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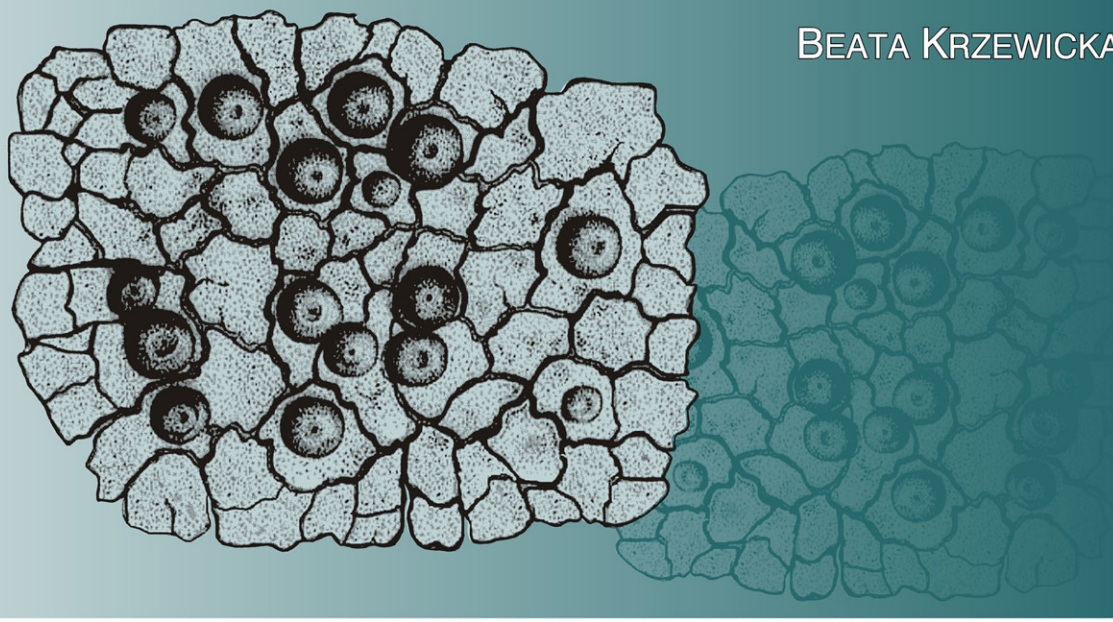
A revision of *Verrucaria* s.l. (Verrucariaceae) in Poland

BEATA KRZEWICKA



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A REVISION OF *VERRUCARIA* S.L. (VERRUCARIACEAE) IN POLAND

This volume is dedicated to Professor Janusz Nowak,
W. Szafer Institute of Botany, Kraków, an eminent Polish lichenologist and tireless collector in special recognition of his passion for pyrenocarpous lichens

Janusz Nowak
(1930–2004)

Polish Botanical Studies 27: 3–143, 2012

A REVISION OF *VERRUCARIA* S.L. (VERRUCARIACEAE) IN POLAND

BEATA KRZEWICKA

Abstract. A taxonomic treatment of the genus *Verrucaria* s.l. in Poland is provided, based on a study of *ca* 1700 specimens from Polish and foreign herbaria. A total of 62 species belonging to seven genera currently separated within *Verrucaria* s.l. are presented including two new combinations, *Verruculopsis minutum* (Hepp) Krzewicka and *Parabagliettoa disjuncta* (Arnold) Krzewicka. The following genera and species are recognized in the study area: *Bagliettoa* – *B. baldensis* (A. Massal.) Vězda, *B. calciseda* (DC.) Gueidan & Cl. Roux, *B. marmorea* (Scop.) Gueidan & Cl. Roux, *B. parmigerella* (Zahlbr.) Vězda & Poelt; *Hydropunctaria* – *H. maura* (Wahlenb.) Keller, Gueidan & Thüs, *H. rheitrophila* (Zschacke) Keller, Gueidan & Thüs, *H. scabra* (Vězda) Keller, Gueidan & Thüs; *Parabagliettoa* – *P. cyanea* (A. Massal.) Gueidan & Cl. Roux, *P. disjuncta*, *P. dufourii* (DC.) Gueidan & Cl. Roux; *Placopyrenium* – *P. canellum* (Nyl.) Gueidan & Cl. Roux, *P. fuscellum* (Turner) Gueidan & Cl. Roux, *P. trachyticum* (Hazsl.) Breuss; *Verrucaria* – *V. acrotella* auct., *V. amylacea* Hepp, *V. andesiatica* Servít, *V. aquatilis* Mudd, *V. bryoctona* (Th.Fr.) Orange, *V. caerulea* DC., *V. cataleptoides* (Nyl.) Nyl., *V. cernaensis* Zschacke, *V. cincta* Hepp, *V. denudata* Zschacke, *V. dolosa* Hepp, *V. elaeina* Borrer, *V. elaeomelaena* (A. Massal.) Arnold, *V. funckii* (Spreng.) Zahlbr., *V. hochstetteri* Fr., *V. latebrosa* Körb., *V. macrostoma* DC., *V. maculiformis* Kremp., *V. madida* Orange, *V. margacea* (Wahlenb.) Wahlenb., *V. muralis* Ach., *V. myriocarpa* Hepp, *V. nigrescens* Pers., *V. nigroumbrina* (A. Massal.) Servít, *V. obfuscans* (Nyl.) Nyl., *V. ochrostoma* Borrer, *V. pachyderma* (Arnold) Arnold, *V. pinguicula* A. Massal., *V. policensis* Servít, *V. polonica* J. Nowak, *V. polysticta* Borrer, *V. praetermissa* (Trevisan) Anzi, *V. procopii* Servít, *V. sphaerospora* Anzi, *V. sublobulata* Servít, *V. submauroides* auct., *V. submersella* Servít, *V. tectorum* (A. Massal.) Körb., *V. tristis* (A. Massal.) Kremp., *V. umbrinula* Nyl., *V. viridicans* Servít, *V. viridula* (Schrad.) Ach., *V. xyloxena* Norman; *Verrucula* – *V. elegantaria* (Zehetl.) Nav.-Ros. & Cl. Roux, *V. helvetica* (B. de Lesd.) Nav.-Ros. & Cl. Roux, *V. polycarparia* Nav.-Ros. & Cl. Roux, *V. protearia* (Zehetl.) Nav.-Ros. & Cl. Roux; and *Verruculopsis* – *V. lecideoides* (A. Massal.) Gueidan & Cl. Roux, *V. minutum*. Three species, *Parabagliettoa disjuncta*, *Verrucula elegantaria* and *V. polycarparia* are reported for the first time from Poland. Twenty five taxa are excluded from the survey because they were mistakenly reported or not confirmed for the study area. The morphology, anatomy, ecology and known distribution of all treated taxa are discussed. Keys for the identification of genera and particular groups of the species are provided. Additional nomenclatural and taxonomic clarification include the typification of *Thrombium lecideoides* A. Massal., *Verrucaria aquatilis* var. *aerimontana* Servít and *Verrucaria timkoii* Servít, and the synonymy of *Lithoicea nigrescens* var. *acrotella* A. Massal. with *Verrucaria nigrescens*, *Verrucaria amylacea* f. *compacta* Arnold with *Verrucaria amylacea*, *Verrucaria aquatilis* var. *aerimontana* with *Verrucaria aquatilis*, *Verrucaria atroviridis* Servít with *Verrucaria aquatilis*, *Verrucaria denudata* f. *dissulta* Servít with *Verrucaria funckii*, *Verrucaria elaeina* var. *determinata* Körb. with *Verrucaria praetermissa*, *Verrucaria elaeina* var. *effusa* Körb. with *Verrucaria submersella*, *Verrucaria hoffmanni* Hepp with *Bagliettoa marmorea*, *Verrucaria maura* var. *opaca* Körb. with *Hydropunctaria scabra*, *Verrucaria nigrofusca* Servít with *Verrucaria nigroumbrina*, *Verrucaria sublobulata* var. *robustior* Servít with *Verrucaria sublobulata*, *Verrucaria timkoii* with *Bagliettoa calciseda*. The name *Verrucaria funckiana* is rejected because it proved illegitimate as it was nomenclaturally superfluous when published.

Key words: *Verucariaceae*, *Bagliettoa*, *Hydropunctaria*, *Parabagliettoa*, *Placopyrenium*, *Verrucaria*, *Verrucula*, *Verruculopsis*, revision, nomenclature, taxonomy, ecology, key, Poland

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CONTENTS

INTRODUCTION

The concept of '*Verrucaria* s.l.' used here includes pyrenocarpous crustose, areolate or placodioid species with heteromerous thalli of a variable degree of differentiation, and various types of upper cortex, an algal layer and a medulla. The perithecia are immersed or superficial, with or without involucrellum, the hamathecium comprises periphyses and periphysoids, with no paraphyses, and the ascospores are simple and colourless. The members of *Verrucaria* s.l. occur mostly directly on calcareous or siliceous rocks. They rarely live as parasites on other lichens growing on rocks and they are found occasionally on soil or bark. They can grow in terrestrial, freshwater or maritime habitats.

In Poland the history of lichenological data concerning *Verrucaria* species spans a period of

over one hundred and fifty years. The first notes on this genus were published by German lichenologists such as Körber (1855, 1863), Ohlert (1870), Stein (1879), Eitner (1895, 1901, 1911), and Lettau (1912). A contribution to the knowledge of *Verrucaria* was also made by such Polish researchers as Lojka (1868), Rehman (1879), Boberski (1886, 1892), Błoński (1890), and later by Motyka (1924a, b, 1926, 1927), Krawiec (1933, 1936, 1938a, b), and Sulma (1936). This period of expansion of the knowledge of pyrenocarpous lichens in Central Europe was utilised by Zschacke (1933, 1934) in a monograph of *Verrucariaceae* summarising the systematics of all the regional species and their morphology. At the time Zschacke reported 23 *Verrucaria* species occurring in Poland (within its current borders), including three newly described species: *V. infidula* Zschacke, *V. maculata* Zschacke and *V. praesudetica* Zschacke (Zschacke 1933). No lichenological investigations were conducted in Poland during World War Two and in its aftermath. After a break of nearly 20 years a variety of papers was published with further records of this lichen group in the country (Tobolewski 1955a, b, 1957, 1958; Glanc & Tobolewski 1960). Servít (1954) presented his revision of *Verrucariaceae* in Czechoslovakia, introducing many new taxonomic concepts at the species level and below. His revision initiated many field studies in neighbouring countries (Christiansen 1955; Oxner 1955; Servít 1955; Erichsen 1957; Nowak 1959, 1966; Vězda 1970). Calcicolous species of pyrenocarpous lichens in Poland were examined predominantly by Nowak (1960, 1961, 1967) who specialised mainly on the genus *Verrucaria*. He described new species of *Verrucaria* s.l., such as *Amphoridium impurum* J. Nowak (Nowak 1974a), *A. ionospicarpum* J. Nowak (Nowak 1966) and *V. polonica* J. Nowak (Nowak 1959), and added many new records to the Polish lichen biota. Nowak and Tobolewski (1975) gave an overview of the knowledge of Polish lichens in their monograph *Porosty Polski*. The monograph contained all species known from Poland and neighbouring countries with keys for their identification. New and interesting records of *Verrucaria* were also added by Kiszka (1967a, b, 1979, 1981, 1987, 1997a), Kozik (1977), Olech (1974), Alstrup & Olech 1990), Czyżewska (1981), Toborowicz (1983), Lipnicki (1990, 1993, 1994), Fałtynowicz (1992), Śliwa (1998), Bielczyk (1999), Czarnota (2000), and Kukwa (2000). Some noteworthy data have been published lately, including five taxa new to Poland (Czyżewska *et al*. 2001, 2002; Bielczyk 2003; Czarnota *et al*. 2005; Kubiak 2005; Krzewicka & Kiszka 2007; Krzewicka & Hachułka 2008; Krzewicka 2009a, b; Śliwa 2010).

Fałtynowicz (2003) listed both historical and contemporary data in a recent checklist of lichens of Poland. He reported 102 species of *Verrucaria* s.l. in total (97 species under *Verrucaria* and five species under *Bagliettoa*). Many species included by Fałtynowicz in his checklist have subsequently changed their taxonomic position after the critical revision of the saxicolous freshwater *Verrucaria* species by Thüs (2002), the revision of calcicolous species of *Bagliettoa* by Halda (2003) and the revision of the *Verrucaria fuscella* group by Orange (2004a). Molecular studies have also yielded numerous taxonomic resolutions and new insight into the phylogeny of *Verrucariales* (Gueidan *et al*. 2007, 2009; Muggia *et al*. 2009; Navarro-Rosinés *et al*. 2007; Savić & Tibell 2008). Due to these reasons the genus *Verrucaria* has been in urgent need of taxonomic revision in Poland and other countries. Although the knowledge of the genus in Poland was extensive and organised, several taxonomic and nomenclatural problems still remained to be resolved. The present treatment was initiated as such a revision of the Polish collections and resulted in many new discoveries both of regional and more general, including taxonomic, importance.

Systematic background

The first attempt to classify the genera of Verrucariaceae was made by Eschweiler (1824), who created two 'cohors' Verrucariae and Dermatocarpeae, based mainly on the structure of the thallus. He placed the pyrenocarpous crustose taxa into the Verrucariae and the foliose and squamulose ones, into the Dermatocarpeae. Unfortunately, Eschweiler (1824) classified also many non-related genera within these two groups. Zenker (1827)

validated the family Verrucariaceae (called Verrucariae at the time), in which he included the genus *Verrucaria* together with the genera *Antrocarpon*, *Ocellularia*, *Porophora* and *Stigmatidium*. He separated the squamulose and foliose taxa within the family Endocarpa.

The most extensive regional treatment was compiled by Zschacke (1933, 1934) which covered the families Verrucariaceae and Dermatocarpaceae in Central Europe. This work comprehensively dealt with the systematics and morphology of the species. Morphological characters, such as the presence or absence of paraphyses, spore septation, and the presence or absence of algae in the hymenium, were used to define genera within the family Verrucariaceae. Thirteen genera were accepted within the family: *Geisleria*, *Gongylia*, *Henrica*, *Microglaena*, *Paraphysothele*, *Polyblastia*, *Sarcopyrenia*, *Staurothele*, *Thelenidia*, *Thelidium*, *Thrombium*, *Trimmatothele* and *Verrucaria*.

Servít investigated the Verrucariaceae in the late 1940s and in 1950s (Servít 1946, 1948, 1949, 1950, 1951, 1954). Following Zschacke (1933, 1934) he retained the separation of the family Dermatocarpaceae but recognized three additional families: Microglaenaceae with persistent paraphyses, Bagliettoaceae with a radiatingly splitting involucrellum, and Staurothelaceae with algae in the hymenium (Servít 1955). Servít (1954) distinguished seven genera within Verrucariaceae: three genera without an involucrellum – *Amphoridium* with simple spores, *Thelidium* with transversely-septate spores and *Amphoroblastia* with muriform spores, and four genera with the involucrellum present – *Verrucaria* with simple, globose to ellipsoid spores, *Sarcopyrenia* with simple, narrow spores that are expanded at the apices, *Involucrothele* with transverse-septate spores, and *Polyblastia* with muriform spores.

The phylogenetic value of the generic characters used by Zschacke and Servít was later questioned (Poelt & Hinteregger 1993; Halda 2003). Recent molecular phylogenetic studies have revealed that the four most species-rich genera of this family (*Verrucaria*, *Staurothele*, *Thelidium* and *Polyblastia*) are polyphyletic (Gueiden *et al*. 2007, 2009; Savić *et al.* 2008) and that the genus *Verrucaria* was defined using sympleisiomorphic characters (such as a crustose thallus and simple ascospores). It was clear that the elucidation of the taxonomy of the family was virtually impossible without broad and comprehensive molecular phylogenetic studies. Recent such have distinguished some new monophyletic genera, including *Atla* from *Polyblastia* (Savić & Tibell 2008), and *Hydropunctaria*, *Parabagliettoa* and *Wahlenbergiella* from *Verrucaria* (Gueiden *et al*. 2009).

Nearly all genera belonging to the order Verrucariales are at present included in the family Verrucariaceae (Eriksson 2006). The family Verrucariaceae Zenker includes *ca* 50 genera and about 800 species (Hawksworth *et al*. 1995; Eriksson 2006; Savić & Tibell 2008; Gueidan *et al*. 2009). In Poland this family comprises *ca* 200 species within 18 genera (Fałtynowicz 2003).

Although their vegetative forms are quite variable, the members of *Verrucariaceae* are easy to recognize by their ascomata. These are perithecial, with an apical ostiole, with periphyses and periphysoids lining the upper part of the perithecial cavity and projecting downwards, but not or scarcely reaching the asci. The lack of interascal filaments, at least at maturity and the bitunicate asci are also typical of this family (Janex-Favre 1970, 1975; Henssen & Jahns 1974; Grube 1999).

Species of *Verrucariaceae* grow mainly on rocks, either epilithically or endolithically within the superficial layer of the rock. They can also colonize other types of substrates: soils (Orange 1991), wood or bark (Breuss 1994, 1998a), mosses (Döbbeler 1997), leaves (McCarthy 2010) or other lichens (Zehetleitner 1978, Orange 2004a; Navarro-Rosinés *et al*. 2007). Saxicolous species of this family grow mostly in dry environments, but some species are also found in aquatic, freshwater or marine habitats (Harada 1996a, b, 2000; Keller 1996, 2000; Thüs 2002; Krzewicka & Galas 2006). Although saxicolous members of *Verrucariaceae* are particularly diverse on calcareous substrates, they can also colonize siliceous rocks, especially in aquatic or semi-aquatic conditions. Members of this family are found worldwide, from polar regions to the tropics (Feuerer 2011).

Materials and methods

MATERIAL

The study is based on collections from Poland referable to *Verrucaria* s.l. and housed in the following herbaria: BDPA (currently the collection is included in KRAM), BILAS, KRAM, KTC, LBL, LOD, OLTC, POZ, UPS, TRN, UGDA, WA, WRSL, and (acronyms following Mirek *et al*. 1997): GPN, KRAP and Herb. G. Leśniański (Opole). It is worth noting that the largest collection originates from KRAM (*ca* 1350 specimens) and was mostly gathered by J. Nowak from the Carpathians. The material studied also includes the author's own collection, mainly from the Tatra Mts. Type and exsiccatae collections have been examined from B, BM, G, GFW, GZU, H, HBG, KRAM, L, M, NMW, PRM, S, TO, TUR, UPS, W, WRSL, ZT. Acronyms of the herbaria are according to Index Herbariorum, unless stated otherwise. Only selected collections from the total of *ca* 1700 specimens examined are listed in the paper. The type collections studied by the author are marked by '!' in the text.

METHODS

Observations and measurements were made using a Nikon SZM-645 dissecting microscope and a Nikon Eclipse E200 microscope. For light microscopy, free-hand sections were made with a razor blade and mounted in water. The microscopic preparations of calcicolous endolithic species were first treated with HCl solution (10%) for half an hour to dissolve all limestone. The sections of thalli were observed in water or 10% KOH (K) and sometimes in lactophenol cotton blue. Measurements were made in 10% KOH. The reaction of the hymenium with Lugol's iodine solution before (I) or after (K/I) treatment with 10% KOH was tested twice and assessed with the final reaction. The reaction is strongly dependent on the concentration of iodine: at very low concentrations the hymenial gel is I+ red or I+ blue, but I+ red at higher concentrations; K/I reactions are + blue (very rarely + red).

Genera and species are arranged in alphabetical order. The main synonyms, description, notes on the habitat and the documented occurrence in Poland are given for each species. Descriptions and taxonomic discussions of species are based on the material examined in this study.

Localities of species are coded according to the ATPOL grid square system (Zając 1978) and with the application of the Gnomon program or the ATPOL-calculator (http://www.grzyby.pl/cgi-local/atpol-calculator.cgi). The geographical division into macro- and mesoregions follows Kondracki (1998).

Abbreviations of authors' names and journals are according to The International Plant Name Index (http://www.ipni.org/index.html), and names of exsiccatae collections follow Botanische Staatssammlung München Index of Exsiccatae (http://indexs.botanischestaatssammlung.de/).

Lists of synonyms include only names that have been used in Poland (i.e., quoted in literature or used on herbarium labels).

NOTEWORTHY FEATURES – GLOSSARY

PROTHALLUS. A thin, alga-free zone of fungal hyphae bordering the alga-containing part of the thallus. Usually of different colour than the thallus itself, often fimbriate, blackish or pinkish white, sometimes absent or indistinct.

THALLUS. *Endolithic* – the thallus grows inside the upper rock layers, both symbiotic partners, algal cells and fungal hyphae, penetrate the rocks, ascomata often develop inside the upper layer of the substrate. *Superficial* – the thallus grows on the surface of rocks, it is more or less separate from the substrate and only single hyphae penetrate the rocks but never algal cells, ascomata develop inside the thallus or on its surface. *Subgelatinous* – a smooth thallus composed of cells tightly attached to each other without air spaces between them, the texture is like a hard jelly rather than crumbly; consistency of the thallus solid and stiff when dry but more or less like a solid jelly when wet, the upper part and margin becoming transparent. *Non-gelatinous* – cells not in regular columns, small spaces often present between cells, consistency of the thallus more or less the same whether dry or wet, colour of the thallus changed and more intense when wet. *Goniocyst*(*s*) – a small (*ca* 12–40 μm in diam.) aggregation of photobiont cells surrounded by short-celled hyphae (monolayered paraplectenchyma), forming a discrete ± globular structure (minute granular thalli).

