirements: *O. upsaliensis* is a typical terricolous lichen in Poland, growing on plant remains (in different stages of decay) and bryophytes over calcareous soil or rocks; once it was found on a twig of a shrub. HOWARD (1970) also noted the species from rocks.

Distribution: *O. upsaliensis* is an arctic-alpine lichen, mainly known from the Northern Hemisphere. In Poland it only occurs in the Tatra Mts at altitudes of 1600–2000 m (see also OLECH 1977, ALSTRUP & OLECH 1992). It was commonly collected there, but no recent collection has been made, so its status remains unclear. According to CIEŚLIŃSKI et al. (2006), *O. upsaliensis* is critically endangered in Poland.

O. upsaliensis was also reported from Karkonosze Mts (KOERBER 1855, KOSSOWSKA 2006), but those records seem to be doubtful due to the absence of calcareous rocks in that region. One specimen collected by G. W. Körber in WRSL represents a small piece of areolate thallus with gyrophoric acid, possibly *O. frigida*.

So far I have confirmed the species from Austria, Finland, France, Germany, Italy, Norway, Romania, Slovakia, Slovenia, Spain, Sweden and Switzerland. Extra-European material was seen from Canada, USA, Greenland, Mongolia and the Russian Arctic. It has also been reported from Bulgaria (MAYRHOFER et al. 2005), Iceland (KRISTINSSON et al. 2006), Japan (KUROKAWA 2003), Turkey (JOHN & BREUSS 2004), the Canary Islands (HAFELLNER 1995), Argentina (CALVELLO & LIBERATORE 2002) and Colombia (VERSEGHY 1962), but according to SIPMAN et al. (2008), the Colombian collection most probably originated from North America. The record of *O. upsaliensis* from Estonia is suspicious since it was reported from the bark of *Juniperus communis* (see RANDLANE & SAAG 1999).

According to PURVIS (1992), *O. upsaliensis* most likely does not occur in the British Isles; it was reported from the summits of Morrone and Craig Calliach in Highland Scotland, but the material probably originated from outside the British Isles. The 'British' material of *O. upsaliensis* from 19th century in BM is annotated as not reliable, and thus it was not examined by the author. Subsequently, however, another specimen collected from the Clova Mts in 1846 was found in S (see under additional specimen examined). This too may have been mislabelled, but it seems to be too big coincidence. Therefore, it is concluded, that most probably *O. upsaliensis* grew in the British Isles in the 19th century, but has since disappeared.

Number of specimens examined – 15

Selected specimens examined: [Gd–59] – Tatry Zachodnie Mts, Kozi Grzbiet, between Dolina Litworowa and Dolina Mułowa valleys, on plant remains over limestone, 03.10.1964, Z. Tobolewski (POZ); Zadnie Kamienie, 1760 m, rock crevices, on plant remains, 24.06.1971, M. Olech (KRA); Dolina Kościeliska valley, Gładkie Upłazińskie, c. 1650 m, 49°14'N/19°53'E, on bryophytes and plant remains, 26.07.1926, J. Motyka (LBL – two specimens, one without date); Czerwone Wierchy Mt., E slope of Małołączniak Mt., 1960 m, on ground, 11.09.1955, Z. Tobolewski (POZ); **[Ge–50] –** Tatry Zachodnie Mts, Kopa Magury, above Dolina Jaworzynki valley, rock crevices, on plant remains, 21.07.1961 & 25.07.1961, J. Nowak (KRAM-L–8648, 7373 & 7374); **[Ge–60] –** Tatry Mts, Rysy Mt., 1950 m, below the top, on bryophytes, 13.06.1963, J. Nowak (KRAM-L–17701).

Additional selected specimen examined: Great Britain. Summits of the Clova Mountains, on bryophytes, 06.1846, W. Gardiner (S).