UPPER CORTEX. *Absent* – the upper cortex is considered as absent when no layer of fungal hyphae can be observed above the algal layer or when some fungal hyphae are present, forming a thin,

irregularly developed and prosoplectenchymatous net surrounding clusters of algae but not differentiating into a cortex. *Pseudocortex* – a poorly differentiated type of the cortex, thin, usually less than 30 µm high, weakly delimited from the algal layer, paraplectenchymatous, formed by cells of (2–)4–8(–9.5) µm in diam. The uppermost layers of cortical cells generally pigmented (usually brown). An epinecral layer is often present. This type of the cortex is also observed in some endolithic species in which it is formed by a thin prosoplectenchyma intermingled with microcrystals, sometimes with one layer of pigmented cells at the top. *Eucortex* – a well-differentiated cortex, clearly delimited from the algal layer, without any algal cells, paraplectenchymatous to scleroplectenchymatous, usually over 30 µm high. The uppermost layers of cortical cells generally pigmented (usually brown). An epinecral layer is often present. *Lithocortex* – occurs in some endolithic species, the upper cortex is about 30 µm` thick, densely prosoplectenchymatous, and formed by conglutinated hyphae intermingled with microcrystals dissolving in hydrochloric acid (calcium carbonate). The top cortical layers of some species can contain amorphous pigments.

MEDULLA. *Paraplectenchymatous* tissue – a tissue comprised of hyphal cells which are more or less isodiametric. The hyphae are very typically tightly packed and densely coherent. *Prosoplectenchymatous* tissue – hyphal cells with an elongated lumina; they may be oriented in one direction, or lack a distinct orientation; in Verrucariaceae there are typically intercellular spaces. *Black basal layer* – alga-free tissue of compact fungal cells with brownish-black cell walls in the basal part of the thallus. *Macrospheroids* (oil cells) – individual cells of hyphae (spherical and wider than other hyphal cells) that produce and store oils, often present in the lower layers of endolithic thalli.

INVOLUCRELLUM. Darkly pigmented protective tissues associated with the exciple, varying from a ring around the ostiole, to a conical structure reaching to the base-level of the excipulum; sometimes fused with the excipulum and then only recognizable by an abrupt thickening of the perithecial wall.

HAMATHECIUM. All filamentous tissues occurring between the asci or projecting into the cavity of ascomata. *Periphyses* – short unbranched filaments located in the ostiolar canal and directed upwards. *Periphysoids* – simple or slightly branched hyphae hanging downwards from the upper part of the perithecial cavity, but not reaching to the base.

ASCI. *Bitunicate* asci have two functional wall layers. In fissitunicate asci, the outer wall (exoascus) is not expandible and opens apically; the inner wall (endoascus) is highly expandible and elongates substantially towards the hymenial surface prior to spore release. The *Verrucaria*-type of ascus is fissitunicate, clavate, an ocular chamber is usually present, the ascus apex does not show a reaction with Lugol's solution, and dehiscence is by extrusion of an endotunica to form a delicate rostrum.

CONIDIOMATA. *Staurothele*-type – a pycnidium characterized by a single (rarely semi-plural) cavity enclosed by more or less elongated hyphae. *Dermatocarpon*-type – a pycnidium characterized by a multilocular cavity and a wall composed of almost isodiametric cells.

The terminology used in the descriptions and the explanations above follow: in case of thallus Nash (2008); cortex, Gueiden *et al*. (2007); medulla, Thüs and Schultz (2008); hamathecium, Orange (2008); conidiomata, Harada (1993).

RESULTS

Seven genera currently separated within *Verrucaria* s.l. occur in Poland: *Bagliettoa* (4 species), *Hydropunctaria* (3), *Parabagliettoa* (3), *Placopyrenium* (3), *Verrucaria* (43), *Verrucula* (4) and *Verruculopsis* (2). A total of 62 species recognized from the study area are presented here: *Bagliettoa* – *B. baldensis* (A. Massal.) Vězda, *B. calciseda* (DC.) Gueidan & Cl. Roux, *B. marmorea* (Scop.) Gueidan & Cl. Roux, *B. parmigerella* (Zahlbr.) Vězda & Poelt; *Hydropunctaria* – *H. maura* (Wahlenb.) Keller, Gueidan & Thüs, *H. rheitrophila* (Zschacke) Keller, Gueidan & Thüs, *H. scabra*

(Vězda) Keller, Gueidan & Thüs; *Parabagliettoa* – *P. cyanea* (A. Massal.) Gueidan & Cl. Roux, *P. disjuncta* (Arnold) Krzewicka, *P. dufourii* (DC.) Gueidan & Cl. Roux; *Placopyrenium* – *P. canellum* (Nyl.) Gueidan & Cl. Roux, *P. fuscellum* (Turner) Gueidan & Cl. Roux, *P. trachyticum* (Hazsl.) Breuss; *Verrucaria* – *V. acrotella* auct., *V. amylacea* Hepp, *V. andesiatica* Servít, *V. aquatilis* Mudd, *V. bryoctona* (Th. Fr.) Orange, *V. caerulea* DC., *V. cataleptoides* (Nyl.) Nyl., *V. cernaensis* Zschacke, *V. cincta* Hepp, *V. denudata* Zschacke, *V. dolosa* Hepp, *V. elaeina* Borrer, *V. elaeomelaena* (A. Massal.) Arnold, *V. funckii* (Spreng.) Zahlbr., *V. hochstetteri* Fr., *V. latebrosa* Körb., *V. macrostoma* DC., *V. maculiformis* Kremp., *V. madida* Orange, *V. margacea* (Wahlenb.) Wahlenb., *V. muralis* Ach., *V. myriocarpa* Hepp, *V. nigrescens* Pers., *V. nigroumbrina* (A. Massal.) Servít, *V. obfuscans* (Nyl.) Nyl., *V. ochrostoma* Borrer, *V. pachyderma* (Arnold) Arnold, *V. pinguicula* A. Massal., *V. policensis* Servít, *V. polonica* J. Nowak, *V. polysticta* Borrer, *V. praetermissa* (Trevisan) Anzi, *V. procopii* Servít, *V. sphaerospora* Anzi, *V. sublobulata* Servít, *V. submauroides* auct., *V. submersella* Servít, *V. tectorum* (A. Massal.) Körb., *V. tristis* (A. Massal.) Kremp., *V. umbrinula* Nyl., *V. viridicans* Servít, *V. viridula* (Schrad.) Ach., *V. xyloxena* Norman; *Verrucula* – *V. elegantaria* (Zehetl.) Nav.-Ros. & Cl. Roux, *V. helvetica* (B. de Lesd.) Nav.-Ros. & Cl. Roux, *V. polycarparia* Nav.-Ros. & Cl. Roux, *V. protearia* (Zehetl.) Nav.-Ros. & Cl. Roux; and *Verruculopsis* – *V. lecideoides* (A. Massal.) Gueidan & Cl. Roux, *V. minutum* (Hepp) Krzewicka. The morphology and anatomy as well as habitat and documented distribution of all treated species are discussed.

Twenty five species are excluded from the study because they were mistakenly reported or not confirmed for the country: *Bagliettoa limborioides* A. Massal., *Verrucaria apomelaena* (A. Massal.) Hepp, *V. barranderi* Servít, *V. beltraminiana* (A. Massal.) Trevis., *V. buellioides* Servít, *V. crassiuscula* Servít, *V. erichsenii* Zschacke, *V. fatrana* Servít, *V. funckiana* Servít, *V. fusconigrescens* Nyl., *V. glaucovirens* Grumm. *V. halizoa* Leight., *V. infidula* Zschacke, *V. infumata* Nyl., *V. körberi* Hepp, *V. longicollis* (Eitner) Zahlbr., *V. maculata* Zschacke, *V. mortarii* Lamy, *V. obnigrescens* Nyl., *V. podzimeki* Servít, *V. praesudetica* Zschacke, *V. pulicaris* A. Massal., *V. pulvinata* Eitner, *V. pustulifera* Servít, *V. tapetica* Körb.

Key to the genera

1. Involucrellum present **2**
1*. Involucrellum absent **7**
2. Thallus with carbonized punctae and/or columns in section; upper surface of involucrellum uneven, rough . . . . . ***Hydropunctaria***
2*. Thallus without carbonized punctae and/or columns in section; upper surface of involucrellum ± smooth **3**
3. Involucrellum with star-shaped aperture; perithecia completely immersed, thallus calcicolous endolithic, macrospheroids always present . . . . . ***Bagliettoa***
3*. Involucrellum without a star-shaped aperture . . . **4**
4. Thallus hyphae K/I– . . . . . ***Verrucaria***
4*. Thallus hyphae K/I+ violet-blue or pinkish violet **5**
5. Thallus endolithic, uncracked, perithecia superficial or half immersed, macrospheroids never present . . . . . ***Parabagliettoa***
5*. Thallus ± superficial, ± cracked into areoles, perithecia half to three-quarters immersed in the thallus, macrospheroids sometimes present **6**
6. Macrospheroids present, thallus hyphae K/I+ violet-blue . . . . . ***Verrucaria polonica***
6*. Macrospheroids absent, thallus hyphae K/I+ pinkish violet . . . . . ***Verrucaria amylacea***
7. Thallus growing on soil, mosses or soil-impregnated wood **8**
7*. Thallus growing on rocks or other lichens **9**
8. Ascospores narrowly ellipsoid 19–25 × 6–7 µm, with small gelatinous appendages, thallus without pigment . . . . . ***Verrucaria bryoctona***
8*. Ascospores ellipsoid 15–21 × 5–7 µm, without appendages, thallus with brown pigment . . . . . ***Verrucaria xyloxena***
9. Thallus superficial, areolate to placodioid or subsquamulose, areoles black-bordered and narrower at the base, upper surface marked by dark lines, medulla in lower part often dark brown to black . . . . . ***Placopyrenium*** (see also *Verrucaria polysticta*)
9*. Thallus immersed or superficial, areolate or not, never placodioid or subsquamulose, areoles if present without black sides and never narrower at the base, medulla often whitish **10**

10. Thallus immersed . . . . . ***Verrucaria*** (see also *Bagliettoa calciseda*)
10*. Thallus superficial, regular-areolate or cracked-areolate **11**
11. Perithecia between areoles or at the margin of the thallus . . . . . ***Verruculopsis***
11*. Perithecia within areoles, never between **12**
12. Thallus growing as a parasite on the species of *Caloplaca* or *Xanthoria* . . . . . ***Verrucula***
12*. Thallus growing on different substrate . . . . . ***Verrucaria***

KEY TO THE PARASITIC SPECIES

1. Parasitic on lichens containing anthraquinones (e.g. *Caloplaca*, *Xanthoria*) **2**
1*. Parasitic on lichens without anthraquinones (e.g. *Aspicilia*, *Verrucaria*) **5**
2. Medulla K/I+ dark blue, ascospores 14–18 × 6–8 µm, parasitic on *Caloplaca cirrochroa* . . . . . ***Verrucula helvetica***
2*. Medulla K/I– **3**
3. Parasitic on *Xanthoria elegans*, ascospores 12–14 × 6–7 µm . . . . . ***Verrucula elegantaria***
3*. Parasitic on *Caloplaca* spp. **4**
4. Parasitic on *Caloplaca proteus*, ascospores 15–20 × 6–8.5 µm . . . . . ***Verrucula protearia***
4*. Parasitic on *Caloplaca polycarpa*, ascospores 12.5–16 × 5–6(–7.5) µm . . . . . ***Verrucula polycarparia***
5. Ascospores 20–23 × 6–7 µm, initially parasitic on *Aspicilia calcarea* . . . . . ***Placopyrenium canellum***
5*. Ascospores <20 µm long **6**
6. Perithecia arising within photosynthetic units on the thallus surface, in surface view not connected by dark lines, prothallus absent, ascospores 12–15 × 5.5–7 µm . . . . . ***Placopyrenium fuscellum***
6*. Perithecia arising between photosynthetic units on the thallus surface, in surface view often connected by dark lines, prothallus often apparent, ascospores (11–)12–14 × 5.5–7 µm . . . ***Verrucaria polysticta***

THE GENUS *BAGLIETTOA*

The genus *Bagliettoa* was described by Massalongo (1853) to differentiate the calcicolous endolithic taxa with immersed perithecia with a black, disc-shaped and radiately splitting (star-like cracking) involucrellum. *Bagliettoa limborioides* A. Massal. (genero-type) is characterized by non-septate ascospores, reaching up to 18.5–24 × 9 µm, and by the presence of a colourless excipulum. Zschacke (1934) transferred the species known at that time to two other genera: *Thrombium* [e.g. *T. limborioides* (A. Massal.) Zschacke] and *Verrucaria* [e.g. *B. sphinctrina* Körb. was included in the synonymy of *V. steineri* Kušan]. In 1939 Servít placed 15 calcicolous species with a radiately splitting involucrellum and having macrospheroids (oil cells) present in the medulla, in the *Verrucaria sphinctrina* group. Later the same author established a new family, *Bagliettoaceae* (Servít 1955), based on the form of the involucrellum and including two genera: *Bagliettoa* A. Massal. *emend.* Servít (transversely and longitudinally septate spores) and a newly described genus *Protobagliettoa* Servít (non-septate spores). The majority of taxa belonging to the *V. sphinctrina* group were moved to *Protobagliettoa*. Poelt and Vězda (1981) revised taxa with a radiately splitting involucrellum, and they subsequently reduced *Protobagliettoa* into the synonymy of *Bagliettoa*. The authors accepted seven species – *B. baldensis* (A. Massal.) Vězda, *B. cazzae* Zahlbr., *B. parmigera* J. Steiner, *B. parmigerella* (Zahlbr.) Vězda & Poelt, *B. quarnerica* (Zahlbr.) Vězda, *B. steineri* (Kušan) Vězda and *B. sphinctrina* (Duf.) Körb. Recently the taxa of *Bagliettoa* have been studied by Halda (2003), who subsumed them under the genus *Verrucaria* into the *Bagliettoa* section (sensu Massalongo) and reduced the number of accepted species to the four: *V. baldensis* A. Massal., *V. limborioides* (A. Massal.) Clauzade & Cl. Roux, *V. marmorea* (Scop.) Arnold, and *V. parmigerella* Zahlbr. However, recent molecular investigations confirmed the distinctiveness and monophyly of *Bagliettoa* at generic level (Gueidan *et al*. 2007, 2009), and showed that is also contains species without a splitting involucrellum, such as *Verrucaria calciseda* (Gueidan *et al*. 2009). Consequently, the genus is morphologically defined on a combination of characters, including an endolithic thallus with a lithocortex and sometimes with macrospheroids, and immersed ascomata, sometimes with a splitting involucrellum. The most recently incorporated species is *B. operculata* (P. M. McCarthy) P. M. McCarthy (McCarthy 2008).

Bagliettoa A. Massal.

Mem. Lichenogr.: 146. 1853. – TYPE SPECIES: *Bagliettoa limborioides* A. Massal., Mem. Lichenogr.: 146. 1853.

Prothallus absent or brown-black to black, in contiguous conspecific thalli visible as thin dark lines. *Thallus* calcicolous, endolithic. *Upper cortex* differentiated into a lithocortex, densely prosoplectenchymatous, up to 30 μm and formed by conglutinated hyphae intermingled with microcrystals. *Algal* layer discontinuous, 50–120 μm high, photobiont cells in clusters, 25–40 μm in diam., rounded, scattered, cells 6–12 μm. *Medulla* prosoplectenchymatous, often with oil cells (macrospheroids) in the lower part, macrospheroids laterally or terminally branching and often with a basal swelling. *Perithecia* completely immersed in thallus. *Involucrellum* when present black, disc-shaped, first whole, later often with radial cracks. *Excipulum* colourless to brownish when mature. *Hymenium* colourless, K/I+ blue. *Hamathecium* formed by periphyses located in the ostiolar canal and short periphysoids located in the half upper part of the perithecial cavity. *Asci* 8-spored, clavate, oblong or cylindrical, two-layered, fissitunicate. *Ascospores* simple, often absent or deformed. *Conidiomata* very rare, immersed, globose, with external wall dark brown and internal wall colourless, conidia bacilliform.

NOTE. *Bagliettoa* is characterized by the calcicolous habitat and by the presence of an endolithic thallus with a lithocortex, and oil cells (macrospheroids) in the lower part of the medulla as well as by completely immersed perithecia, and a star-like cracking involucrellum (with exception of *B. calciseda*, which has infrequent macrospheroids, lacks an involucrellum but in mature stage the excipulum is star-shaped in upper part). Based on molecular data, *Bagliettoa* is the sister group to the newly described genus *Parabagliettoa* (Gueidan *et al*. 2009). However, the latter differs by sessile or semi-sessile perithecia, the presence of a pseudocortex and the absence of macrospheroids. *Verrucaria hochstetteri* is similar to *Bagliettoa* calciseda in its endolithic thallus and lack of involucrellum, but differs by larger ascospores (29–36 × 15–20 μm) and absence of macrospheroids. Molecular data suggest it is closer to *Thelidium* than to *Bagliettoa* (Gueidan *et al*. 2009).

HABITAT. On calcareous rock or mortar, mostly exposed to the sun, in slightly to moderately eutrophic environments. The species are calcicolous (entirely, strongly or moderately calcicolous), basiphilous, mesophilous or xerophilous, photophilous or heliophilous, from slightly nitrophilous to moderately nitrophilous (Gueidan & Roux 2007).

REMARKS. Gueidan *et al*. (2009) included specimens representing seven taxa of the genus into her analyses: *Bagliettoa baldensis*, *B. calciseda*, *B. cazzae*, *B. marmorea*, *B. parmigera*, *B. parmigerella* and *B. steineri*. However, according to a previous taxonomic revision of sect. *Bagliettoa*, the names *V. parmigera* and *V. steineri* were included as synonyms of *V. baldensis* (Halda 2003). For this reason, although the genus *Bagliettoa* is treated as separate from *Verrucaria* following Gueidan *et al*. (2009), the names *V. parmigera* and *V. steineri* are included into the synonyms of *B. baldensis* in this study following Halda (2003).

KEY TO THE SPECIES OF *BAGLIETTOA*

1. Involucrellum present, disc-shaped, often with radial cracks, excipulum colourless or brownish, exceptionally black **2**
1*. Involucrellum absent, excipulum dark brown to black, when mature star-shaped in the upper part **5**
2. Thallus purple, pink or red tint (red crystals in the cortical layer); involucrellum 100–300 μm in diam. and 30–40 μm thick, ascospores 18–30 × 9–15 μm . . . . . ***Bagliettoa marmorea***
2*. Thallus otherwise, not purple or red **3**
3. Thallus dark green, blue green or blue grey (blue green crystals in the cortical layer), involucrellum 100–150 μm in diam., ascospores 20–28 × 9–15 μm, radial cracks weakly visible . . . . . ***Bagliettoa parmigerella***
3*. Thallus white or ochre, involucrellum wider and ± thicker, radial cracks easily visible **4**
4. Involucrellum 200–300 μm in diam., thallus white, often bordered by a black line of the prothallus, ascospores 18–28 × 8–12 μm. . . . . ***Bagliettoa baldensis***

4*. Involucrellum 350–450(–500) μm in diam. thallus ochre, not bordered by a black line of the prothallus, ascospores 17–35 × 10–13 μm . . . . . ***Bagliettoa limborioides***

5. Perithecia 150–300 μm wide, macrospheroids sometimes present, ascospores 19–27 × 8–13 μm . . . . . ***Bagliettoa calciseda***

5*. Perithecia 400–800 μm wide, macrospheroids absent, ascospores (25–)30–32(–40) × 15–20(–23) μm . . . . . ***Verrucaria hochstetteri***

Bagliettoa baldensis (A. Massal.) Vězda

Fig. 1

in Poelt & Vězda, Biblioth. Lichenol. **16**: 363. 1981. – *Verrucaria baldensis* A. Massal., Ric. Auton. Lich. Crost.: 173, Fig. 349. 1852. TYPE: [Italy] M. Baldo (Mad. Corona), *A. Massalongo* (VER – LECTOTYPE, designated by Halda 2003). – *Protobagliettoa baldensis* (A. Massal) Servít *ex* J. Nowak & Tobol., Porosty Polskie: 1118. 1975.

Limboria sphinctrina Duf., Fr. Lich. Eur. Ref.: 465. 1831. TYPE: [Germany] Mittenwald in Bayern, *A. Krempelhuber* (hb. ?). – *Bagliettoa sphinctrina* (Duf.) Körb., Syst. Lich. Germ: 375. 1855.

Verrucaria bagliettoaeformis var. *istriana* Servít, Beih. Bot. Cbl. **59**: 157. 1939. TYPE: [Croatia] Istria, Pola, Pt. Christo, *J. Hruby* (PRM – HOLOTYPE). – *Protobagliettoa bagliettoaeformis* var. *istriana* (Servít) Servít *ex* J. Nowak & Tobol., Porosty Polskie: 1118. 1975.

Verrucaria calciseda var. *lactea* Arnold, Verh. Zool.-Bot. Ges. Wien **20**: 463. 1870. TYPE: [Germany] Bavaria, inter Wasserzell et Eichstätt, 1866, *F. Arnold* (M – LECTOTYPE, designated by Halda 2003). – *Protobagliettoa lactea* (Arnold) Servít, Rozp. Čs. Akad. Věd 65(3): 35. 1955.

Verrucaria gyelnikii Servít, Beih. Bot. Cbl. **59**: 126. 1939. TYPE: Hungaria, Zala, Tihany, Akasztóhegy, 150–200 m, *V. Gyelnik* (BP – HOLOTYPE). – *Protobagliettoa gyelnikii* (Servít) Servít *ex* J. Nowak & Tobol., Porosty Polskie: 1118. 1975.

Verrucaria gyelnikii f. *obscurata* Servít, Beih. Bot. Cbl. **59**: 126. 1939. TYPE: [Czech Republic] Moravia, Brno, Hády, 450 m, *J. Suza* (PRM – HOLOTYPE). – *Protobagliettoa obscurata* (Servít) Servít, Rozp. Čs. Akad. Věd **65**(3): 35. 1955.

Verrucaria parmigera J. Steiner, Verh. Zool.-Bot. Ges. Wien **61**: 34. 1911. TYPE: In Belgia ad Spa. *Nylander* (PRM-758127! – LECTOTYPE, designated by Halda 2003). – *Protobagliettoa parmigera* (J. Steiner) Servít, Rozp. Čs. Akad. Věd **65**(3): 31. 1955. – *Bagliettoa parmigera* (J. Steiner) Vězda & Poelt *in* Poelt & Vězda, Biblioth. Lichenol. **16**: 363. 1981.

Verrucaria parmigera var. *bohemica* Servít, Beih. Bot. Cbl. **59**: 143. 1939. TYPE: [Czech Republic] Bohemia, Beroun, Sv. Jan, 400 m, *M. Servít* (PRM – HOLOTYPE). – *Protobagliettoa parmigera* var. *bohemica* (Servít) J. Nowak & Tobol., Porosty Polskie: 1119. 1975.

Verrucaria steineri Kušan, Acta Bot. Inst. Bot. Univ. Zagreb **5**: 28. 1930. TYPE: [Croatia], Ins. Krk, Malinska, *F. Kušan* (hb. ?). – *Protobagliettoa steineri* (Kušan) Servít *ex* J. Nowak & Tobol., Porosty Polskie: 1119. 1975. – *Bagliettoa steineri* (Kušan) Vězda *in* Poelt & Vězda, Biblioth. Lichenol. **16**: 363. 1981.

Prothallus absent in case of single thalli or visible as thin brown-black to black lines separating contiguous conspecific thalli. *Thallus* endolithic, calcicolous, continuous, not cracked, white, grey-whitish, to greenish in shade, matt, sometimes with shallow pits left by dead ascomata. *Upper cortex* a lithocortex, not pigmented, 25–30 μm high, formed by loosely woven hyphae surrounded by crystals of calcium carbonate and by dead cells. *Algal* layer 50–120 μm high, discontinuous, algal cells forming clusters (25–40 μm in diam.) or not, clusters rounded, scattered, cells 6–12 μm. *Medulla* prosoplectenchymatous, 80–800 μm high, with macrospheroids in the lower part, cells cylindrical to oblong, 12–14 μm. *Perithecia* entirely immersed in the thallus, in well-defined pits in the rock, 300–400 μm wide, 220–300 μm high. *Involucrellum* disc-shaped, black, spreading sideways but scarcely downwards, 150–200(–300) μm in diam., and 20–25 μm thick, with 3–5 cracks radiating from the centre. *Excipulum* colourless to brownish when mature, 200–350(–400) μm wide, ± as wide as involucrellum. *Hamathecium* formed by periphyses located in the ostiolar canal, 20–36 × 1–1.5 μm and periphysoids located in the half upper part of the perithecial cavity, 29–50 × 2.5–4 μm. *Asci* clavate, oblong or cylindrical, 30–60 μm long, 5–15 μm wide, at the base narrowed, the widest in apical part with a thick tholus. *Ascospores* simple, very rarely present, 18–28 × 8–12 μm, oblong to ellipsoid. *Conidiomata* not observed.

NOTE. *Bagliettoa baldensis* is characterized by an endolithic, calcicolous thallus, immersed perithecia, a star-shaped aperture of the involu-

crellum and the lack of pigmented crystals in the upper cortex which are present in *B. marmorea* and *B. parmigerella*. *Bagliettoa calciseda* differs in the presence of an elongated, dark brown excipulum and the lack of involucrellum.

HABITAT. Very common on hard limestone, gravestones, rarely on mortar; growing in sunny and exposed places. Sometimes parasitized by *Opegrapha rupestris* and *Caloplaca polycarpa* subsp. *verrucariarum* (Gueidan & Roux 2007). Furthermore in Italy, Tretiach and Navarro-Rosinés (1996) observed the species *Sarcopyrenia sigmideospora* growing parasitically on thalli of *Verrucaria* gr. *parmigera*.

DISTRIBUTION IN POLAND. Occurs at scattered localities in the Wyżyna Śląsko-Krakowska upland and the Pieniny Mts. It has also been reported from a few localities in the Tatra Mts and the Góry Świętokrzyskie Mts. The occurrence of *B. baldensis* in Poland is associated with the presence of larger xerotermic areas of calcareous outcrops. Most recently it was found, however, also on isolated localities in northern Poland, e.g. in the Pojezierze Kaszubskie lakeland.

WORLD DISTRIBUTION. The species is widespread in Europe (Halda 2003), and it is also known from other continents, for instance North America (Breuss 2007b), Asia (Halda 2003), and Australia (McCarthy 2008).

REMARKS. Halda (2003) found that the colour of the excipulum varies in this species, and that the variation was related to the degree of maturity of the ascoma. Young perithecia with a colourless excipulum and mature perithecia with a darker excipulum were seen on the same individual. Therefore the colour of the excipulum cannot be treated as a good taxonomic feature in this genus. Reliance on this character resulted formerly in the description of many new species, which are now reduced to synonymy. Halda (2003) listed eleven species and 75 varieties and forms as synonyms of *Verrucaria baldensis*. In this study only the names that were recorded in the study area are considered and follow Halda (2003).

EXSICCATAE SEEN. Hepp, Flechten Eur. 428 (as *Verrucaria calciseda*) (GFW).

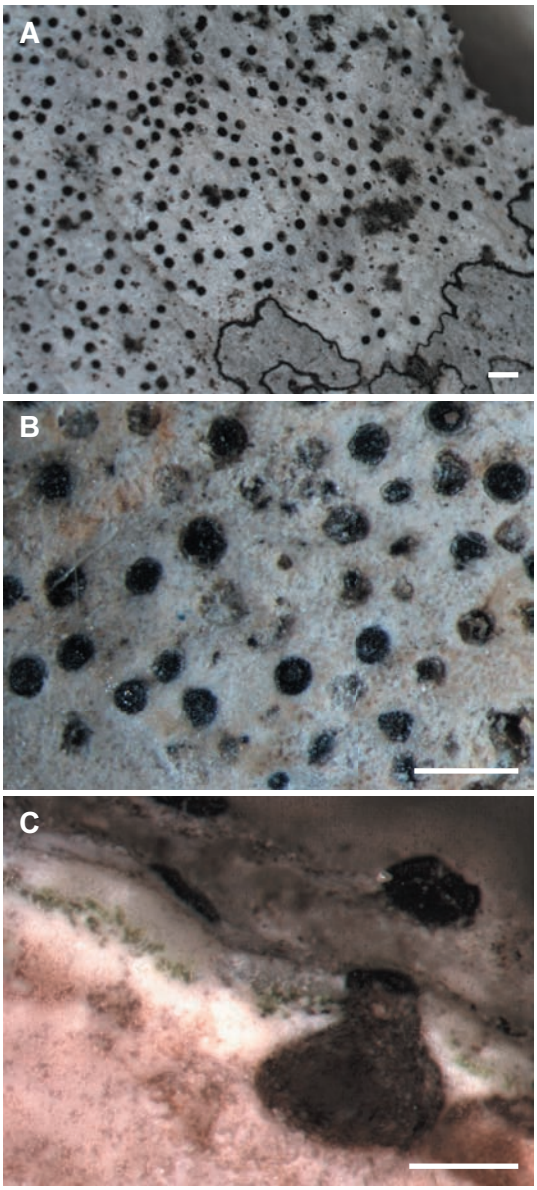

Fig. 1. *Bagliettoa baldensis* (A. Massal.) Vězda. A & B – thallus (A – *Nowak*, KRAM; B – *Nylander*, PRM as *Verrucaria parmigera* J. Steiner, lectotype); C – vertical section of thallus (*Nowak*, KRAM). Scale bars: A & B = 0.5 mm; C = 250 μm.

SPECIMENS EXAMINED. CB-16 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Kościerzyna, Modrowo forest, 15 July 1935, *F. Krawiec* (POZ), as *Verrucaria muralis*; DE-51 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND,

Wyżyna Wieluńska upland: Węże near Działoszyn, 30 May 1963, *J. Nowak* (KRAM); Góra Św. Genowefy near Bobrowniki, 23 June 1963, *J. Nowak* (KRAM); DE-52 – Zalesiaki near Działoszyn, 1 June 1963, *J. Nowak* (KRAM); DE-61 – Rębielice Królewskie, 3 June 1964, *J. Nowak* (KRAM); DE-73 – Kamyk near Kłobuck, 266 m and 270 m, 21 May 1964, *J. Nowak* (KRAM); DE-95 – Wyżyna Krakowsko-Częstochowska upland, Wyżyna Częstochowska upland: near Zawada, 10 June 1974, *J. Nowak* (KRAM); DE-96 – Złoty Potok, 26 May 1926, *J. Motyka* (LBL); DF-37 – Wyżyna Krakowsko-Częstochowska upland, Wyżyna Olkuska upland: Pazurek near Olkusz, 7 April 1956, *J. Nowak* (KRAM); DF-48 – Jerzmanowice, 17 July 1957, *J. Nowak* (KRAM); DF-48 – Ojców National Park, Ojców, 28 June 1955, *J. Nowak* (KRAM); Ojców, 9 April 1956, *K. Glanc* (KRAM); DF-58 – Ojców National Park, Skała Krzyżowa rock, 27 May 2005, *J. Kiszka* (KRAM); DF-68 – Wyżyna Krakowsko-Częstochowska upland, Rów Krzeszowicki depression: Nielepice near Rudawa, 9 Oct. 1971, *J. Nowak* (KRAM); and 330 m, 30 Sept. 1986, *J. Nowak* (KRAM); Dolina Brzoskwinki near Brzoskwinia, 12 Oct. 1971, *J. Nowak* (KRAM); Dolina Będkowska valley, 300 m, 23 Aug. 1957, *J. Nowak* (KRAM); Dolina Kobylańska valley, Kula rock, 30 m, 2 March 1995, *J. Nowak* (KRAM); DF-78 – Brama Krakowska gate: Podgórki Tynieckie, Skołczanka nature reserve, 9 April and 28 Aug. 1958, *J. Nowak* (KRAM); Tyniec, 240 m, 27 Aug. 1957, *J. Nowak* (KRAM); Podgórki Tynieckie 21 March 1955, *J. Nowak* (KRAM); DG-59 – Tatra Mts, Western Tatra Mts: Dolina Małej Łąki, 6 Aug. 1926, *J. Motyka* (LBL); Dolina Kościeliska valley, Wąwóz Kraków, 1600 m, 10 June 1963, *J. Nowak* (KRAM); on slope of Saturn, 1200 and 1500 m, 29 May 1959, *J. Nowak* (KRAM); Dolina Smytnia valle below Kominy Tylkowe, 1400 m, 12 June 1963, *J. Nowak* (KRAM); Rzędy Tomanowe, 1750 m, 13 June 1963, *J. Nowak* (KRAM); Dolina Strążyska, 28 July 1924, *J. Motyka* (LBL); EE-72 – Wyżyna Kielecko-Sandomierska upland, Góry Świętokrzyskie mts: Zakrucze near Małogoszcz, 7 May 1959, *J. Nowak* (KRAM); Miedzianka hill near Zajączków by Chęciny, 340 m, 6 Sept. 1976, *J. Nowak* (KRAM); EE-82 – Zakrucze near Małogoszcz by Chęciny, 7 May 1959, *J. Nowak* (KRAM); EE-83 – Góra Zelejowa nature reserve near Chęciny, 29 July 1951, *Sucharski* (LBL); EG-32 – Obniżenie Orawsko-Podhalańskie depression, Pieniny Mts: Czorsztyn, 1878, *A. Rehmann* (KRAM) as *Verrucaria rupestris*; EG-33 – Przełęcz Szopka pass, 12 Sept. 1959, *J. Nowak* (KRAM); Wąwóz Sobczański gorge, on calcareous rocks, 12 Sept. 1959, *J. Nowak* (KRAM); Sokolica Mt., 14 July 1987, *J. Rydzak* (LBL); Trzy Korony Mt., 1 Sept. 1926, *J. Motyka* (LBL); Zawiasy by Dunajec river near Krościenko, 460 m, 16 Sept. 1959, *J. Nowak* (KRAM); EG-50 – Tatra Mts, Western Tatra Mts: Kalacka Turnia by Dolina Kondratowa, 1350 m, 21 May 1959, *J. Nowak* (KRAM); FE-51 – Wyżyna Kielecko-Sandomierska upland, Pogórze Iłżeckie upland: Krzemionki, 1923 and 1926, *J. Motyka* (LBL).

Bagliettoa calciseda (DC.) Gueidan & Cl. Roux Fig. 2.

Bull. Soc. Linn. Provence **58**: 187. 2007. – *Verrucaria calciseda* DC. *in* Lamarck & de Candolle, Flore française, 3e éd., **2**: 317. 1805. Type: [Germany, Jura of Franconie] An Kalkfelsen gegenüber Kunstein [recent name: Konstein] bei Eichstätt, 3 Juni 1866, *Arnold* (Arnold, Lich. Exs. Lich. Jur. 311, ZT! – neotype, designated by Gueidan and Roux 2007). – *Verrucaria rupestris* var. *calciseda* (DC.) Schaer., Lich Helv. Spicil. **2**: 55. 1826. – *Amphoridium calcisedum* (DC.) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 32. 1954.

Verrucaria timkoii Servít, Stud. Bot. Čech. **9**(2–4): 108. 1948. Type: [Hungaria] Veszprém, Öskii, 200 m, 1926, *Timkó* (PRM-858073! – lectotype designated here). Synonymized here. – *Amphoridium timkoi* (Servít) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 36. 1954.

Prothallus absent. *Thallus* endolithic, calcicolous, continuous, white, whitish, grey-whitish, white-yellowish. *Upper cortex* a lithocortex, not pigmented, 75–145 μm high, formed by hyphae perpendicular to the surface of the thallus, hyphae loose and surrounded by crystals of calcium carbonate and by dead cells. *Algal* layer 35–100 μm high, cells 7.5–14.5 μm in diam. *Medulla* 400–1000 μm high, the hyphae obscured by abundant crystals from the substrate, dense in the upper part, less dense below, with sparse macrospheroids. *Perithecia* entirely immersed in the thallus and the rock, 150–300 μm wide, the thallus surrounding the perithecia often slightly prominent and with one or a few cracks radiating from the perithecium. *Involucrellum* absent. *Excipulum* black, surrounded by a thalline envelope denser than the thallus, ostiolar canal first very distinct and elongated, then becoming less distinct

and shorter at maturity. *Hamathecium* formed by periphyses located in the ostiolar canal and short periphysoids located in the half upper part of the perithecial cavity, periphyses 31–36 × 1–1.5 µm, periphysoids 29–40 × 2.5–4 µm. *Asci* 68–108 × 18–27 µm, fissitunicate, but with dehiscence occurring by gelification of ascus tip. *Ascospores* simple, with yellowish contents, 19–27 × 8–13 µm. *Conidiomata* very rare, immersed, globose, 200 µm wide, unicellular, with external wall dark brown and internal wall colourless, conidia reported as bacilliform, 4–5.5 × 1–1.5 µm, but not observed in the material examined.

NOTE. This species is characterized by an endolithic, calcicolous thallus, immersed perithecia that are surrounded by a somewhat raised and radially cracked area of thallus. It differs from other *Bagliettoa* species by the absence of the involucrellum and the presence of an excipulum dark throughout. *Verrucaria hochstetteri* is similar in the endolithic calcicolous habitat and the presence of a dark excipulum but differs by the larger perithecia (375–700 µm wide) and larger ascospores (24.5–)29–34(–41) × (14–)15–20(–24) µm.

HABITAT. At xerothermic localities on calcareous rocks exposed to the sun, in slightly to moderately eutrophic environments, in the association *Aspicilion calcareae* Alberson 1964 *emend*. Cl. Roux 1978. It occurs in the montane and more rarely subalpine belt. It is often parasitized by *Caloplaca polycarpa* (Gueidan & Roux 2007).

DISTRIBUTION IN POLAND. This species occurs in the Wyżyna Śląsko-Krakowska upland, and at scattered localities in the mountainous region in the Pieniny Mts, the Tatra Mts, and the Góry Świętokrzyskie Mts.

WORLD DISTRIBUTION. It is distributed throughout Europe, especially in the Mediterranean region and the xerothermic localities in temperate and boreal zones (Feuerer 2010).

REMARKS. The concept of this species was revised and stabilized by Gueidan and Roux (2007). These authors observed an I+ blue hymenium, changing to I+ reddish brown with an increase in the concentration of I. It was also often observed on specimens examined in this study. However, the type specimen (ZT) was I+ blue at low concentrations of iodine, and did not change colour

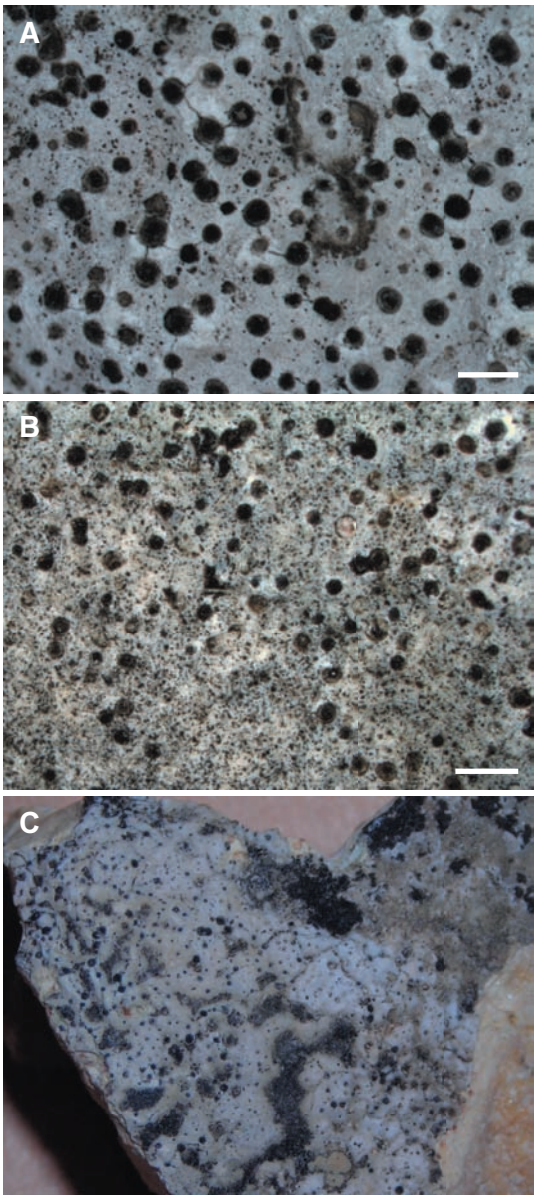

Fig. 2. *Bagliettoa calciseda* (DC.) Gueidan & Cl. Roux. A & B – thallus (A – *Nowak*, KRAM; B – *Arnold*, ZT, as *Verrucaria calciseda* DC., neotype); C – thallus (*Timkó*, PRM, as *Verrucaria timkoii* Servít, lectotype). Scale bars: A = 0.5 mm; B = 1 mm.

with increasing concentration. Additionally on the type material some small macrospheroids were observed, they are reported also by Clauzade and Roux (1985). Whereas according to Gueidan and Roux (2007) *B*. *calciseda* is characterized by lack of them.

Verrucaria timkoii is proposed here as a synonym of *B*. *calciseda*, as it agrees in the whitish endolithic thallus, radially cracked around the perithecium, and in the dark exciple without an involucrellum.

SPECIMENS EXAMINED. DE-41 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Jarzębie near Bobrowniki, 8 km W of Działoszyn, 190 m, 23 June 1964, *J. Nowak* (KRAM); DE-51 – Węże near Działoszyn, 30 May 1963, *J. Nowak* (KRAM); DE-52 – Zalesiako near Działoszyn, 230 m, 1 June 1963, *J. Nowak* (KRAM); DE-62 – Łabodno near Kłobuck, 220 m, 2 July 1964, *J. Nowak* (KRAM); DE-73 – Kamyk near Kłobuck, 270 m, Oct. 1962 and 21 May 1964, *J. Nowak* (KRAM); Biała near Kłobuck, 260 m, 21 May 1964, *J. Nowak* (KRAM); DE-74 – Jaskrów near Mstów, 250 m, 20 June 1964, *J. Nowak* (KRAM); DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Pieskowa Skała near Ojców, 2 May 1958, *J. Nowak* (KRAM); Ojców National Park, Górkowa rock near road to Jerzmanowice, 10 Oct. 2005, *J. Kiszka* (KRAM); Kołowrocie rock in Babie Doły gorge, 5 Oct. 2004, *J. Kiszka* (KRAM); rock boulder in Dolina Sąspowska valley, 18 Aug. 2004, *J. Kiszka* (KRAM); DF-58 – Ojców National Park, Wapiennik rock, 28 July 2005, *J. Kiszka* (KRAM); Okopy rock, 28 June 2005, *J. Kiszka* (KRAM); Wąwóz Korytania, Węże Skały rock, 18 Aug. 2005, *J. Kiszka* (KRAM); Skała Krzyżowa rock, 27 May 2005, *J. Kiszka* (KRAM); Bolechowice near Zabierzów, 370 m, 17 May 1957, *J. Nowak* (KRAM); DF-67 – GARB TENCZYŃSKI HUMMOCK: Brodła, Skały Gaudynowskie, 12 April 1970, *J. Diak* (KRAM); DF-68 – RÓW KRZESZOWICKI DEPRESSION: Kamyk near Nielepice, 320 m, 23 May 1957, *J. Nowak* (KRAM); Dolina Kobylańska valley, 380 m, 6 Aug. 1957, *J. Nowak* (KRAM); DF-78 – BRAMA KRAKOWSKA GATE: Piekary near Tyniec, 230 m, 27 March 1956, *J. Nowak* (KRAM); EE-72 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Zakrucze near Małogoszcz, 7 May 1959, *J. Nowak* (KRAM); EE-83 – Zalejowa Góra near Chęciny, 6 May 1959, *J. Nowak* (KRAM); Korzecko, by the way to Chęciny, 6 Oct. 1974, *K. Toborowicz* (KTC) as *Amphoridium timkoii*; EG-31 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, KOTLINA ORAWSKO-NOWOTARSKA: Skalice Nowotarskie, Kramnica, 15 Aug. 1998, *J. Kiszka* (KRAP); Obłazowa near Krempachy, 28 Sept. 1997, *J. Kiszka* (KRAP); EG-32 – PIENINY MTS: Biała Skała hill near Niedzica, 28 Aug. 1997, *J. Kiszka* (KRAM); Pieniny National Park, Cisowiec Mt. near Sromowce Wyżne, 2 Sept. 1998, *J. Kiszka* (KRAM) as *V. mastoidea*; Zielone Skałki rocks road near Falsztyn, 18 Aug. 1995, *J. Kiszka* (KRAM); Czorsztyn, 25 Sept. 2002, *J. Kiszka* (KRAM); EG-34 – Jaworki near Szczawnica, July 191, *W. Boberski* (KRAM); Wąwóz Homole, May 1891, *W. Boberski* (KRAM); Wąwóz Homole, 11 Sept. 1959, *J. Nowak* (KRAM); Małe Pieniny Mts, Biała Woda nature reserve by Jaworki, 25 Sept. 1998, and 2 June 1999, *J. Kiszka* (KRAM); Dolina Białej Wody, 1 km from Jaworki, 27 June 1971, *K. Wajdowska* (KRAM); FE-51 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, POGÓRZE IŁŻECKIE UPLAND: Krzemionki, 1924, *J. Motyka* (LBL).