Exsiccates examined: Anderson, Shushan, Lich. W. N. Amer. 62 (B, GZU, S–L49433). Anonymous, Lich. Exs. Arizona State Univ. 45 (B–31585, B–without number, GZU). Anzi, Lich. Rar. Langob. Exs. 547 (sub *Lecanora pallescens* var. *upsaliensis*, S). Britzelmayr, Lichenes exsiccati Bavariae 949c (W–19920004974). Cummings, Williams & Seymour, Dec. N. Amer. Lich. 71 (sub *L. pallescens*, S–L5466). Cummings, Williams & Seymour, Lich. Bor.-Amer. 54 (sub *L. pallescens*, BP–20096, S). Desmazières, Pl. Crypt. France, Ed. 2, Ser. 2 647 (sub *L. parella* var. *upsaliensis*, BR – three specimens, W–20080000608). Follmann, Lich. Exs. 215 (B, GZU, herb. Diederich). Funck, Crypt. Gew. Fichtelgeb.(no series indicated) 659 (sub *O. parella* var. *upsaliensis*, BR–LICH). Hansen, Lich. Groenl. Exs. 732 (B, GZU, S–L7611, W–19990001610). Havaas, Lich. Norveg. Occid. Exs. 9 (BP–20085, W–19130010366). Macoun, Canad. Lich. 123 (sub *L. pallescens* var. *upsaliensis*, S). Malme, Lich. Suec. Exs. 338 (B–91625, W–19130013198). Mougeot & Nestler, Stirp. Crypt. Vog.-Rhen. 1147 (W). Obermayer, Dupla Graec. Lich. 63 (GZU). Rabenhorst, Lich. Europ. Exs. 168 (sub *O. pallescens* var. *upsaliensis*, BR-LICH,

S). Räsänen, Lichenoth. Fenn. 552 (B–31580, S). Räsänen, Lichenoth. Fenn. 772 (H, S). Schaerer & Hepp, Lich. Helv. Exs. 1151 (sub *L. pallescens* var. *upsaliensis*, BR-LICH, S, WRSL). Schaerer, Lich. Helv. 316 (sub *Parmelia parella* var. *pallescens* f. *muscicola*, BP–20083, BR-LICH, GZU). Schaerer, Lich. Helv. Exs. Ed. I 318 (WRSL). Vězda, Lich. Bohemoslov. Exs. 17 (POZ). Vězda, Lich. Sel. Exs. 144 (BP–49891, W–19620017977). Wartmann & Winter, Schweiz. Krypt. 746 (sub *O. pallescens* var. *tumidula* f. *upsaliensis*, S). Weber, Lich. Exs. 57 (B–31586, E, GZU, KRAM-L–3262, POZ, S). Wong & Brodo, Lich. Canad. Exs. 275 (TU).

Appendix

Ochrolechia bahusiensis H.Magn.

Bot. Not. 1927: 115 (1927).

Type: Sweden, Bohuslän, par. Långelandia, Röd, alt. 15 m, open situation facing the south-west and the sea, on *Quercus* sp., 26.07.1926, A. H. Magnusson, Magnusson, Lich. Sel. Scand. 4 (GB, without number – lectotype, selected here; B–92402, BM, BP–19914 & 43574, GB–92816, GZU, H – two specimens, KRAM-L–20036, S, W–19280000797 – isolectotypes).

= *Ochrolechia subviridis* f. *pulverulenta* Erichsen, Verh. Bot. Vereins Prov. Brandenburg **72**: 4 (1930). – *Pertusaria subviridis* var. *pulverulenta* (Erichsen) Erichsen, in Zahlbr., Rabenh. Kryptog.-Flora von Deutschland, Österreich und der Schweiz, part IX, **5**(1): 550 (1936). – *Pertusaria subviridis* f. *pulverulenta* (Erichsen) Almb., Bot. Not. Suppl. **1**(2): 86 (1948).

Germany, Schleswig-Holstein, Lanenburg, im Sachsenwald bei Friedrichsruh, an Eichen, 05.1928, C. F. E. Erichsen (W–19310009701 – isotype).