Bagliettoa marmorea (Scop.) Gueidan & Cl. Roux Fig. 3

in Gueidan *et al*., Mycol. Res. **111**: 1157. 2007. – *Lichen marmoreus* Scop., Fl. Carniol. **2**: 367. 1772. TYPE: [Slovenia] montes Julijske Alpe, in declivibus vallis 'dolina Triglavskih jezer' supra Veliko jezera, secus viam, 1830 m, 23 June 2000, *J. Halda* & *Š. Haldová* (PRM-900619! – NEOTYPE, designated by Halda 2003). – *Verrucaria marmorea* (Scop.) Arnold, Verh. Zool. Bot. Ges. Wien **32**: 147. 1882. – *Amphoridium marmoreum* (Scop.) Baroni – Nuov. Giorn. Bot. Ital. **23**: 445. 1891.

Verrucaria hoffmanni Hepp, Flechten Eur. No. 431. 1857. TYPE: An Kalkfelsen der Lägern, *H[epp]*. (GFW! – ISOTYPE). Synonymized here.

Prothallus absent or brown black to black visible as thin dark lines separating conspecific thalli or a row of brown pycnidia. *Thallus* endolithic, calcicolous, continuous, not cracked, pale or dark purple with dark purple spots, matt. *Upper cortex* a lithocortex, purple, 20–40 µm thick, with red crystals, up to 1 µm diam. aggregated in clusters up to 30 µm in diam. *Algal* layer 100–150 µm high, discontinuous, clustered cells scattered, photobiont cells 10–13 µm diam. *Medulla* prosoplectenchymtous, with rare macrospheroids in the lower part, cells cylindrical to oblong, 9–15 µm wide. *Perithecia* 250–350 µm wide, entirely im-

mersed in well-defined pits in rocks, surrounded by a dark purple pigmented thallus. *Involucrellum* disc-shaped, black, up to 100–300 µm wide, 30–40 µm thick, slightly convex, spreading sideways but scarcely downwards, black, glossy with bent edge, when mature beaking up and forming a black ring. *Excipulum* colourless, later the upper part darker, 200–300 µm wide. *Hamathecium* formed by long periphyses located in the ostiolar canal and periphysoids located in the half upper part of the perithecial cavity, periphyses 20–30 × 1–1.5 µm, periphysoids 35–60 × 2.5–3 µm. *Asci* clavate, oblong to cylindrical, 30–60 µm long, 10–15 µm wide, at the base narrowed, the widest in apical part with a thick tholus. *Ascospores* simple, oblong to ellipsoid, 18–30 × 9–15 µm. *Conidiomata* present, pycnidia frequent, scattered or visible as thin dark lines, 60–100 µm wide, conidia rod-shaped, 3.3–4.5 × 0.8–1.2 µm.

NOTE. This species is characterized by the purple-coloured upper surface of the thallus, resulting from lareg red crystals in the upper cortex, by a thick black involucrellum 30–40 µm, reaching up to 100–300 µm in diam., and by a colourless excipulum. *Verrucaria rubrocincta* Breuss, from North America, also contains red pigment, but here it is mainly concentrated around the perithecia (Breuss 2000).

HABITAT. On calcareous rocks mainly in sunny places but occasionally some individuals in partial shade; often occurring with other species of the genus.

DISTRIBUTION IN POLAND. *Bagliettoa marmorea* is known from the Western Tatra Mts. It was recorded by Tobolewski (1957) at one locality in the Dolina Małej Łąki valley.

WORLD DISTRIBUTION. In Europe widespread in the Mediterranean region, it also occurs at xerothermic localities in temporate and boreal zones (Clauzade & Roux 1985; Halda 2003; Nimis & Martellos 2003).

REMARKS. *Verrucaria hoffmanni* is proposed here as a synonym of *B. marmorea*. The type material of *V. hoffmanni* (GFW) is characterized by a purple-coloured thallus with the red crystals in the upper cortex, a black involucrellum with a radially cracked aperture on mature perithecia, and spores reaching up to 23–32 × 9–15 µm. Therefore the two species are considered conspecific.

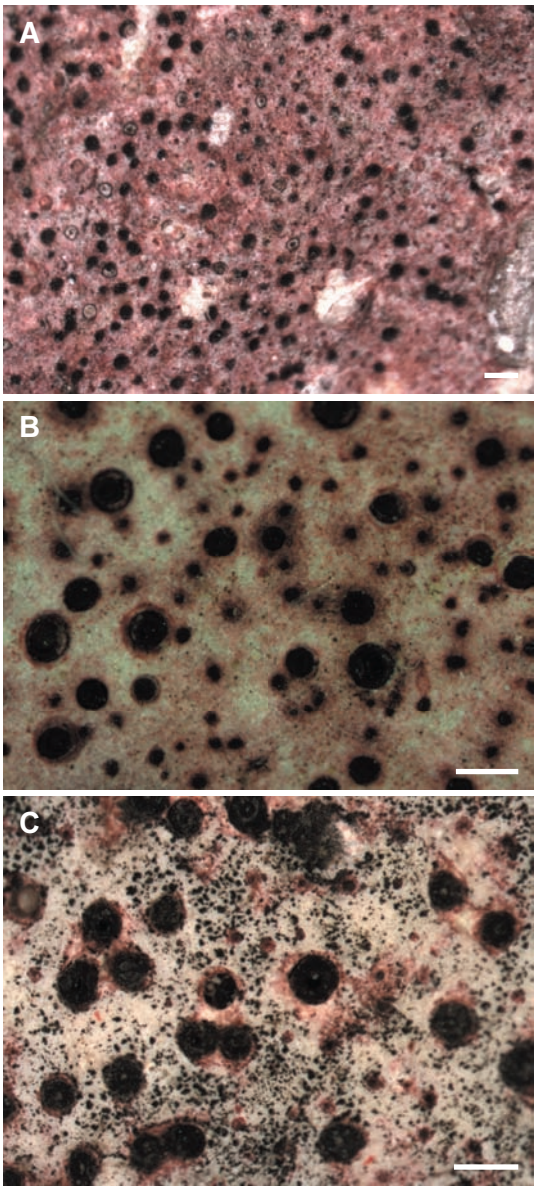

Fig. 3. *Bagliettoa marmorea* (Scop.) Gueidan & Cl. Roux. A–C – thallus (A – *Tobolewski*, POZ; B – *Halda & Haldová*, PRM, as *Lichen marmoreus* Scop., neotype; C – *Hepp*, GFW, as *Verrucaria hoffmanni* Hepp, isotype). Scale bars = 0.5 mm.

SPECIMENS EXAMINED. Gd-59 – TATRA MTS, WESTERN TATRA MTS: Niżnia Świstówka in Dolina Małej Łąki valley, 1500 m, 11 Sept. 1955, *Z. Tobolewski* (POZ).

Bagliettoa parmigerella (Zahlbr.) Vězda & Poelt
Fig. 4

Biblioth. Lichenol. **16**: 363.1981. – *Verrucaria parmigerella* Zahlbr., Österr. Bot. Zeitschr. **68**: 64. 1919. TYPE: [Croatia], Zadar (Zara), Ins. Mljet (Meleda), Wegmauern Brgulje gegen Zapuntello, 13.04.1913, 80–90 m, *J. Baumgartner* (W-1913-14275 – HOLOTYPE, PRM-757645! – ISOTYPE). – *Protobagliettoa parmigerella* (Zahlbr.) Servít, Rozp. Čs. Akad. Věd **65**(3): 36. 1955.

Protobagliettoa kutakiana Servít, Rozp. Čs. Akad. Věd **65**(3): 34. 1955. TYPE: [Czech Republic] Bohemia orient.: Vápenný Podol, Pleskotův mlýn, calc. 1908, *Kuťák* (PRM – HOLOTYPE).

Verrucaria calciseda f. *bagliettoaeformis* Hazsl., Magyar Birod. Zuzmofl.: 270. 1884. TYPE: Romania, Domugled, *Hazslinszky* (PRM – HOLOTYPE). – *Verrucaria bagliettoaeformis* (Hazsl.) Servít, Beih. Bot. Cbl. **59**: 156. 1939. – *Protobagliettoa bagliettoaeformis* (Hazsl.) Servít *ex* J. Nowak & Tobol., Porosty Polskie: 1118. 1975.

Verrucaria parmigera var. *pieninensis* Servít, Beih. Bot. Cbl. **59**: 146. 1939. TYPE: Slovakia, Pieniny, Haligovce, 650 m, *J. Suza* (PRM – HOLOTYPE). – *Protobagliettoa parmigera* var. *pieninensis* (Servít) J. Nowak & Tobol., Porosty Polskie: 1119. 1975.

Verrucaria sphinctrinella Zschacke, Hedwiga **71**: 232. 1931. TYPE: [Greece] Corfu, Mt. Deka, *K. Rechinger* (HP).

Verrucaria steineri var. *inaequata* Servít, Beih. Bot. Cbl. **55B**: 260. 1936. TYPE: Croatia, Velebit, Alancić, 1610 m, *M. Servít* (PRM – HOLOTYPE). – *Verrucaria inaequata* (Servít) Servít, Beih. Bot. Cbl. **59**: 127. 1939. – *Protobagliettoa inaequata* (Servít) Servít *ex* J. Nowak & Tobol., Porosty Polskie: 1118. 1975.

Prothallus present dark grey, visible as a black line. *Thallus* endolithic, continuous, not cracked, grey, blue to grey green or dark green, floury matt or glossy, slightly wrinkled. *Upper cortex* a lithocortex, 25–30 µm thick, formed by thickly woven hyphae, dirty green in upper part due to the presence of minute blue-green crystals. *Algal* layer discontinuous, 100–200 µm high, algal cells 8–12 µm in diam., arranged in groups 30–30 × 30–50 µm. *Medulla* 80–300 µm high, prosoplectenchymatous, hyphae loosely woven, with macrospheroids in the lower part, cells cylindrical 18 × 6 µm. *Perithecia* scattered over the whole thallus surface or absent, completely immersed, globular to bottled shaped, 180–260 µm wide, 220–300 µm high, surrounded by a paler ring of thallus. *Involucrellum* disc-shaped, flat to slightly convex, spreading sideways but scarcely downwards, black, 100–150 µm wide and 15–25 µm thick, distinctly narrower than excipulum width, when mature with three to five radial cracks. *Excipulum* colourless to pale brown, 150–200 µm wide. *Hamathecium* formed by periphyses located in the ostiolar canal 5–15 × 1–1.5 µm and periphysoids located in the half upper part of the perithecial cavity ended by a short clavate cell, unbranched, 10–30 × 2.5 µm. *Asci* cylindrical, oblong or clavate, 30–60 µm long, 20 µm wide. *Ascospores* rare, only few observed in the material examined, simple, oblong to ellipsoid, 20–28 × 9–15 µm. *Conidiomata* unknown.

NOTE. This species is characterized by the presence of fine blue green crystals in the upper cortex, by small globular to bottled shaped perithecia, a colourless excipulum and the involucrellum distinctly narrower than the excipulum. It is easily distinguished from other species of the genus by a blue-grey thallus with completely immersed

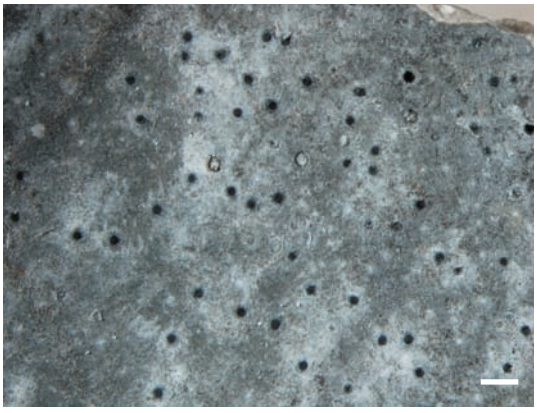

Fig. 4. *Bagliettoa parmigerella* (Zahlbr.) Vězda & Poelt (*Baumgartner*, PRM, as *Verrucaria parmigerella* Zahlbr., isotype). Scale bar = 0.5 mm.

perithecia often visible as black dots surrounded by a paler ring of the thallus.

HABITAT. On exposed hard calcareous rocks.

DISTRIBUTION IN POLAND. This species was recorded at scattered localities in areas with natural calcareous outcrops, such as the Jura Krakowsko-Częstochowska upland, the Pieniny Mts, and the Western Tatra Mts. It was also recorded at several localities in the Góry Świętokrzyskie Mts. Its distribution in Poland is connected with the presence of lager areas of calcareous outcrops.

WORLD DISTRIBUTION. Species known mainly in Europe where it is widespread; it was also recorded in Asia (Halda 2003).

REMARKS. In his revision of sect. *Bagliettoa*, Halda (2003) listed two species and 20 varieties and forms as synonyms of *Verrucaria parmigerella*. Following his classification, only these synonyms that refer to the material examined are presented here.

SPECIMENS EXAMINED. DE-41 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Jarzębie near Bobrowniki, 8 km W of Działoszyn, 190 m, 23 June 1964, *J. Nowak* (KRAM); DE-51 – Węże near Działoszyn, 30 May 1963, *J. Nowak* (KRAM); DE-52 – Zalesiaki near Działoszyn, 1 June 1963, *J. Nowak* (KRAM); DE-61 – Opatów near Krzepice, 3 June 1964, *J. Nowak* (KRAM); DE-73 – Biała near Kłobuck, 266 m, 21 May 1964, *J. Nowak* (KRAM); DE-74 – Jaskrów near Mstów, 20 July 1964, *J. Nowak* (KRAM); DE-84 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA CZĘSTOCHOWSKA UPLAND: Olsztyn near Częstochowa, 2 April 1957, *J. Nowak* (KRAM); DF-06 – Podlesice near Kroczyce, Berkowa Góra, 5 May 1958, *J. Nowak* (KRAM); DF-48 – WYŻYNA OLKUSKA UPLAND: Pieskowa Skała near Olkusz, 2 May 1958, *J. Nowak* (KRAM); Dolina Prądnika near Ojców, 3 May 1958, *J. Nowak* (KRAM); Ojców Brama Krakowska, 2 May 1958, *J. Nowak* (KRAM); DF-59 – Dolina Bolechowicka, 17 May 1957, *J. Nowak* (KRAM); DF-68 – RÓW KRZESZOWICKI DEPRESSION: Dolina Brzoskwinki, 12 Oct. 1971, *J. Nowak* (KRAM); Dolina Będkowska valley, 11 and 14 April 1958, *J. Nowak* (KRAM); DF-78 – BRAMA KRAKOWSKA GATE: Podgórki Tynieckie, 9 April 1958, *J. Nowak* (KRAM); DG-59 – TATRA MTS, WESTERN TATRA MTS: Dolina Kościeliska valley, Wąwóz Kraków, 1600 m, 10 June 1963, *J. Nowak* (KRAM); EE-83 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Góra Zalejowa near Chęciny, 6 May 1959, *J. Nowak* (KRAM); EG-33– OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Góra Zamkowa, 5 May 1957, *J. Nowak* (KRAM).

THE GENUS *HYDROPUNCTARIA*

Hydropunctaria is a recently described genus which was segregated from the polyphyletic genus *Verrucaria* (Gueidan *et al*. 2009). The species of *Hydropunctaria* are well distinguished by a combination of characters including small ascospores, a paraplectenchymatous and subgelatinous thallus, and the presence of black punctae often visible on the upper surface of the thallus as dark dots. Two marine species (*V. adriatica* Zahlbr., *V. maura* Wahlenb.) and two freshwater species (*V. rheitrophila* Zschacke, *V. scabra* Vězda) were transferred from *Verrucaria* to the genus. The species included in *Hydropunctaria* are hydrophilic and their occurrence is restricted to sites that are periodically inundated or are strongly influenced by water spray.

Hydropunctaria Keller, Gueidan & Thüs

in Gueidan *et al*., Taxon **58**(1): 193. 2009. – TYPE SPECIES: *Hydropunctaria maura* (Wahlenb.) Keller, Gueidan & Thüs *in* Gueidan *et al.*, Taxon **58**(1): 194. 2009.

Prothallus often present, continuous, whitish. *Thallus* crustose, continuous to rimose or areolate, yellowish-brown, green, dark greyish olive to black, sub-gelatinous, mostly with black punctae visible on the upper surface of the thallus. *Upper cortex* weakly differentiated, but with uppermost layer of cortical cells often with brownish to olive-blackish pigments. *Algal layer* not clearly delimited from the upper cortex, algal cells usually arranged in vertical columns, sometimes interrupted by black punctae or columns. *Medulla* paraplectenchymatous, sometimes very thin or absent, often replaced by a black (carbonaceous) basal layer, interrupted by isolated black punctae or columns, never forming black ridges. *Perithecia* completely immersed to half-immersed.

Involucrellum always present, apical to dimidiate, usually spreading and eventually fusing with the black basal layer. Upper surface of involucrellum often uneven-rough or with protruding small columns. *Excipulum* either pale with a brown ostiole or entirely pigmented. *Hamathecium* consisting at maturity of periphyses and periphysoids. *Asci* clavate, 8-spored, two-layered, fissitunicate. *Ascospores* simple, rounded to ellipsoid, of size variable between species or populations, but in general characterized by a median length greater than 12 µm and a length/width ratio greater than 2, without halo. *Conidiomata* sometimes present, *Staurothele*-type (Harada 1993), conidia simple, bacilliform, 3–4.5 × 1–1.5 µm.

NOTE. The genus *Hydropunctaria* is distinguished by the hydrophilic habit, the presence of carbonized punctae and columns in thallus section, the algal cells usually arranged in vertical columns, the involucrellum always present, apical to dimidiate, usually spreading and eventually fusing with the black basal layer. The upper surface of the involucrellum is often uneven-rough, possibly with protruding small columns. *Hydropunctaria* is quite similar to the newly described genus *Wahlenbergiella* Gueidan & Thüs (Gueidan *et al*. 2009), which also includes marine species with carbonaceous structures in the thallus but differs by the smooth involucrellum, greenish thallus and by the carbonized structures forming black ridges rather than punctae.

HABITAT. Aquatic and amphibious saxicolous species, colonizing either marine or freshwater habitats.

REMARKS. According to Thüs (2002) and Thüs and Schultz (2008), morphs without carbonized structures were also observed in this genus. Individuals without black punctae were observed in Poland very rarely and only on juvenile thalli growing at lower altitudes in northern Poland.

KEY TO THE SPECIES OF *HYDROPUNCTARIA*

Key to the species with carbonized punctae and/or columns in thallus section present but black ridges never present, with the upper surface of involucrellum uneven-rough and with small ascospores (morphs without black structures were included in the *Verrucaria* key).

1. Species of maritime habitats; thallus blackish, thick, crustose-areolate, black dotted, ascospores 8–10.5 × 3.5–4.5 µm . . . . . ***Hydropunctaria maura***
1*. Species of freshwater habitats **2**
   2. Thallus dark to black, uneven with roughened upper surface, perithecia forming prominent mounds, black basal layer of thallus continous, ascospores 11.0–17 × 6.5–8.7 µm . . . . . ***Hydropunctaria scabra***
   2*. Thallus olive greenish, black dotted, even, perithecia immersed, not forming mounds, black basal layer of thallus discontinuous, ascospores 7.5–10 × 6–6.5 µm . . . . . ***Hydropunctaria rheitrophila***

Hydropunctaria maura (Wahlenb.) Keller, Gueidan & Thüs Fig. 5.

in Gueidan *et al*. Taxon **58**(1): 194. 2009. – *Verrucaria maura* Wahlenb. *in* Ach., Methodus, Suppl.: 19. 1803. TYPE: Finmarkia Norvegia, in insula sinus Altensis, 10 & 11 May 1802 [*G. Wahlenberg*] (UPS L-048912! – LECTOTYPE and ISOLECTOTYPE, designated by Gueidan *et al*. 2009).

Prothallus absent. *Thallus* up to 1000 µm thick, crustose-areolate, dull greenish brown to dark brown or black, cracked into discrete areoles. Areoles angular, black-dotted, margins darkly pigmented, continuous with the dark basal layer. *Upper cortex* weakly differentiated, thin, 10–15 µm, the uppermost layer of cells dark pigmented. *Algal* layer 50–60 µm high, with algal cells arranged in vertical columns. Algal cells 7.5–10 µm in diam., often in pairs or tetrads. *Medulla* absent, dark basal layer present, with dark columns reaching up to the upper cortex. *Perithecia* immersed in the thallus to slightly prominent, 200–300(–500) µm wide. *Excipulum* dark-brown to black, 120–150(–200) µm wide. *Involucrellum* black, dimidiate, often appearing continuous with the black basal layer. *Periphysoids* 20–30 × 1.5–3 µm. *Ascospores* simple, colourless, 12–18 × 6.5–8.7 µm. *Conidiomata* sometimes abundant, scattered, conidia oblong, 3.3–4 × 1.6 µm.

NOTE. The species is easily distinguished in Poland by the coastal rock habitat. It is character-

ized by a dull, brown to black thallus with a roughened upper surface with tiny punctae and large perithecia with a dark excipulum. The thallus is cracked into angular areoles resembling cracked mud. *Hydropunctaria adriatica* (Zahlbr.) Keller & Gueidan, the second maritime species in this genus, differs by having a non-cracked thallus with perithecia forming much larger projections (0.4–1 mm) and a colourless excipulum. *Verrucaria halizoa* a maritime species of *Verrucaria*, is distinguished by an uncracked and thin thallus without ridges and punctae, an excipulum pale at the base, and smaller perithecia and smaller ascospores 8–10.5 × 3.5–4.5 µm. *Wahlenbergiella striatula* (Wahlenb.) Gueidan & Thüs is a similar species having a subgelatinous thallus with black carbonaceous structures and also occurring in the marine habitat; it differs, however, by having a greenish thallus and a smooth upper surface of the involucrellum. Additionally, its carbonaceous structures form elongated ridges and sometimes ramified structures, giving a fingerprint-like appearance if viewed from above.

HABITAT. An amphibious saxicolous species, colonizing maritime habitats, rocky coasts and concrete breakwaters. It occurs from below to well above the high-water mark. It usually forms the main constituent of the upper part of the black zone observed on coastal rocks and on anthropogenic substrates such as concrete breakwaters.

DISTRIBUTION IN POLAND. This maritime species was recorded only once by Erichsen (1933) nearly one hundred years ago in the town of Świnoujście (NW Poland), where it was found on granite blocks of a mole. Recently the occurrence of *H. maura* was confirmed at this locality in the western part of the coast of Poland, near Świnoujście Lighthouse on Wolin Island. However, the species is not known from the central and eastern part of the coast of Poland.

WORLD DISTRIBUTION. A cosmopolitan species, occurring on seashores of all continents (Øvstedal & Lewis Smith 2001; Feuerer 2010).

REMARKS. In Poland this maritime species was mistakenly reported from freshwater sites in the

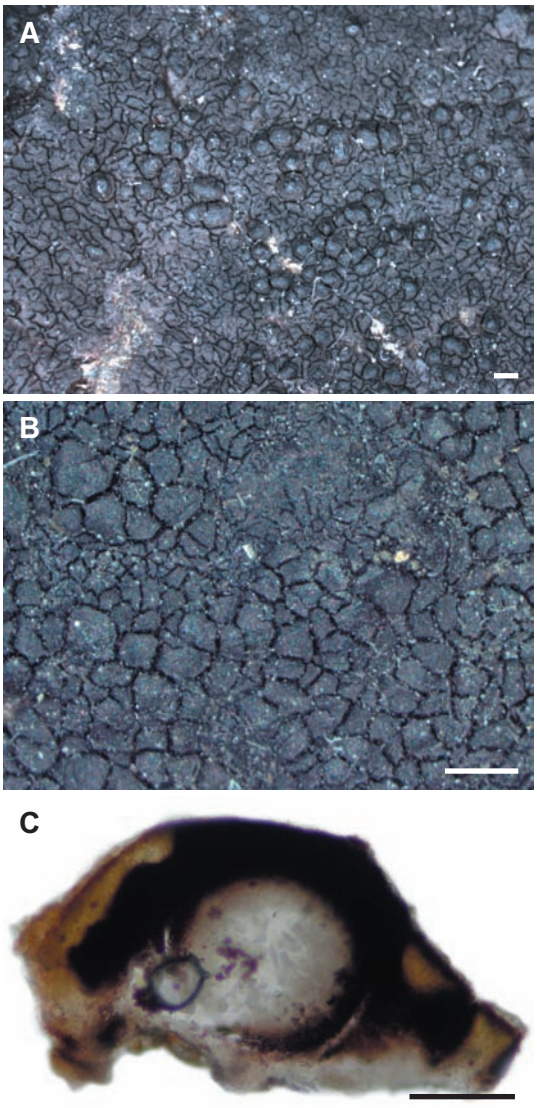

Fig. 5. *Hydropunctaria maura* (Wahlenb.) Keller, Gueidan & Thüs. A & B – thallus (A – *Nowak*, KRAM; B – *Wahlenberg,* UPS, as *Verrucaria maura* Wahlenb., lectotype); C – vertical section of perithecium (*Nowak*, KRAM). Scale bars: A & B = 0.5 mm; C = 100 µm.

Sudeten Mts (Körber 1855). Körber described two varieties of *Verrucaria maura* from the Karkonosze Mts based on his and Flotow's collection, namely var. *opaca* and var. *memnonia*. Stein (1879) incorrectly included var. *opaca* in the synonymy of *Lithoicea maura*. The species was later transferred

to *Verrucaria* and, consequently, the maritime species *V. maura* was erroneously listed from the Polish mountains, one thousand km from the sea (Tobolewski 1965). Unfortunately, the type material of *Verrucaria maura* var. *opaca* (Körber 1855) was not found in this study. However, features of the protologue, including the freshwater habitat, black and dull to slightly glossy cracked thallus, slightly prominent perithecia and small ascospores, indicates that the specimens probably belong to *Hydropunctaria scabra* (see also under the species). On the other hand, in Parerga Lichenologica, Körber (1863) reported two Exsiccatae collections: Hepp, Flechten Eur. 716 and Rabenhorst Lich. Exs. 385 as referable to *Verrucaria maura* var. *opaca*; in fact, they both belong to *Hydropunctaria maura*. Probably for this reason Zschacke (1933) incorrectly included *V. maura* var. *opaca* and *Lithoicea maura* in the synonymy of *Verrucaria maura*.

EXICCATAE SEEN. Hepp, Flechten Eur. 716 (as *Verrucaria maura* var. *opaca*) (GFW).

SPECIMENS EXAMINED. AB-21 – POBRZEŻE SZCZECIŃSKIE LITTORAL REGION, THE UZNAM AND WOLIN ISLANDS: Świnoujście, seashore by the path between port and lighthouse, 15 Sept. 2009, *A. Otocka* (KRAM).

Hydropunctaria rheitrophila (Zschacke) Keller, Gueidan & Thüs Fig. 6

in Gueidan *et al*., Taxon **58**(1): 194. 2009. – *Verrucaria rheitrophila* Zschacke, Verh. Bot. Vereins Prov. Brandenburg **64**: 108. 1922. TYPE: [Germany] Harz: Selketal, im Bach am Meiseberge, Nordost-Harz, 20 July 1920, *H. Zschacke* (B! – LECTOTYPE, designated by Harada 1996).

Verrucaria kernstockii Zschacke, Hedwigia **67**: 65. 1927.

Verrucaria scotinodes Zschacke, Hedwigia **67**: 57. 1927.

Verrucaria minutipuncta Erichsen, Schr. Naturw. Ver. Schlesw.-Holst. **22**: 94. 1937. – *Verrucaria kernstockii* f. *minutipuncta* (Erichsen) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 141. 1954.

Verrucaria sagedioides Servít, Stud. Bot. Čes. **11**(1–2): 33. 1950. TYPE: Western Bohemia, the valley N of Klasterec [Ohre] 400 m, 1947, *Servít* (PRM! – HOLOTYPE).

Prothallus whitish, non fimbriate, contiguous thalli often separated by thin black lines. *Thallus* thin to thick, 60–140 µm thick, superficial, subgelatinous, well-developed, 60–95 µm thick, even, smooth or roughened, usually uncracked, but sometimes with sparse cracks, pale brownish green to olive green or dark green, with sparse to numerous black dots. *Upper cortex* paraplectenchymatous, poorly defined, 20 µm thick, cell walls dark pigmented, yellowish brown to blackish brown. *Algal* cells 8–15 µm in diam., arranged in more or less vertical columns. *Medulla* paraplectenchymatous, with intensely pigmented patches appearing as more or less discrete, black punctae or black columns, black basal layer generally absent or present only in small areas of the thallus. *Perithecia* completely immersed and visible as black points, or projecting, depending on the thickness of the thallus. *Involucrellum* very variable, from apical and little-developed, to well-developed in the upper half of the excipulum, often spreading outwards and downwards. *Excipulum* (90–)110–210 µm wide, colourless or partly brown. *Periphysoids* 20–30 × 1.5–3 µm. *Ascospores* simple, colourless, ellipsoid, 10–12(–15) × 4.5–7 µm. *Conidiomata* not observed.

NOTE. *Hydropunctaria rheitrophila* is easily distinguished from freshwater *Verrucaria* species by completely immersed perithecia visible as black dots and by a greenish thallus with black punctae giving a spotted and weakly roughened appearance on the upper surface. Black punctae are well visible in thinner thalli; they are sometimes completely immersed in the thicker ones and then the upper surface is even. *Hydropunctaria scabra* is the other freshwater species with black punctae in the thallus but it differs in the larger perithecia forming projecting mounds, larger ascospores 14–17 × 7.5–9 µm, and the presence of a greenish black to black thallus with a continuous black basal layer.

HABITAT. On submerged or frequently wetted siliceous rocks and pebbles in the lower splash zone.

DISTRIBUTION IN POLAND. The species occurs mainly in the mountainous regions of southern

Poland in the Sudeten Mts (Stein 1879) and in the Carpathian Mts, where it is widespread in the Western Carpathians in the Tatra Mts (Krzewicka 2006), the Beskid Śląski Mts (Kiszka 1967a), the Beskid Mały Mts (Nowak 1965), the Beskid Wyspowy Mts and the Beskid Żywiecki Mts (Nowak 1998) in the Beskid Niski Mts (Krzewicka 2009b), the Pogórze Spiskie Foothills (Kiszka 1985), the Pogórze Ciężkowickie Foothills (Kozik 1977) and noted on a few localities in the Eastern Carpathians the Bieszczady Mts (Kościelniak & Kiszka 2003). Outside the Carpathians, it occurs at scattered localities in central Poland in the Wyżyna Wieluńska Upland (Nowak 1967), the Wzniesienie Łódzkie Hills (Krzewicka & Hachułka 2008) and in northern Poland in the Pojezierze Kaszubskie Lakeland, the Pojezierze Płoudniowopomorskie Lakeland and the Pobrzeże Gdańskie Coastland.

WORLD DISTRIBUTION. The species occurs mainly in the holarctic region in central and northern Eurasia, North America, Asia, Australia (Thüs 2002; Orange 2004b; Santesson *et al*. 2004; Nascimbene & Nimis 2006) but is also recorded from the Southern Hemisphere in New Zealand (McCarthy 1991).

REMARKS. The list of synonyms presented here is based on the taxonomic revision of freshwater species of *Verrucaria* by Thüs (2002) and a recent systematic classification based on phylogeny of the Verrucariaceae by Gueidan *et al*. (2009). According to Thüs (2002) and Thüs and Schultz (2008), morphs without carbonaceous structures may occur in this species. The morphs of *H. rheitrophila* without carbonaceous patches were rarely observed in the material in this study and only on juvenile thalli growing at low altitudes, for example in the Pojezierze Kaszubskie Lakeland.

The material reported from Poland by Stein (1879) as *Lithoicea aethiobola* (currently *Verrucaria aethiobola*) in fact belongs to *Hydropunctaria rheitrophila*. The specimen deposited in the WRSL herbarium has a strongly cracked greenish brown thallus with well visible black carbonaceous punctae (see also Zschacke 1933).

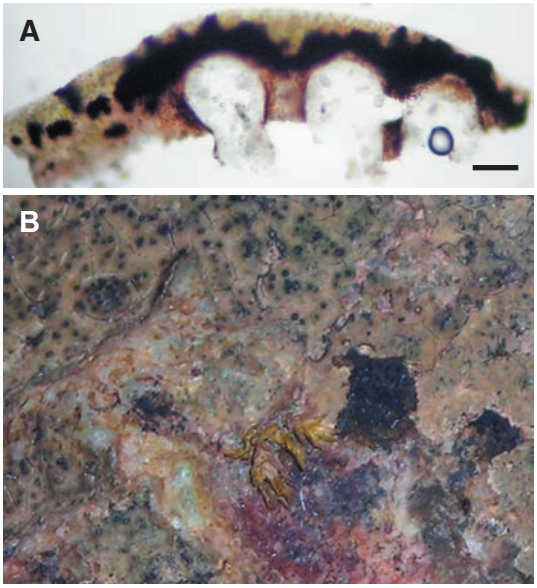

Fig. 6. *Hydropunctaria rheitrophila* (Zschacke) Keller, Gueidan & Thüs. A – vertical section of thallus (*Nowak*, KRAM); B – thallus (*Zschacke*, B, as *Verrucaria rheitrophila* Zschacke, lectotype). Scale bars: A = 50 µm.

SPECIMENS EXAMINED. BE-95 – MIDDLE SUDETES, GÓRY SOWIE MTS: Kamionki [Steinkunzendorf] near Dzierżoniów [Reichenbach], *Schumann* (WRSL) as *Lithoicea aethiobola*; CA-68 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Potok Zagórzański stream, 18 July 1935, *F. Krawiec* (POZ), with *V. praetermissa*; Zagórze, in stream, 19 Aug. 1930, *F. Krawiec* (POZ); CA-89 – POBRZEŻE GDAŃSKIE COASTLAND, POBRZEŻE KASZUBSKIE COASTLAND: Gdańsk Oliwa, Dolina Ewy valley, July 2000, *M. Kukwa* (UGDA); CB-16 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Kościerzyna, stream in Jarząbce forest, Aug. 1935, *F. Krawiec* (POZ); CB-68 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND, BORY TUCHOLSKIE FOREST: 1 km E of Stare Rzeki, on stones in water, 13 June 2004, *M. Kukwa 3292*, *3294* (UGDA); DD-67 – WZNIESIENIA POŁUDNIOWOMAZOWIECKIE HEIGHTS, WZNIESIENIA ŁÓDZKIE HEIGHTS: Wzniesienia Łódzkie Landscape Park, on stones in Młynkówka stream, 27 Sept. 2006, *M. Hachułka* (LOD); DD-68 – Wzniesienia Łódzkie Landscape Park, on stones in Kammienna stream, 23 June 2006, *M. Hachułka* (LOD); 5 June 2006, *M. Hachułka* (LOD) ; on stones in Grzmiąca stream, 26 June 2006, *M. Hachułka* (LOD); DE-51 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA

Wieluńska upland: Załęcze Małe village near Warta river, submerged in stream in wood, 5 June 1964, *J. Nowak* (KRAM); DF-95 – Western Beskidy Mts, Beskid Mały Mts: Wielki Cisownik, 550 m, 13 April 1961, *J. Nowak* (KRAM); DG-16 – Beskid Żywiecki Mts: Massif Babiej Góry range, below Sulowa Cyrhla, 750 m, 23 June 1961, *J. Nowak* (KRAM); DG-33 – Wielka Racza range, valley of Danielka stream, 650 m, 8 Aug. 1964, *J. Nowak* (KRAM); DG-58 – Tatra Mts, Western Tatra Mts: Dolina Chochołowska valley, Chochołowski stream, by Niżnia Jarząbcza Polana, 1130 m, *B. Krzewicka 2706a* (KRAM); Chochołowski stream, by Polana Huciska, 975 m, *B. Krzewicka 2731a*, (KRAM); Chochołowski stream, by Wielkie Koryciska, 960 m, *B. Krzewicka 2727a* (KRAM); DG-59 – near Ścieżka pod Reglami, in the stream Chochołowski on granite boulders, 1010 m, 16 July 2004, *B. Krzewicka 2766* (KRAM); EB-42 – Pojezierze Mazurskie lakeland, Pojezierze Olsztyńskie lakeland: Olsztyn city, Las Miejski, Wadąg river, Aug. 2009, *D. Kubiak* (KRAM); EF-95 – Pogórze Środkowobeskidzkie foothills, Pogórze Rożnowskie foothills: Majdan, N slope in stream, 400 m, 21 June 1971, *R. Kozik* (KRAP); EF-99 – Pogórze Ciężkowickie foothills: Liwocz Mt. aboveWróblowa, 400 m, 30 June 1972, *R. Kozik* (KRAP); EG-50 – Obniżenie Orawsko-Podhalańskie depression, Rów Podtatrzański depression: Las Brzeziny near Murzasichle, 1000 m, 7 July 1971, *J. Nowak* (KRAM); EG-50 – Tatra Mts, Western Tatra Mts: Las Brzeziny forest, in Chowańcówka stream, 1000 m, 7 July 1971, *J. Nowak* (KRAM); FA-86 – Masurian Lakeland, Węgorapa Land: Park Krajobrazowy Puszczy Rominckiej, Bludzia river by Bludzie Małe village, 19 Aug. 2010, *D. Kubiak* (OLTC); FG-20 – Middle Beskidy Mts, Beskid Niski Mts: Rostajne village, stream between Cyrla Mt. and 601 peak, 480 m, 21 Sept. 1979, *J. Nowak* (KRAM); Krempna village, Las Słodki forest, stream on N slope of Cyrla, 500 m, 8 Oct. 1979, *J. Nowak* (KRAM) together with *V. praetermissa*; FG-23 – stream between Dział Mt. near Szklary village and Obłaz Mt.near Daliowa village, 520 m, 11 Sept. 1974, *J. Nowak* (KRAM); FG-57 – Eastern Beskidy Mts, Western Bieszczady Mts: Buk village, in stream, right of tributary of Solinka river, W slope of Bukowinka hill, 17 May 2008, *B. Krzewicka* (KRAM); FG-58 – Bieszczadzki National Park, E slope of Połonina Wetlińska, in stream, 29 Sept. 2000, *J. Kiszka* (KRAP); FG-69 – Bieszczadzki National Park, watercourse by Kańczowa stream, 1 Oct. 2000, *J. Kiszka* (KRAP); stream in the Kańczowa valley, 1 Oct. 2000, *J. Kiszka* (KRAP); S slope of Stuposiańskiej Magury Mt., on splash rocks, 650 m, 23 Sept. 1958, *K. Glanc* (KRAM); GB-92 – Nizina Północnopodlaskac Wysoczyzna Białostocka plateau: Puszcza Knyszyńska forest, nature reserve Budzisk, by the stream, 10 June 1999, *K. Czyżewska* (LOD) together with *V. praetermissa*; Budzisk Nature Reserve, forest area No. 109, on siliceous stone in forest stream bed, 11 June 1999, *J. Motiejūnaite* (BILAS); GG-60 – Eastern Beskidy Mts, Western Bieszczady Mts: Bieszczadzki National Park, valley of the Zwór stream, 2 Oct. 2000, *J. Kiszka* (KRAP); GG-70 – Bieszczady National Park, Rozsypaniec Mt. in stream, 1042 m, 13 July 2005, *J. Kiszka* (KRAP).

Hydropunctaria scabra (Vězda) Keller, Gueidan & Thüs Fig. 7

in Gueidan *et al*., Taxon **58**(1): 194. 2009. – *Verrucaria scabra* Vězda, Folia Geobot. Phytotax. **5**(3–4): 308. 1970. Type: [Slovakia] Carpaticum, Tatra Minor: in declivi orientali montis ‘Košariská’ dicti, in parte supriore vallis ‘Biela voda’, alt. 1300 m, ad lapides schistosos siliceous in torrente minore, 7. X.1966, *A. Vězda* (Vězda, Lich. Sel. Exs. 876, PRM! – isotype).

Verrucaria maura var. *opaca* Körb., Syst. Lich. Germaniae: 340. 1855. Type: [Poland] in Schlesien um den Kochelfall [Wodospad Szklarki], im Sattler und Bobergrund bei Hirschberg [Jelenia Góra]. Synonymized here. – *Lithoicea maura* Stein, Cohn Kryptog.-Flora von Schlesien **2**(2): 321. 1879. [*non Lithoicea maura* (Sm.) Gray, Nat. Arr. Brit. Pl. (London) **1**: 449. 1821].

Prothallus absent, or rarely whitish, not fimbriate, contiguous to few cracked, thalli often separated by thin black lines. *Thallus* superficial, subgelatinous, usually well-developed, 110–150 μm thick, uneven, often with projection formed by perithecia, sometimes cracked but not areolate, roughened, dark greenish black, brownish black or black. *Upper cortex* paraplectenchymatous, poorly defined, cell walls darkly pigmented. *Algal* cells arranged in more or less distinct columns, cells 5.7–8 μm in diam., photobiont in poor condition in studied material. *Medulla* paraplectenchymatous, weakly-defined; black basal layer present, in older thalli connected to pigmented patches of medulla, in thallus section black columns often reaching the upper surface, the tips of the columns giving a roughnened appearance to the thallus surface. *Perithecia* numerous, completely covered by thallus, forming conical projections which are too

ill-defined. *Involucrellum* present, well-developed, black, connected with the black basal layer, upper part roughened, the rough surface often visible as black spots surrounding the ostiole on the upper surface of the thallus. *Excipulum* 250–300 µm wide, sides and base colourless or partly brown. *Periphysoids* 15–20 × 2.0 µm. *Ascospores* simple, ellipsoid to oblong-ellipsoid, 14–17 × 7.5–9 µm. *Conidiomata* rarely present, conidia straight or slightly curved, 3.5–5 × 1.2 µm.

NOTE. *Hydropunctaria rheitrophila* differs from this species by pale brownish green, olive green to dark green thallus and completely immersed perithecia. *Hydropunctaria scabra* is easily distinguished from the freshwater *Verrucaria* species by a dark brown to black thallus with a roughed upper surface, a well developed black basal layer and the medium size of ascospores. The only aquatic species of *Verrucaria* with a black thallus is *V. aquatilis*, which differs by the very small, broadly ellipsoid ascospores, 5–7 × 4.5–5.5 µm. *Verrucaria pachyderma* has a greenish black thallus but differs in the larger ascospores (17–22 × 6–8 µm) and lack of a distinct black basal layer (sometimes with brownish punctae in medulla).

HABITAT. On temporarily submerged siliceous rocks or on siliceous rocks in the splash zone.

DISTRIBUTION IN POLAND. Infrequent, currently known from a few scattered localities in mountains. So far, it was reported only from one site in the Tatra Mts, in the Dolina Kościeliska valley (Nowak 1974b) and from Sudeten as *Verrucaria pissina* by Eitner (1911). In this study, it was confirmed at other localities in the Tatra Mts and at scattered sites in the Beskid Żywiecki Mts and the Bieszczady Mts.

WORLD DISTRIBUTION. In Europe, it is known from scattered localities mainly in central part as well as in Switzerland, Poland, Slovakia, Germany, England and Wales (Orange 2004b; Thüs 2002).