= *Pertusaria subviridis* var. *lignaria* Erichsen, in Zahlbr., Rabenh. Kryptog.-Flora von Deutschland, Österreich und der Schweiz, part IX, **5**(1): 550 (1936). – *Ochrolechia subviridis* var. *lignaria* (Erichsen) Erichsen, Ann. Mycol. **40**: 147 (1942).

Type: Germany, Schleswig-Holstein, Fürstentum Lübeck, Brückengeländer am Timmendorfer Strand (on wood), 02.10.1931 (1913 – misprint in original description), C. F. E. Erichsen (S–L1385 – holotype; it seems to be the only existing specimen).

= *Ochrolechia androgyna* C sensu Tønsberg (1992)

Description: see under *O. androgyna* C in Tønsberg (1992) and Jabłońska & Kukwa (2007).

Chemistry: Gyrophoric (major) and lecanoric acids (in trace to minor amounts) and 2–3 substances of the murolic acid complex, often with pigments and rarely with a trace of atranorin (Tønsberg 1992, Jabłońska & Kukwa 2007).

Notes: *O. bahusiensis* has been neglected for a long time. Sometimes it was considered as a synonym of *O. subviridis* (Almborn 1952), but the type material is sorediate, as already noted by Magnusson (1927), and contains fatty acids. It is identical to *O. androgyna* C, and thus *O. bahusiensis* is proposed here to replace this name (see also comments under *O. subviridis*).

The type material is very rich and was distributed as Magnusson, Lich. Sel. Scand. no 4, with two specimens preserved in GB; in four specimens, *O. subviridis* is intermixed, as in the case of one sample in GB; the other specimen in GB consisted exclusively of *O. bahusiensis* and this is selected here as lectotype.

O. subviridis var. *lignaria* (syn. *Pertusaria subviridis* var. *lignaria*) and *O. subviridis* f. *pulverulenta* belong to *O. bahusiensis*. Two original specimens from S and W were studied, and both contain gyrophoric acid (with lecanoric acid in a trace amount) and the murolic acid complex. The morphology of both is similar in general appearance to *O. subviridis* and soredia are rather atypical (distinctly whitish, but still different from soft isidia of *O. subviridis*, produced in irregular soralia), but the chemistry matches *O. bahusiensis* perfectly.

Distribution: The distribution of *O. bahusiensis* in Poland is provided by Jabłońska & Kukwa (2007). To date, it has only been found in Europe in Austria, Finland, Germany, Norway, Slovakia and Sweden (Tønsberg 1992, Jabłońska & Kukwa 2007). Here it is reported for the first time from Croatia, Czech Republic, France, Great Britain (England and Scotland), Luxembourg and Russia.

Additional selected specimens examined: Croatia. Dalmatia, Brač Island (Brazza), vicinity of Nerezisca and Bol, on *Pinus* sp. 22.03.1904, J. Baumgartner (W–19040005135). **Czech Republic**. Moravia, N of Rychtážov village, NE of Ošlouch Mt., Vápenný žleb valley, c. 49°20'60"N/16°55'17"E, on *Acer pseudoplatanus*, 21.04.2007, M. Kukwa 5543 (UGDA-L–15031). **France**. Moselle, Entre Neunhoffen et Sturzelbronn, le long de la route D87, au sud du Grosser Hundskopf, 235 m, le long d'une route, *Tilia cordata*, 25.07.2001, P. Diederich 14717, J. Signoret (herb. Diederich). **Great Britain**. England, East Sussex (V.C. 14), Sheffield Park Gardens, on *Quercus* sp., 26.05.1973, B. J. Coppins (E); Scotland, Angus (V.C. 90), grounds of Cortachy Castle, near Kirriemuir, on *Fraxinus excelsior*, 12.03.1968 U. K. Duncan (E). **Luxembourg**. Distr. ardennais, S Doncols, ruisseau de Sonlez, on *Sorbus aucuparia*, 22.03.1987, P. Diederich 7882 (herb. Diederich). **Russia**. Kalingrad region, Jablonovka, (orig.: in silva Wilhelmsberg), on *Betula* sp., 11.1867, B. Stein (WRSL).