REMARKS. As previously mentioned Körber (1855) described a new taxon, *Verrucaria maura* var. *opaca*, from Wodospad Szklarki in the Sudeten Mts. This variety is characterized by a dull, irregularly cracked, black thallus growing on granite rocks in moist habitats. Unfortunately, the type material was not found. However, the brief description of the variety seems to refer to *H. scabra*. The short note given by Körber (1855) could also very well characterize those specimens of *H. scabra* with a thick and often cracked thallus and with few punctae on the upper surface, recorded also in this study. In fact, *H. scabra* is very similar to *V. maura* in appearance, and it may have been mistakenly treated by Körber as the species. Here, *Verrucaria maura* var. *opaca* is considered as a synonym of *H. scabra* (see also under *H. maura*).

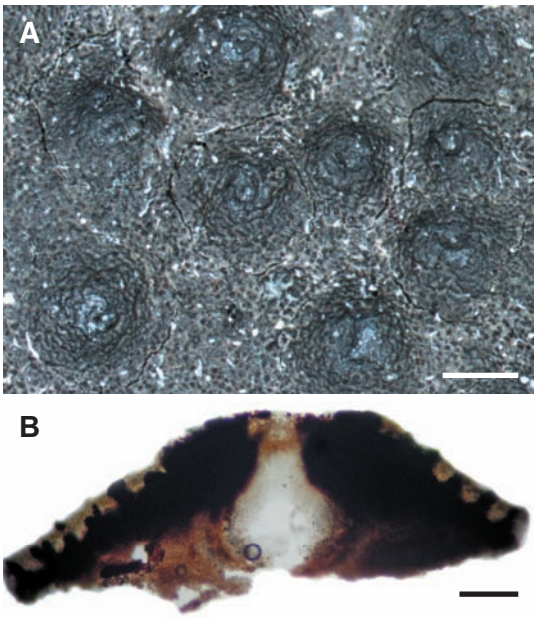

Fig. 7. *Hydropunctaria scabra* (Vězda) Keller, Gueidan & Thüs. A – thallus (*Nowak*, KRAM); B – vertical section of perithecium (*Nowak*, KRAM). Scale bars: A = 0.5 mm; B = 200 µm.

The specimens reported from Silesia by Eitner (1911) as *V. pissina* (unfortunately not treated) should probably be recognized as *H. scabra* not as *V. pachyderma* (Fałtynowicz 2003). The size of ascospores [8–13(–17) µm long] and the black, glossy and cracked thallus with projecting perithecia, mentioned in the description, suggest this determination.

SPECIMENS EXAMINED. DG-25 – WESTERN BESKIDY MTS, BESKID ŻYWIECKI MTS: Pilsko, Glinna

stream, 1340 m, 15 July 1966, *J. Nowak* (KRAM); DG-58 – Tatra Mts, Western Tatra Mts: Dolina Starobociańska, in stream, 1250 m, 11 July 1959, *J. Nowak* (KRAM); DG-59 – Dolina Kościeliska valley, Mała Polana Ornaczańska meadow, 1000–1100 m, on siliceous rocks submerged in stream, 22 May 1959, *J. Nowak* (KRAM); EG-50 – Obniżenie Orawsko-Podhalańskie depression, Rów Podtatrzański depression: Las Capowski by Murzasichle, in stream, 930 m, 30 Aug. 1971, *J. Nowak* (KRAM); EG-50 – Tatra Mts, High Tatra Mts: Hala Gąsienicowa, stream by Czarny Staw Gąsienicowy, 16 Sept. 1949, *J. Motyka* (LBL); FG-58 – Eastern Beskidy Mts, Western Bieszczady Mts: Bieszczadzki National Park, E slope of Połonina Wetlińska, in stream, 29 Sept. 2000, *J. Kiszka* (KRAP).

The genus *Parabagliettoa*

The genus *Parabagliettoa* was segregated from *Verrucaria* by Gueidan and Roux (Gueidan *et al*. 2009) and refers to *Verrucariomyces* Thomas *ex* Cif. & Tomas. (Ciferri & Tomaselli 1953). The old name is illegitimate and it was rejected by Lücking and Hawksworth (2007). Two calcicolous species, *Verrucaria dufourii* DC. and *V. cyanea* A. Massal., have been transferred to *Parabagliettoa* based on molecular phylogenetic analyses and a combination of unique morphological characters (Gueidan *et al*. 2009). *Verrucaria disjuncta* Arnold is included into the genus in this study based on morphological and anatomical characters.

Parabagliettoa Gueidan & Cl. Roux

in Gueidan *et al*., Taxon **58**(1): 194. 2009. – Type species: *Parabagliettoa dufourii* (DC.) Gueidan & Cl. Roux *in* Gueidan *et al*., Taxon **58**(1): 195. 2009.

Prothallus often present, dark brown to black. *Thallus* endolithic or in part also thinly superficial, continuous, grey-green to grey-brown or bluish grey. *Upper cortex* a pseudocortex, formed by a thin prosoplectenchyma intermingled with microcrystals, sometimes with one layer of slightly pigmented cortical cells at top. *Algal* layer not clearly delimited, with algal cells arranged in clusters or singly. *Medulla* formed by a prosoplectenchyma, without oil cells (macrospheroids absent), hyphae of medulla I+ and K/I+ (also after HCl) violet, violet-blue or blue at least for the hyphae surrounding the perithecia. *Perithecia* superficial to half immersed, globose to flat at top, 0.1–0.4 mm in diam. *Involucrellum* well-developed, black, in upper part of, or reaching the base of the excipulum, never radially cracked. *Excipulum* colourless to pale brown. *Hymenium* colourless, K/I+ blue, I+ red. *Hamathecium* consisting of periphyses and short unbranched periphysoids, the latter abundant or not, but never spreading and detachable. *Asci* clavate, 8-spored, two-layered, fissitunicate. *Ascospores* colourless, ellipsoid and simple (sometimes uniseptate). *Conidiomata* present, conidia simple.

Note. The genus *Parabagliettoa* contains calcicolous endolithic species with continuous and rather uncracked light-coloured thalli, often bordered by a dark brown to black prothallus (as in *Bagliettoa*). It is distinguished by the presence of an upper cortex of the pseudocortex type (lithocortex is present in *Bagliettoa*), the absence of oil cells (macrospheroids) in the medulla, and the presence of superficial or semi-immersed perithecia which are never completely immersed as they are in *Bagliettoa*. It also differs from *Bagliettoa* in having a well-developed involucrellum lacking radial splits and often reaching the base of the excipulum. In *Bagliettoa* the involucrellum is disc-shaped, spreading sideways and scarcely downwards. The majority of calcicolous *Verrucaria* species differ from *Parabagliettoa* by the presence of well-developed superficial thalli. The species of *Verrucaria* with light-coloured endolithic thalli are characterized by the negative reaction of medulla hyphae with Lugol's solution, except *V. polonica*, which reacts positively (violet-blue) but differs by the presence of macrospheroids and, in many cases, of a thin superficial thallus.

Habitat. Saxicolous calcicolous species, more or less tolerant of shade.

Remarks. *Parabagliettoa* is a sister group to *Bagliettoa*, and both genera are well segregated from the polyphyletic genus *Verrucaria* by morphological and molecular analyses based on SSU

nrDNA, LSU nrDNA and *RPB*1 data (Gueidan *et al*. 2007, 2009).

KEY TO THE SPECIES OF *PARABAGLIETTOA*

Key to the species with a calcicolous endolithic thallus, a K/I+ violet reaction of the medulla hyphae (sometimes very weak), superficial or semi-immersed perithecia, an involucrellum lacking a star-shaped aperture, and a thallus lacking macrospheroids.

1. Ascospores broadly ellipsoid to globose, 8–10(–14) × 6–7 µm . . . . . ***Parabagliettoa disjuncta***
1*. Ascospores narrowly ellipsoid, ≥12 µm long . . . **2**
   2. Ascospores 12–17(–20) × 6–8 µm, perithecial projections 200–280 µm in diam., involucrellum 30–40 µm thick . . . . . ***Parabagliettoa cyanea***
   2*. Ascospores 18–23 × 8–10 µm, perithecial projections (350–)400–600 µm in diam., involucrellum 80–150(–250) µm thick . . . . . ***Parabagliettoa dufourii***

Parabagliettoa cyanea (A. Massal.) Gueidan & Cl. Roux Fig. 8

in Gueidan *et al*., Taxon **58**(1): 195. 2009. – *Verrucaria cyanea* A. Massal., Mem. Lichenogr.: 144. 1853. TYPE: Vive sulle roccie nummolitiche del Paese di Garda (Rocca) nel Veronese (probably kept in VER).

Verrucaria limitata Kremp. *in* Massalongo, Sched. Crit.: 123. 1855. TYPE: E Franconia misit quoque Clar., *Arnold* (Hepp, Flechten Eur. 429, GFW! – SYNTYPE).

Prothallus whitish when thallus not contiguous with other conspecific thalli or brown-black to black when contiguous with conspecific thalli, then visible as thin dark lines which are more or less single, or double. *Thallus* endolithic, immersed or in part thinly superficial, whitish, uncracked. *Upper cortex* a pseudocortex, weakly delimited from the algal layer. *Algal* layer not clearly delimited, algal cells 8–12 µm in diam., arranged in clusters. *Medulla* formed by a prosoplectenchyma, hyphae surrounding the perithecium I+ and K/I+ violet-blue. *Perithecia* half to rarely three-quarters immersed, forming black projections 200–280 µm in diam., sometimes forming poorly defined pits in the rock. *Involucrellum* black, 30–40 µm thick, flanking upper half of the excipulum. *Excipulum* globose, colourless, 200–250 µm wide. *Periphysoids* 15–20 µm long. *Asci* 45–55 µm long, 14–17 µm wide. *Ascospores* simple, ellipsoid, colourless, 12–17(–20) × 6–8 µm. *Conidiomata* not observed.

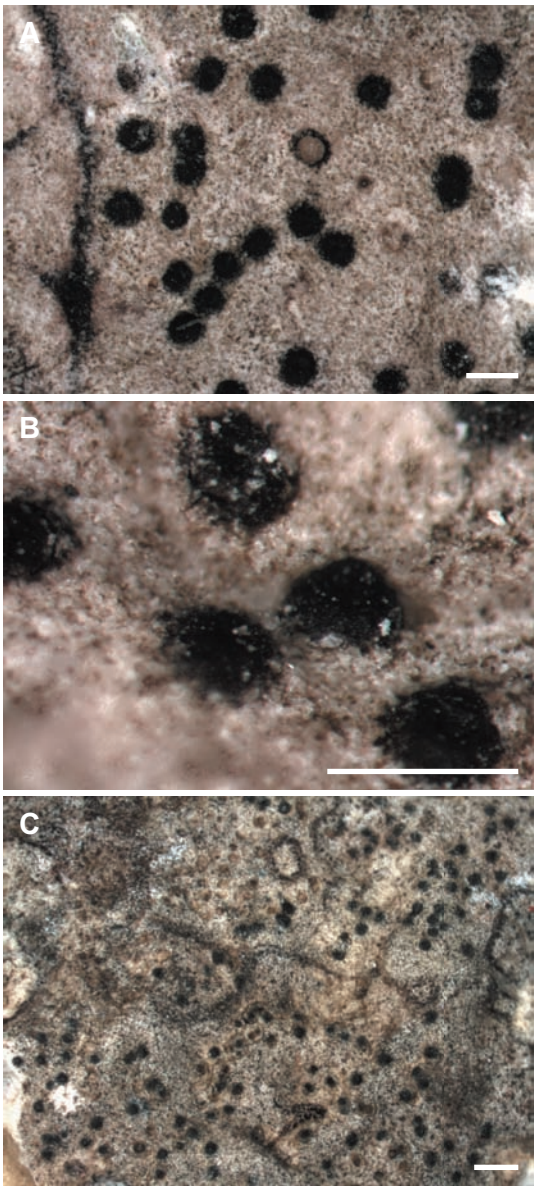

Fig. 8. *Parabagliettoa cyanea* (A. Massal.) Gueidan & Cl. Roux. A – thallus (*Nowak*, KRAM); B – perithecia (*Nowak*, KRAM); C – habit (Hepp, Flechten Eur. 429, GFW, as *Verrucaria limitata* Kremp., syntype). Scale bars: A & B = 0.5 mm; C = 1 mm.

NOTE. This species has endolithic thalli typically forming a mosaic with thalli separated by

dark lines. *Parabagliettoa dufourii* has larger ascospores and larger more promunent perithecia. *Parabagliettoa disjuncta* differs by the smaller, broadly-ellipsoid to globose ascospores [8–10(–14) × 6–7 µm], the perithecia distinctly flat at the top and a disc-shaped involucrellum with the margin scarcely spreading downwards. *Verrucaria polonica* is similar in having a whitish more or less endolithic thallus separated by dark lines and the violet blue reaction of medulla hyphae in Lugol's solution but it differs by the presence of macrospheroids in the medulla. *Verrucaria pinguicula* differs by having a brownish or dirty white superficial thallus, often distinctly raised above the surrounding rock, by lacking a reaction of medulla hyphae with I, and the presence of nearly completely immersed perithecia.

HABITAT. On exposed calcareous rocks, at lower altitudes in mountains and uplands.

DISTRIBUTION IN POLAND. This species occurs at scattered localities in the Wyżyna Krakowska-Częstochowska upland, the Tatra Mts and the Pieniny Mts. The occurrence of *P. cyanea* in Poland is associated with large areas of calcareous outcrops. Species probably more frequent but overlooked.

WORLD DISTRIBUTION. Known in Europe from England, Ireland, Norway, Sweden, and Central and Southern Europe (Llimona & Hladun 2001; Nimis & Martellos 2003; Santesson *et al*. 2004; Orange *et al*. 2009).

REMARKS. A neglected taxon in Poland. This species was first reported by Lojka (1868) as *Verrucaria cyanea*, but not recorded again until 2001, when it was rediscovered by Kiszka in the Pieniny Mts (Kiszka 2001). Specimens of the taxon were collected by J. Motyka (1924–1926) and J. Nowak (1956–1958) but they were included into unidentified collections in herbaria LBL and KRAM.

EXSICCATAE SEEN. Hepp, Flechten Eur. 429 [as *Verrucaria baldensis* A. Massal. – editorial error, as *V. limitata* Kremp. according to an exsiccatae list by Hepp (1857)] (GFW); Rabenhorst, Lich. Europ. Exs. 331 (as *Verrucaria limitata* Kremp.) (KRAM).

SPECIMENS EXAMINED. DF-58 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Dolina Bętkowska, 7 Sept. 1956, *J. Nowak* (KRAM); DF-68 – Dolina Będkowska valley, 300 m, 20 Aug. 1958, *J. Nowak* (KRAM) as *Verrucaria fatrana*; DG-59 – TATRA MTS, WESTERN TATRA MTS: Dolina Kościeliska, 1924, *J. Motyka* (LBL); Dolina Białego, 10 July 1926, *J. Motyka* (LBL); EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Wąwóz Sobczański gorge, on calcareous rocks, 4 May 1957, *J. Nowak* (KRAM); EG-31 – Kramnica, Przełom Białki pod Krempachami nature reserve, in a sunny place, 28 Sept. 1997, *J. Kiszka* (KRAP); EG–51 – TATRA MTS, HIGH TATRA MTS: on rocks by Łysa Polana, 13 July 1926, *J. Motyka* (LBL).

Parabagliettoa disjuncta (Arnold) Krzewicka, ***comb. nov.*** Fig. 9

BASIONYM: *Verrucaria disjuncta* Arnold, Flora **47**(38): 599. 1864. TYPE: [Germany] An Kalkfelsen des sonnigen Felsenabhanges oberhalb von Neuessing im Altmühltale, *F. Arnold* (Arnold, Lich. Exs. Lich. Jur. 284, W! – ISOTYPE).

Prothallus brown-black to black when contiguous with conspecific thalli, and visible as thin dark lines. *Thallus* endolithic and bluish grey to in part thinly superficial and grey-brown. *Upper cortex* a pseudocortex, ill-delimited from the algal layer. *Algal* layer not clearly delimited, algal cells 8–12 µm, scattered. *Medulla* formed by a prosoplectenchyma, hyphae surrounding the perithecium K/I+ violet-rose, macrospheroids absent. *Perithecia* half immersed, forming black projections 350–450(–500) µm in diam., distinctly flat at top (truncate). *Involucrellum* well-developed, 80–150 µm thick, disc-shaped with the margin scarcely spreading downwards, extending downwards to the upper part of the excipulum, never radially cracked. *Excipulum* dark brown in upper part, colourless at base, 300–400 µm wide, 250–300 µm high. *Periphysoids* 25–35 µm long. *Asci* 45–55 µm long, 12–17 µm wide. *Ascospores* simple or rarely uniseptate, colourless, broadly-ellipsoid to globose, 8–10(–14) × 5–7 µm. *Conidiomata* not observed.

NOTE. *Parabagliettoa disjuncta* is characterized by an endolithic calcareous thallus with

perithecia distinctly flat at top and the presence of a disc-shaped involucrellum with the margin scarcely spreading downwards. Ascospores are small, broadly-ellipsoid to nearly globose. *Parabagliettoa cyanea* and *P. dufourii* differ by the size and shape of ascospores which are narrowly ellipsoid and longer than 12 µm. *Parabagliettoa disjuncta* also differs from *P. cyanea* by the size and shape of perithecia which are twice as large, also distinctly flat-topped, but with a thicker involucrellum. *Parabagliettoa dufourii* is distinguished by an involucrellum extending to the base of the excipulum, larger ascospores and conical perithecia with the apex only flat or usually concave.

HABITAT. On calcareous rocks at higher altitudes.

DISTRIBUTION IN POLAND. It was recorded on calcareous rocks in the mountains, such as the Western Tatra Mts in the Carpathians. This taxon is reported from Poland for the first time here, but specimens were collected nearly one hundred years ago in 1925 by Motyka on Łysanki Mt. but stored as unidentified collections the LBL herbarium.

WORLD DISTRIBUTION. In Europe it is known in Central Europe in Germany (Scholz 2000), the Czech Republic (Servít 1954; Vězda & Liška 1999), Slovakia (Lisická 2005), and Austria (Breuss & Berger 2010).

REMARKS. *Verrucaria disjuncta* has the same characters as the species of *Parabagliettoa*, such as the calcareous habitat, an endolithic thallus separated by dark lines, upper cortex of the pseudocortex-type, superficial to semi-immersed perithecia with an involucrellum lacking radial cracks and the lack of macrospheroids in the medulla. This combination of unique characters distinguishes the genus *Parabagliettoa* very well. For this reason *V. disjuncta* is transferred here to *Parabagliettoa*.

Pykälä (2010b) observed that the perithecia of *V. disjuncta* are quite similar to the perithecia of *V. muralis* in appearance but the sectioned perithecia of *V. disjuncta* resembled *P. dufourii* in having a very thick involucrellum. According to Breuss (2008) some spores of *V. disjuncta* are usually uniseptate. Two-celled spores were not observed in the material examined in this study but larger spores with two distinctly visible vacuoles were often recorded.

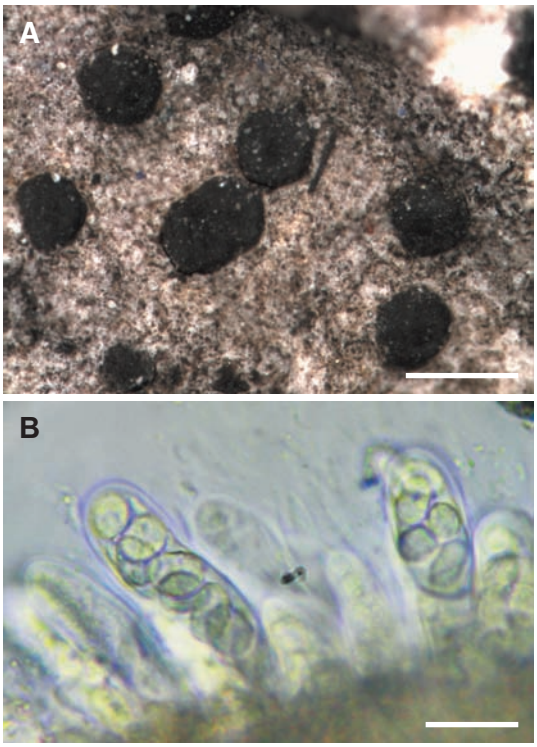

Fig. 9. *Parabagliettoa disjuncta* (Arnold) Krzewicka. A – thallus (Arnold, Lich. Exs. Lich. Jur. 284, W, as *Verrucaria disjuncta* Arnold, isotype); B – hymenium (*Motyka*, KRAM). Scale bars: A = 0.5 mm; B = 20 µm.

SPECIMENS EXAMINED. DG-59 – TATRA MTS, WESTERN TATRA MTS: Łysanki Mt. by Dolina Strążyska valley, on dolomite, 24 Aug. 1925, *J. Motyka* (KRAM, LBL).

Parabagliettoa dufourii (DC.) Gueidan & Cl. Roux Fig. 10

in Gueidan *et al*., Taxon **58**(1): 195. 2009. – *Verrucaria dufourii* DC. *in* Lamarck & De Candolle, Fl. Franç., ed. 3, **2**: 318. 1815. TYPE: France, on stones of a wall in Meudon, *s. coll*. (G – missing). – *Thelidium dufourii* (DC.) Servít, Stud. Bot. Čes. **11**(1–2): 129. 1950.

Verrucaria concinna Borrer *in* Hooker, Engl. Bot., Suppl. **1**: Tab. 2623, fig. 1. 1831. TYPE: [Great Britain,

England] on limestone rocks on the Durham shore of the Tees, near Eglistone (BM).

Prothallus whitish in isolated thalli, or brown-black to black when contiguous with conspecific thalli, then visible as thin dark lines, thalli separated by a row or a double row of brown pycnidia. *Thallus* immersed, usually level with surrounding rock or slightly lower, pale grey to brownish grey, not cracked, sometimes visible on the surface of the rock as minute brownish spots. *Upper cortex* a pseudocortex, formed by a thin prosoplectenchyma intermingled with microcrystals, sometimes with one layer of slightly pigmented cortical cells at top. *Algal* layer not clearly delimited, with algal cells in clusters, hyphae K/I+ violet. *Medulla* formed by a prosoplectenchyma, hyphae surrounding the perithecium K/I+ violet, macrospheroids absent. *Perithecia* superficial, forming distinct projections (350–)400–600 µm wide, black, not covered by thallus, apex flat or usually concave, leaving shallow pits in rock when decayed. *Involucrellum* dark reddish-brown, well-developed, 80–150(–250) µm thick in lower part, extending to the base of the excipulum. *Excipulum* pale brown to brown, 180–250 µm wide. *Periphysoids* 20–30 µm long. *Asci* 65–90 µm long, 16–20 µm wide. *Ascospores* simple, colourless, oblong to ellipsoid, 18–23 × 8–10 µm. *Conidiomata* frequent, scattered, often numerous and easily seen, appearing as brown pits 60–100 µm wide. Conidia rod-shaped, 3.3–4.5 × 0.8–1.2 µm.

NOTE. This species is characterized by an endolithic thallus often dotted with pycnidia, and by the large and prominent perithecia, commonly with a concave to deeply excavate apex, and a very thick involucrellum, often as thick as the diameter of the excipulum or more. *Parabagliettoa cyanea* differs in the smaller ascospores [12–17(–20) × 6–8 µm], a thinner involucrellum, and less prominent perithecia. *Parabagliettoa disjuncta* is easily distinguished by small, wide ellipsoid ascospores [8–10(–14) × 5–7 µm] and truncate involucrellum.

HABITAT. On the vertical surface of calcareous rocks in S- or W-facing sunny and exposed places.

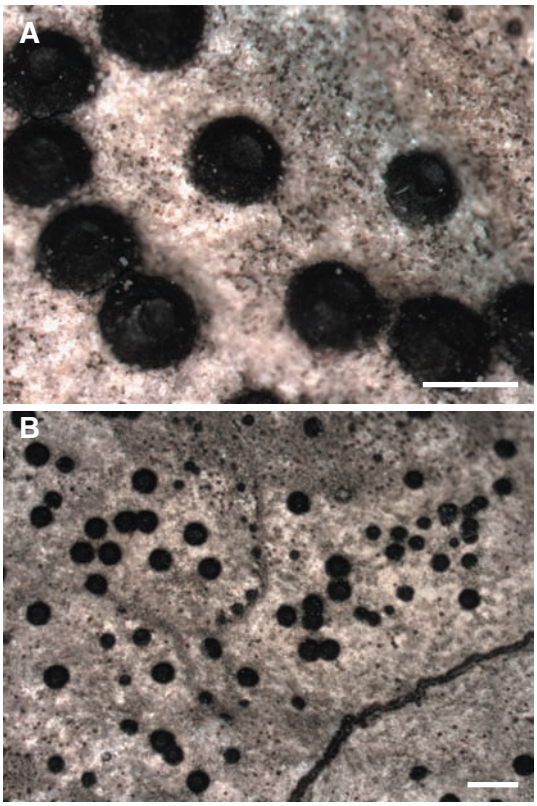

Fig. 10. *Parabagliettoa dufourii* (DC.) Gueidan & Cl. Roux. A – perithecia (*Nowak*, KRAM); B – thallus (*Nowak*, KRAM). Scale bars: A = 0.5 mm; B = 1 mm.

DISTRIBUTION IN POLAND. Reported from a few localities in the Western Tatra Mts in the Carpathians.

WORLD DISTRIBUTION. In Europe it is known in limestone areas of Britain, Ireland (Orange *et al*. 2009), France (Clauzade & Roux 1985), Spain (Llimona & Hladun 2001), Italy (Nimis & Martellos 2003), and Bulgaria (Krzewicka *et al*. 2007).

REMARKS. Rehman (1879) probably mistakenly reported this species from the Pieniny Mts and Ojców in Poland (under the synonyms *Verrucaria concinna* and *V. dufourii*). The specimens reported by him from Ojców as *V. concinna* are recognized here as *Verrucaria caerulea* (KRAM L–10191). The material from the Pieniny Mts was not found in any herbaria but they may also have belonged to *V. caerulea* because the occurrence of *P. dufourii*

in Poland was confirmed only in the Tatra Mts, the highest Polish mountains.

EXSICCATAE SEEN. Hepp, Flechten Eur. 436 (as *Verrucaria dufourii*) (GFW).

SPECIMENS EXAMINED. DG-59 – TATRA MTS, WESTERN TATRA MTS: Kominy Tylkowe Mt., 1700 m, 11 July 1959, *J. Nowak* (KRAM); Dolina Białego valley, 11 Aug. 1926, *J. Motyka* (LBL); Gładkie Upłaziańskie, 1926, *J. Motyka* (LBL); Dolina Strążyska valley, 900 m, on calcareous rock, 27 Aug. 1963, *J. Nowak* (KRAM); Dolina Smytnia valley by Dolina Kościeliska valley, 1400 m, on calcareous rock, S aspect, 12 July 1963, *J. Nowak* (KRAM); Rzędy Tomanowe by Hala Tomanowa, 1900 m, 16 June 1963, *J. Nowak* (KRAM).

THE GENUS *PLACOPYRENIUM*

Breuss (1987) transferred *Endopyrenium trachyticum* Hazsl. and *Dermatocarpon bucekii* Nádv. & Servít to the newly described genus *Placopyrenium*. The genus was established by him to include the species formerly placed in *Dermatocarpon* but characterized by placodioid thalli and areoles attached to the substrate by stipes. Subsequently, some other species were moved to the genus from *Placidiopsis* [*P. tatrense* (Vězda) Breuss – Breuss 1990], *Catapyrenium* [*C. caeruleopulvinum* J. W. Thomson – Breuss 2002], *Dermatocarpon* [*D. heppioides* Zahlbr. – Breuss 2002] and *Verrucaria* [*V. stanfordii* Herre (Knudsen & Lendemer 2006), *V. canella* Nyl. – Navarro-Rosinés *et al*. 2007]. Additionally, some species new to science were distinguished, such as *P. noxium* Breuss (Breuss 1998c), *P. insuetum* Breuss (Breuss 2000).

Recently, *Placopyrenium* was taxonomically revised by Breuss (2009), who reported 14 currently known species and three currently known varieties, including eight taxa occurring in Europe, namely *P. bucekii* (Nádv. & Servít) Breuss, *P. canellum* (Nyl.) Gueidan & Cl. Roux, *P. fuscellum* (Turner) Gueidan & Cl. Roux, *P. rubescens* (Timkó) Breuss, *P. tatrense* (Vězda) Breuss, *P. tatrense* var. *hispanicum* Breuss, *P. trachyticum* (Hazsl.) Breuss, and *P. trachyticum* var. *subtrachyticum* (B. de Lesd.) Breuss. Almost at the same time Orange (2009) reported two new species occurring in freshwater habitats: *P. cinereoatratum* (Degel.) Orange and *P. formosum* Orange. Most recently *Dermatocarpon subfuscellum* var. *serpentine* Servít was placed in the synonymy of *P. fuscellum* (Krzewicka 2009a).

Placopyrenium Breuss

in Nimis & Poelt, Stud. Geobot. **7**(Suppl. 1): 182. 1987. TYPE SPECIES: *Placopyrenium bucekii* (Nádv. & Servít) Breuss *in* Nimis & Poelt, Stud. Geobot. **7**(Suppl. 1): 182. 1987. (*Dermatocarpon bucekii* Nádv. & Servít, Beih. Bot. Centralbl. **55B**: 267. 1936).

Prothallus absent or indistinct. *Thallus* superficial, well-developed, thickly crustose, rimose-areolate, sometimes placodioid, or subsquamulose, areoles flat or convex to almost bullate, upper surface smooth, dull, whitish-grey pruinose, or naked and brown. Areoles often with black borders and subdividing lines, basally constricted to stipitate or rhizinate. *Upper cortex* a pseudocortex, paraplectenchymatous, composed of small roundish-angular cells. *Algal* layer continuous, cells more or less in columns. *Medulla* subparaplectenchymatous, or composed of densely intricate filamentous hyphae, white to densely pigmented, black basal layer present or not. *Perithecia* entirely immersed in the thallus, subglobose. *Involucrellum* absent or rudimentary. *Excipulum* colourless to brown or black. *Hamathecium* consisting of short periphyses and short periphysoids. *Asci* clavate, two-layered, fissitunicate, 8-spored. *Ascospores* simple or 1-, rarely 3-septate, colourless, ellipsoid to oblong-ovoid. *Conidiomata* present, pycnidia laminal, immersed, *Dermatocarpon*-type, conidia subcylindrical to bacilliform.

NOTE. The genus *Placopyrenium* is characterized by crustose areolate to placodioid, or subsquamulose thalli growing autonomously or facultatively parasitic on diverse crustose species. It has black-bordered areoles attached to the substrate by short stipe-like holdfasts. The pycnidia are of *Dermatocarpon*-type (Harada 1993). According to Roux (unpubl., see Gueidan *et al*. 2009), the hamathecium of *P. bucekii* is composed, as in all *Verrucariaceae*, of periphyses (very difficult to

observe and not seen in Ménard & Roux 1995) and of short periphysoids.

HABITAT. It grows on calcareous, non-calcareous or siliceous rocks, often parasitic or parasymbiotic on other lichens, especially at young developmental stages.

REMARKS. The most recent revision of *Placopyrenium* together with a key to nearly all species (except two new European taxa, *P. cinereoatrum* and *P. formosum*) is provided by Breuss (2009). Breuss confirmed the occurrence of eight species in Europe, eight in the USA, six in Mexico, and two in Asia reported from Iran and Israel.

KEY TO THE SPECIES OF *PLACOPYRENIUM*

Thallus distinctly areolate to placodioid or subsquamulose, areoles black-bordered, attached to the substrate by short stipe-like holdfasts, involucrellum absent or rarely apical, perithecia immersed in areoles. The key below includes *Verrucaria polysticta*.

1. Areoles subdivided by dark lines into few to numerous (up to 30) small units, plane to slightly convex, dark pigmented medulla absent, non-parasitic; asospores 14–18 × 5–7 µm . . . . ***Placopyrenium trachyticum***
1*. Areoles hardly subdivided, dark pigmented medulla present, initially parasitic **2**
   2. Ascospores 20–23 × 6–7 µm, with halo, young thallus initially parasitic on *Aspicilia calcarea* . . . . . ***Placopyrenium canellum***
   2*. Ascospores <20 µm long, without halo, young thallus initially parasitic on *Verrucaria* species **3**
3. Perithecia arising within photosynthetic units on the thallus surface, in surface view not connected by dark lines, prothallus absent, ascospores 12–15 × 5.5–7.0 µm . . . . . ***Placopyrenium fuscellum***
3*. Perithecia arising between photosynthetic units on the thallus surface, in surface view often connected by dark lines, prothallus often apparent, ascospores (11–)12–14 × 5.5–7.0 µm . . . . . ***Verrucaria polysticta***

Placopyrenium canellum (Nyl.) Gueidan & Cl. Roux Fig. 11

in Navarro-Rosinés *et al*., Bull. Soc. Linn. Provence **58**: 174. 2007. – *Verrucaria canella* Nyl., Flora **66**: 102. 1883. TYPE: [Great Britain] N Wales, ad Bangor, 1883, *J. E. Griffith* (H-NYL 2502); Anglia occid., 1883, *J. E. Griffith* (H-NYL 2503); Great Ormes Head, July 1882, *J. E. Griffith* (NMW 27.76.970) – SYNTYPES.

Prothallus absent or indistinct, black. *Thallus* superficial, well-developed, 260–600 µm thick, cracked. Areoles separated by deep cracks, angular in outline, plane or slightly concave, pale grey to brownish, pruinose, 0.12–0.8(–1.1) mm in diam. Upper surface subdivided by dark lines. Margin thin, initially not broken into discrete areas, but very early divided by cracks. *Upper cortex* a pseudocortex, paraplectenchymatous. *Algal* layer continuous to dissected by brown pigmented medulla parts, algae up to 5–7 µm in diam., arranged in well-defined columns. *Medulla* colourless in the upper part to densely pigmented in the lower, with dark part often occupying half of the thallus thickness. *Perithecia* 1–3(–5) per mature areole, immersed, ostiole visible as a small depression. *Involucrellum* absent. *Excipulum* 150–280 µm wide, colourless to brown in lower part. *Ascospores* simple, narrowly to oblong-ellipsoid, (18–)20–23(–28) × 6–7(–10) µm, halo present, sometimes difficult to distinguish from ascospore wall. *Conidiomata* not observed.

NOTE. The species is distinguished by large ascospores of about 20–23 × 6–7 µm, and the presence of a halo. Young thalli of *P. canellum* grow on *Aspicilia calcarea*. The other species growing on *Aspicilia* is *P. cinereoatratum* but that is parasitic on *A. aquatilis* and occurs only in freshwater habitats. *Placopyrenium fuscellum* is also parasitic but grows on members of the *Verrucaria nigrescens* group. In addition, it differs in the smaller ascospores 12–15 × 5.5–7.0 µm without a halo. *Placopyrenium trachyticum* has stipe-like attachment organs that have black cortices but are pale inside, and it lacks a dark pigmented medulla. Individuals of *P. canellum* with a reddish pigmented upper surface are similar to *P. rubescens*. However, the latter species has a clearly rosette-forming thallus with radiately elongated margin lobes and smaller ascospores (13–16 × 5–6 µm).

HABITAT. Young individuals parasitic on thalli

of *Aspicilia calcarea*, then growing independently on calcareous rocks in non-shaded places.

DISTRIBUTION IN POLAND. *Placopyrenium canellum* was reported from two sites in the mountainous region of southern Poland, such as from the Gorce Mts and the Pieniny Mts (Krzewicka 2009a).

WORLD DISTRIBUTION. In Europe, it is known from scattered localities in the Mediterranean Basin as well as in France, Hungary, Italy, Sweden, England and Wales (Zehetleitner 1978; Orange 2004a; Breuss 2009).

REMARKS. The taxon was for a long time neglected by lichenologists until 1978 when it was re-described by Zehetletiner (1978; see also Orange 2004a) from Croatia as *Verrucaria aspiciliae* Zehetl. This name was then included in the synonymy of *Verrucaria canella* by Orange (2004a). It was recently transferred from *Verrucaria* to *Placopyrenium* based on multi-gene molecular analyses (Navarro-Rosinés *et al*. 2007; Gueidan *et al*. 2009).

SPECIMENS EXAMINED. EG-22 – WESTERN BESKIDY MTS, GORCE MTS: Ochotnica Dolna, Brysiówka village, S slope of the Twarogów hill, 520 m, 5 Aug. 1999, *P. Czarnota* (GPN) as *V. fuscella*; EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Wąwóz Sobczański, on calcareous rocks, 680 m, 1 Sept. 1981, *J. Pyrek* & *Z. Toborowicz* (KTC) as *V. subfuscella*; FG-27 – EASTERN BESKIDY MTS, GÓRY SANOCKO-TURCZYŃSKIE MTS: Góry Słonne Mt., Machliny 25 Aug. 1989, *J. Kiszka* & *J. Piórecki* (KRAM).

Placopyrenium fuscellum (Turner) Gueidan & Cl. Roux Fig. 12.

in Navarro-Rosinés *et al*., Bull. Soc. Linn. Provence **58**: 174. 2007. – *Lichen fuscellus* Turner, Trans. Linn. Soc. London **7**: 90. 1804. TYPE: [Great Britain, England, East Suffolk, Yarmouth] Habitat in ecclesiarum muris apud Bradwell et Gorlestone, May 1803, *D. Turner* (BM! – LECTOTYPE; designated by Orange 2004a). – *Verrucaria fuscella* (Turner) Winch, The Botanist's Guide **2**: 45. 1807.

Dermatocarpon subfuscellum var. *serpentini* Servít, Beih. Bot. Centralb. **55**: 270. 1936. TYPE: Moravia, Mohelno in rup. serpentini ca. 300 m, 1927, *J. Suza* (PRM! – SYNTYPE). – *Dermatocarpon serpentini* (Servít) Servít, Stud. Bot. Čech. **7**(2–4): 57. 1946.

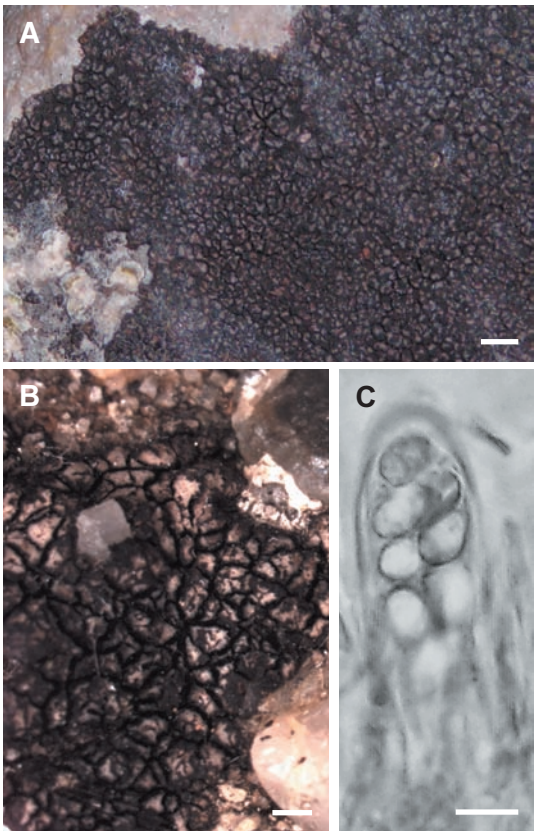

Fig. 11. *Placopyrenium canellum* (Nyl.) Gueidan & Cl. Roux. A – habit (*Jones*, NMW); B – thallus (*Czarnota*, GPN); C – ascospores (*Czarnota*, GPN). Scale bars: A = 1 mm; B = 0.5 mm; C = 15 μm.

Prothallus absent. *Thallus* superficial, well-developed, 250–800 μm thick, cracked. Young areoles 0.1–0.2 × 0.3–0.6 mm, angular, elongated; mature areoles, (0.3–)0.5–1.0 × 0.7–1.0(–2.0) mm, separated by deep cracks, angular in outline. Upper surface of mature areoles divided into smaller angular units by dark lines, pruinose. *Upper cortex* a pseudocortex, poorly defined, with dilute brown pigment. *Algal* layer dissected by brown pigmented medulla parts, algae up to 7–10 μm in diam., arranged in well-defined columns, photosynthetic units with perithecia often 3–4 times thicker than units without perithecia. *Medulla* densely pigmented. *Perithecia* 200–300 μm wide, a few

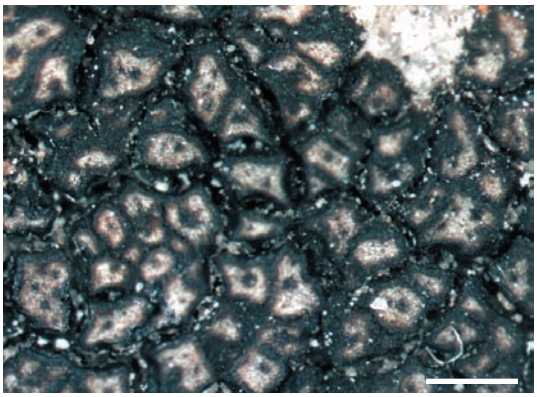

Fig. 12. *Placopyrenium fuscellum* (Turner) Gueidan & Cl. Roux (*Nowak*, KRAM). Scale bar = 0.5 mm.

present in the same photosynthetic unit, ostiole appearing at the thallus surface as a brownish spot 20–50(–80) μm wide. *Involucrellum* absent. *Excipulum* colourless to dilute brown below, 150–290 μm wide, immersed in photosynthetic units, occasionally flanked by the darkly pigmented medulla. *Ascospores* simple, oblong-ellipsoid 12–15 × 5.5–7.0 μm, without halo. *Conidiomata* not observed in examined material, according to Orange (2004a) pycnidia immersed in marginal areole, 75 × 33 μm, wall colourless, cells at ostiole faintly brown, conidia 4.5 × 1.2 μm.

NOTE. *Placopyrenium fuscellum* is distinguished by angular, elongated areoles with the upper surface usually sparsely marked by dark lines, perithecia are surrounded by the dark medulla and arise in the photosynthetic units with ostioles appearing at the thallus surface as spots up to 20–50(–80) μm wide. Young individuals are characterized by small angular areoles parasitic on *Verrucaria nigrescens*. The most similar species is *Verrucaria polysticta* Borrer (Orange 2004a), which differs by multi-angular areoles with the upper surface usually richly marked by dark lines, the presence of perithecia flanked by the dark medulla, mostly arising among photosynthetic units, and ostioles appearing at the thallus surface as disc-shaped spots up to 100–260 μm wide. *Placopyrenium canellum* differs in the presence of larger ascospores 20–23 × 6–7 μm with halo whereas *P. trachyticum* var. *subtrachyticum* and *P. tatrense* are similar in the size of ascospores but differ in 1-septate spores.

HABITAT. On exposed, sunny, natural calcareous rocks and walls and buildings. Young individuals parasitic on thalli of *Verrucaria nigrescens* while mature ones become independent.

DISTRIBUTION IN POLAND. *Placopyrenium fuscellum* occurs on natural outcrops in the mountainous regions of Poland: in the southern part of the Sudeten Mts and in the Carpathian Mts. It was also recorded in Central Poland in the Góry Świętokrzyskie Mts and the Wyżyna Woźnicko-Wieluńska Upland and the Wyżyna Krakowsko-Częstochowska Upland (Krzewicka 2009a).

WORLD DISTRIBUTION. It is known in Europe, where it is widely distributed (Orange 2004a; Breuss 2009), and in North America, where it was reported from Mexico (Breuss 2009).

REMARKS. The species was recently transferred from *Verrucaria* to *Placopyrenium* based on molecular analyses and on morphological and anatomical evidences (Navarro-Rosinés *et al*. 2007; Gueidan *et al*. 2009). *Dermatocarpon microphyllinum* Zahlbr. (Breuss 2009) and *Dermatocarpon subfuscellum* var. *serpentini* (Krzewicka 2009a) were recently included in the synonymy of *P. fuscellum*.

EXSICCATAE SEEN. Hepp, Flechten Eur. 90 (as *Verrucaria glaucina*) (GFW).