Exsiccates examined: Magnusson, Lich. Sel. Scand. 4 (type collection; for herbaria see above). Räsänen, Lich. Fenn. Exs. 76 (sub *O. androgyna*, BM, S–F93602).

Key to the species of *Ochrolechia* in Poland (with some similar taxa, which may occur in the country)

1 Variolaric acid present in cortex of the thallus, thalline margin and/or soredia (C+ yellow); gyrophoric acid, when present, only in epihymenium (C+ red) **2**
1* Gyrophoric acid present in the cortex of thallus, thalline margin, epihymenium and soredia or isidia (C+ red); variolaric acid absent **9**

2 Gyrophoric acid present in epihymenium; if apothecia absent, then thallus sorediate **3**
2* Gyrophoric acid absent in epihymenium; thallus without soredia in Polish material **8**

3 Thallus with soredia; apothecia usually absent **4**
3* Thallus lacking soredia; apothecia always present **6**

4 Lichesterinic and protolichesterinic acids always absent; alectoronic acid sometimes present; soralia regular usually at least in younger parts of the thallus ..... ***O. turneri***
4* Lichesterinic acid always present, often with protolichesterinic acid; alectoronic acid always absent; soralia regular or irregular **5**

5 Lichesterinic and protolichesterinic acids always present; thallus thick, often folded; soralia more or less delimited; apothecia often present ..... ***O. alboflavescens***
5* Lichesterinic acid always present, protolichesterinic acid usually absent; thallus usually thin, even to folded; soralia rather irregular and soon confluent, at least in central part of the thallus; apothecia very rare, not known in Polish material ..... ***O. microstictoides***

6 Lichesterinic and protolichesterinic acids present; murolic acid complex and alectoronic acid absent, esorediate form of ..... ***O. alboflavescens***
6* Lichesterinic and protolichesterinic acids absent; murolic acid complex and/or alectoronic acid often present **7**

7 Lichen growing on bark or wood ..... ***O. pallescens***
7* Lichen growing on rocks ..... ***O. parella*** (so far not confirmed from Poland)

8 Terricolous, or rarely on shrubs at high elevations; margin cortex not expanded or indistinctly expanded at the base, white, never glassy, but opaque in sectioned apothecia (under stereomicroscope); alectorialic acid always absent ..... ***O. upsaliensis***
8* Corticolous or lignicolous; margin cortex distinctly expanded at the base and glassy, but opaque; alectorialic acid often present in the cortex ..... ***O. szatalaensis***

9 Thallus sorediate or isidiate; apothecia present or absent **10**
9* Thallus not sorediate or isidiate; apothecia almost always present, but often absent in terricolous material **14**

10 Lichexanthone present; soralia UV+ orange ..... ***O. arborea***
10* Lichexanthone absent; soralia UV– **11**

11 ‘Androgyna B unknowns 1–3‘ present ..... ***O. androgyna* B**
11* ‘Androgyna B unknowns 1–3‘ absent **12**

12 Thallus with soft, soredioid and/or typical isidia; fatty acids always absent; on bark or wood .... ***O. subviridis***
12* Thallus sorediate; fatty acids present, if absent, then terricolous **13**

13 Murolic acid complex always present; on bark or wood ..... ***O. bahusiensis***
13* Murolic acid complex (usually one fatty acid) present or absent, sometimes other fatty acids present; terricolous in high mountains ..... ***O. frigida***

14 ‘Androgyna B unknowns 1–3‘ present ..... ***O. tartarea*** (so far not confirmed from Poland)
14* ‘Androgyna B unknowns 1–3‘ absent **15**

15 Thallus and apothecial margin with pustulate areoles; apothecia always present; thalline margin ± pinkish; on bark in forest ..... ***O. trochophora* s.str.**
15* Thallus and apothecial margin without pustulate areoles, but thallus may consist of bullate and delicate, swollen or subglobose to coralloid areoles; apothecia often absent; thalline margin grayish; on soil, bryophytes (outside Poland also on trees and wood, but then in open places) ..... ***O. frigida***

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