SPECIMENS EXAMINED. AE-59 – POGÓRZE ZACHODNIOSUDECKIE FOOTHILLS, POGÓRZE IZERSKIE FOOTHILLS: Pilchowice, Wapniak Mt., 1997, *M. Kossowska* (WRSL); BE-61 – WESTERN SUDETES, GÓRY KACZAWSKIE MTS: Wojcieszów, 610 m, 6 Sept. 1978, *J. Nowak* (KRAM); Wojcieszów, Miłek Mt., 1988, *A. Zalewska* (WRSL); DE-51 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Węże near Działoszyn, 20 May 1963 and 8 Oct. 1971, *J. Nowak* (KRAM); DE-62 – Łobodno near Kłobucko, 2 June 1964, *J. Nowak* (KRAM); DE-73 – Kamyk near Kłobuck, 21 May 1964, *J. Nowak* (KRAM); DE-84 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA CZĘSTOCHOWSKA UPLAND: between Olsztyn and Przymiłowice, 4 July 1963, *J. Nowak* (KRAM); DF-48 – WYŻYNA OLKUSKA UPLAND: valley of Prądnik stream by Ojców, 370 m, on calcareous rock, 16 Sept.

1958, *J. Nowak* (KRAM); DG-04 – WESTERN BESKIDY MTS, BESKID ŚREDNI MTS: Koleby near Żywiec, 400 m, 21 Sept. 1965, *J. Nowak* (KRAM) as *V. subfuscella*; EE-77 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Góra Jeleniowska Mt., 1981, *E. Pietrzyk* (KTC); EE-83 – Góra Zelejowa nature reserve near Chęciny, 29 July 1951, *J. Rydzak & W. Lecewicz* (LBL); EE-84 – POGÓRZE SZYDŁOWSKIE UPLAND: Brzeziny, on calcareous rock, 1984, *G. Sikora* (KTC); EG-22 – WESTERN BESKIDY MTS, GORCE MTS: Ochotnica Dolna Brysiówka, S slope of the Twarogów hill, 520 m, 5 Aug. 1999, *P. Czarnota* (GPN); EG-23 – near Ochotnica Dolna Michałki, 430 m, 5 Aug. 1999, *P. Czarnota* (GPN); Lubań Mt., E slope of Baszta hill, 480 m, 27 Aug. 1967, *K. Glanc* (KRAM); EG-32 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: slope of Cisowiec hill, 2 Sept. 1998, *J. Kiszka* (KRAM); Zielone Skałki near Falsztyn by stream, 27 July 1995, *J. Kiszka* (KRAM); EG-33 – Wąwóz Sobczańsk gorge, on calcareous rocks 580 m, 6 Aug. 1954, *Z. Tobolewski* (POZ); Małe Pieniny Mts, Stolarzówka, 742 m, 24 June 1982, *J. Pyrek & K. Toborowicz* (KTC); EG-34 – Małe Pieniny Mts, Biała Woda nature reserve near Jaworki, 2 June 1999, *J. Kiszka* (KRAP); EG-36 – WESTERN BESKIDY MTS, BESKID SĄDECKI MTS: Pasmo Jaworzyny range, Żebracze nature reserve, 810 m, 5 July 2001, *P. Czarnota* (GPN); EG-44 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Małe Pieniny Mts, Wysokie Skałki nature reserve near Jaworki, 12 Aug. 2002, *J. Kiszka* (KRAP); FE-70 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, WYŻYNA SANDOMIERSKA UPLAND: Ćmielów near Ostrowiec Świętokrzyski, 19 Aug. 1971, *J. Nowak* (KRAM); FG-14 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Sieniawa village, by Wisłok river on sandstone, 315 m, 20 Aug. 1974, *J. Nowak* (KRAM); FG-27 – EASTERN BESKIDY MTS, GÓRY SANOCKO-TURCZYŃSKIE MTS: Góry Słonne Mt., Jankowce, 30 May 1990, *J. Kiszka* (KRAM); FG-45 – WESTERN BIESZCZADY MTS: Komańcza Letnisko, 460 m, 18 June 1974, *J. Nowak* (KRAM); FG-69 – Bereżki, 650 m, 25 Sept. 1959, *K. Glanc* (KRAM).

Placopyrenium trachyticum (Hazsl.) Breuss Fig. 13

in Nimis & Poelt, Stud. Geobot. **7**(Suppl. 1): 183. 1987. – *Endopyrenium trachyticum* Hazsl., Verh. Vereins Naturk. Pressburg **5**: 7. 1860. TYPE: [Slovakia] Auf Trachyt bei Soofujfalu nächst Eperies [Prešov] in Ungarn. August 1860, *Weselsky* (Rabenhorst, Lich. Europ. Exs. 541, B!, TO! – SYNTYPES). – *Dermatocarpon trachyticum* (Hazsl.) Vain *in* Természetr, Füzetek **22**: 337. 1899. – *Catapyrenium trachyticum* (Hazsl.) R. Sant., Lichens of Sweden and Norway (Stockholm): 83. 1984.

Prothallus absent. *Thallus* superficial, well-developed, thickly crustose, rimose-areolate, 250–800 μm thick, mature 4–5 mm thick. Areoles subdivided by dark lines into few to numerous (up to 30) small units, plane to slightly convex, with darker and roundish-angular margins, up to (0.5–)1–5 × 3–8(–15) mm, attached to the substratum by black short stipe-like holdfasts. *Upper cortex* a pseudocortex, paraplectenchymatous, composed of small cells, with dilute brown pigment. *Algal* layer continuous, 60–100 μm thick, cells arranged in weak columns. *Medulla* subparaplectenchymatous, of rounded-angular cells, the upper part colourless, the lower more darkly pigmented, 150–500 μm thick. *Perithecia* entirely immersed in the thallus, above a darkly pigmented medulla. *Involucrellum* absent. *Excipulum* colourless to pale brown, 120–250 μm wide. *Ascospores* simple, 13–18 × 5–7 μm. *Conidiomata* not observed.

NOTE. The species is characterized by a very thick and large areolate-diffract thallus with upper surface distinctly subdivided by dark lines into a mosaic of smaller units (up to 30 units per areole). It differs from *P. canellum* and *P. fuscellum* by the absence of a carbonaceous, pigmented medulla. *Placopyrenium trachyticum* var. *subtrachyticum* is very similar to var. *trachyticum* but differs in 1-septate ascospores. *Placopyrenium tatrense* also has 1-septate spores [13–16(–17) × 5–7 μm], and is characterized by an areolate-sublobulate thallus, marginally lobed or not, rounded-angular, slightly convex areoles 0.5–2 mm wide, sparsely subdivided into smaller units. *Placopyrenium tatrense* var. *hispanicum* is identical to var. *tatrense* except for non-septate spores. *Placopyrenium bucekii*, which also has a large thallus, is easily distinguished by areoles not subdivided by dark lines in a mosaic, marginal lobes distinctly elongated 2–5 × 1–2 mm, densely greyish-white pruinose areoles and somewhat larger ascosopores 16–20 × 5–8 μm.

HABITAT. Breuss (2009) noted *P. trachyticum* on a variety of calcareous and siliceous rocks, e.g.

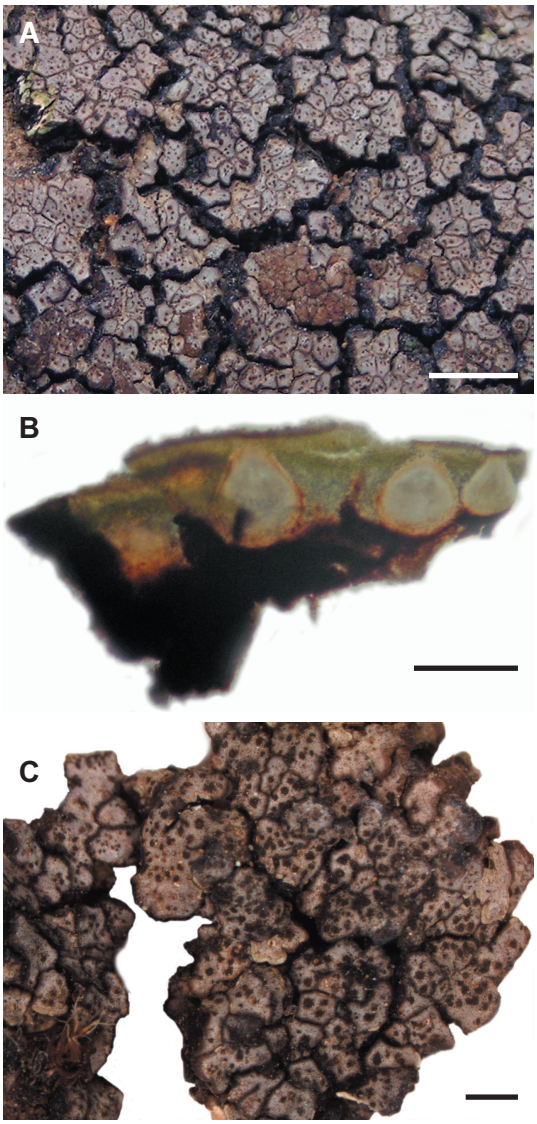

Fig. 13. *Placopyrenium trachyticum* (Hazsl.) Breuss. A – habit (*Tobolewski*, UPS); B – vertical section of thallus (*Tobolewski*, UPS); C – thallus (Rabenhorst, Lich. Europ. Exs. 541, TO, as *Endopyrenium trachyticum* Hazsl., syntype). Scale bars: A = 2 mm; B = 300 μm; C = 2 mm.

limestone, sandstone, granite, basalt, bricks and mortar. According to Breuss, it usually occurs at low altitudes, and occasionally found on coastal cliffs.

DISTRIBUTION IN POLAND. The species occurs in the Pieniny Mts (Breuss 2009), the Wyżyna Krakowsko-Częstochowska Upland (KRAM), and the Góry Świętokrzyskie Mts (KTC) It is probably more frequent in Poland but was overlooked. This taxon was first observed by Z. Tobolewski in the Pieniny Mts in 1956 and recognized as *Dermatocarpon trachyticum* (UPS).

WORLD DISTRIBUTION. In Europe widespread mainly in the central and southern parts; recorded in Bulgaria, Czech Republic, Greece, Hungary, Netherlands, Poland, Romania, Serbia, Slovakia, Spain and Turkey (Breuss 2009).

REMARKS. Breuss (2009) recently distinguished new variety within *P. trachyticum*: var. *subtrachyticum*. The latter taxon differs from typical variety (var. *trachyticum*) only by having 1-septate spores to a varying degree (from 15% to 80% of 1-septate spores).

SPECIMENS EXAMINED. DF-58 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA: Dolina Prądnika valley, Ojców National Park, Wąwóz Korytania gorge, Węże Skały rocks, 18 Sept. 2005, *J. Kiszka* (KRAP); EE-82 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Polichno, S slope of hill by village on calcareous rock, 21 Oct. 1976, *K. Toborowicz* (KTC) together with *V. nigrescens*; EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Grabczychy rocks near Nowy Targ [Sromowce Niżne], 460 m, 11 June 1956, *Z. Tobolewski* (UPS).

THE GENUS *VERRUCARIA*

Schrader (1794) used the name *Verrucaria* to differentiate the pyrenocarpous crustose species: *receptacula subglobosa*, *clausa*, *crustae innata*. He listed four species of which only one is currently included into the genus *Verrucaria* (nomenclatural type – *V. rupestris* Schrader). Based on his own and Wahlenberg's observations, Acharius (1803) later described several species of *Verrucaria*. The author listed nearly fifty species of *Verrucaria* at the time (Acharius 1803, 1810, 1814), including taxa described by other authors, for example by Schrader (1794) and Persoon (1795). In the nineteenth century the species currently recognized as *Verrucaria* and listed in the last Polish checklist

(Fałtynowicz 2003) were reported mainly under the genera *Amphoridium* (Massalongo 1852b), *Bagliettoa* (Massalongo 1853), *Lithoicea* (e.g. Massalongo 1853, 1855a), and *Verrucaria* (e.g. Lamarck & De Candolle 1805; Leighton 1851; Körber 1855; Nylander 1870; Arnold 1858; Anzi 1860; Hepp 1860; Mudd 1861).

In the early twentieth century Zschacke (1933, 1934) gave an overview of the knowledge of *Verrucariaceae* in a monograph containing available information on the systematics of all the species and their morphology. He presented 238 species of *Verrucaria* in three subgenera: *Lithoicea*, *Amphoridium* and *Euverrucaria*. Zschacke's monograph was the basis of further intensive research on *Verrucaria* in Europe. Many taxa were later described by Servít (e.g. 1936, 1946, 1949, 1950, 1951, 1954). The latter author distinguished some taxa based on characters such as the colour of the thallus or the colour or shape of the excipulum. However, in some taxa these characters change during ontogeny or vary in response to environmental conditions (Halda 2003).

The interest in both terrestrial, aquatic and maritime pyrenocarpous lichens has increased and intensified since the mid-20th century. The attention has focused on *Verrucaria* occurring in Europe (Swinscow 1968; Hawksworth 1989; Orange 1991, 2004a; Keller 1996; Thüs 2002; Orange 2000, 2004b; Motiejūnaité 2003; Krzewicka & Galas 2006; Nascimbene & Nimis 2006; Pykälä 2006, 2007, 2008, 2010a, b; Breuss 2008; Nascimbene *et al*. 2009; Pykälä & Breuss 2009; Breuss & Berger 2010) but research has also been conducted on other continents such as America (Breuss 2007a), Asia (Harada 1996b, 2000; Harada & Wang 2008), Australia and Oceania (McCarthy 1991, 1995, 2002).

The twenty first century is an era of molecular research and new perspectives in taxonomy. Phylogenetic analyses in *Verrucariaceae* were conducted for example by the F. Lutzoni team, Duke University, USA (Gueidan *et al*. 2007; Amtoft *et al*. 2008; Savić *et al*. 2008; Gueidan *et al*. 2009), and by the M. Grube team, Karl-Franzens University, Graz, Austria (Muggia *et al*. 2010). The application of new research methods in taxonomy significantly changes the current outlook on the systematic of lichens and allows some taxa of the polyphyletic *Verrucaria* to be transfered into the monophyletic genera *Bagliettoa*, *Hydropunctaria*, *Parabagliettoa*, *Placopyrenium*, *Verrucula*, *Verruculopsis*, *Wahlenbergiella* (Gueidan *et al*. 2007, 2009). However, only a little molecular work has been done on species level so far, but a similar degree of polyphyletic units and the emergence of a new generation of revisions of *Verrucariaceae* species, combining morphology and molecular characters are to be expected in the near future.

Verrucaria Schrader

Spicil. Fl. German. **1**: 108. 1794. TYPE SPECIES: *Verrucaria rupestris* Schrader, Spicil. Fl. German.: 109. 1794. [*non Verrucaria* Scop. 1777. *nom*. *rej*. Art. 14 App. III; *non Verrucaria* Weber *ex* F. H. Wigg. 1780].

Prothallus absent or present, white to black. *Thallus* crustose, immersed or superficial, subgelatinous or non-gelatinous, cracked, areolate or without any cracks, white, green, grey, brown to black, rarely with vegetative propagules (blastidia, isidia, soredia). *Upper cortex* absent, poorly defined (a pseudocortex), or well-defined (eucortex or lithocortex), the uppermost layer often pigmented. *Algal* layer ill-defined or well-developed, algal cells arranged in well-defined columns or uniformly scattered, or aggregated in groups. *Medulla* absent, or more or less well defined and paraplectenchymatous or prosoplectenchymatous, with or without black basal layer. *Perithecia* black (except in pigment deficient mutants), immersed in thallus or projecting to various degrees, sometimes forming shallow pits in substrate. *Involucrellum* usually present (very rarely absent). *Excipulum* colourless to brown. *Hymenium* colourless, the hymenial gel I+ red (I+ blue at very low concentrations of I), K/I+ blue (or rarely K/I+ red). *Hamathecium* formed by very short periphyses located in the ostiolar canal and periphysoids located in the upper part of the perithecial cavity, paraphyses absent. *Asci* two-layered, fissitunicate, 8-spored (4-spored in *V*. *madida*), clavate, K/I–. *Ascospores* simple, colourless, broadly to narrowly ellipsoid, or oblong ellipsoid, smooth, halonate

or not. *Conidiomata* pycnidia, immersed in the thallus, conidia rod-shaped, simple, colourless.

NOTE. The genus *Verrucaria* is a polyphyletic entity and only formally defined by a crustose thallus, perithecia, usually 8-spored and two-layered, fissitunicate asci, unicellular ascospores, the absence of paraphyses and the presence of periphyses and/or periphysoids.

HABITAT. Mainly on calcareous or siliceous rocks, rarely on bark or soil, in dry sites or periodically inundated or submerged in water, in maritime or freshwater habitats.

REMARKS. The genus *Verrucaria* is still polyphyletic (Gueidan *et al*. 2007, 2009; Navarro-Rosinés *et al*. 2007; Savić & Tibell 2008) and needs further studies using molecular markers at the generic as well as at the species level. The revision presented here is based on morphological characters and a first step towards clarifying the nomenclature and taxonomy of *Verrucaria* in Poland.

KEY TO THE SPECIES OF *VERRUCARIA*

1. Species in moist or freshwater habitats **2**
1*. Species in terrestrial habitats **21**
2. Asci 4-spored; ascospores 9–13.5(–15) × 5.5–7.5 µm, perithecia forming moderate projections 200–420 µm in diam., cortex with olive pigment . . . . . ***Verrucaria madida***
2*. Asci 8-spored **3**
3. Ascospores 5.5–12(–15) µm long **4**
3*. Ascospores ≥15 µm long **5**
4. Ascospores 5.5–8.0(–10) × 4.5–7(–8.0) µm, perithecia half or three-quarters immersed, forming low to moderate projections 100–240 µm in diam. . . . . ***Verrucaria aquatilis***
4*. Ascospores 10–12(–15) × 4.5–7 µm, perithecia completely immersed, visible as black points . . . . . ***Hydropunctaria rheitrophila***
5. Thallus with easily-visible continuous or discontinuous black basal layer **6**
5*. Thallus without black basal layer **8**
6. Perithecia entirely immersed in the thallus but not in thallus mounds; ascospores narrowly ellipsoid, rounded at both ends, 18–23 × 7–13 µm, ... ***Verrucaria praetermissa***
6*. Perithecia immersed in the thallus mounds, often completely covered by thallus layer **7**
7. Ascospores ellipsoid to ovoid, rounded at apices (the other end of spore distinctly narrower), 18–25 × 6–8(–10) µm, black basal layer continuous, on siliceous substrata . . . . . ***Verrucaria funckii***
7*. Ascospores broadly ellipsoid, rounded at both ends, 22–30 × 12–16 µm, black basal layer discontinuous, on calcareous substrata . . . ***Verrucaria elaeomelena***
8. Average ascospores length ≥25 µm **9**
8*. Average ascospores length <25 µm **14**
9. On calcareous substrata **10**
9*. On siliceous substrata **11**
10. Apical part of involucrellum naked, involucrellum usually confined to the upper half of the exciplum, rarely reaching to the base, perithecia half or three-quarters immersed in the thallus, raised above the thallus, forming shallow pits in the substrate, thallus dirty white to greenish, ascospores (20–)24–32 × 9–14 µm . . . . . ***Verrucaria submersella***
10*. Apical part of involucrellum usually covered by a thin thallus layer, involucrellum usually reaching to the base of the excipulum, perithecia immersed in thallus mounds, not forming shallow pits in the substrate, thallus brownish, ascospores 22–30 × 12–16 µm ***Verrucaria elaeomelaena***
11. Thallus regularly areolate-cracked, involucrellum developed in upper part of excipulum **12**
11*. Thallus continuous and uncracked to rarely rimose or areolate around perithecia, involucrellum conical, reaching to base of excipulum **13**
12. Ascospores with halo in fresh material (20–)24–29 × 8.5–12.5 µm, perithecia completely immersed in the thallus, not forming shallow pits in the substrate, involucrellum spreading outwards and downwards, thallus grey-green, yellow- or red-brown to dark brown . . . . . ***Verrucaria latebrosa***
12*. Ascospores without halo (20–)24–32 × 9–14 µm, perithecia half or three-quarters immersed, forming shallow pits in the substrate, involucrellum usually in the upper half of the excipulum, rarely reaching to the base, thallus whitish grey to green . . . . . ***Verrucaria submersella***
13. Mature asci 80–100 µm long, perithecia forming moderate to distinct projections (280–)350–800 µm in diam., often entirely covered with thallus but partly exposed later, ascospores 26–36 × 11–15 µm . . . . . ***Verrucaria margacea***
13*. Mature asci 60–80 µm long, perithecia forming conical-hemispherical projections 280–350(–500) µm in

diam., covered by a layer of thallus in lower part or rarely covered up to apex, ascospores (22–)24–27 × 10–14 µm . . . . . ***Verrucaria andesiatica***

14. Thallus dark, greyish brown, olive-brown, dark brown or black **15**

14*. Thallus pale, white-grey, white-green, pinkish, pale brown or almost absent **18**

15. Thallus regularly areolate-cracked; thallus greyish brown, dark brown or reddish brown, areolate, lower part of thallus often with ill-defined areas of brown pigment, perithecia completely or two-thirds immersed, excipulum brown or rarely colourless in the lower part, ascospores 18–22(–25) × 8–14 µm . . . . . ***Verrucaria cernaensis***

15*. Thallus usually uncracked, sometimes with a few cracks around perithecia **16**

16. Thallus smooth, continuous, perithecia completely covered by thallus, forming low projections 100–150 µm in diam., sometimes eroded later to reveal black apex **17**

16*. Thallus uneven, scabrous, granulate-bullate, perithecia half to three-quarters immersed, forming moderate to distinct projections 240–300 µm in diam., ascospores 18–23(–25) × 8–10 µm . . . . ***Verrucaria submauroides*** auct.

17. Thallus brown, brown-black, involucrellum well-visible as dark disc through wet thallus, ascospores ellipsoid, 20–25(26) × 10–15 µm . . . . . ***Verrucaria denudata***

17*. Thallus black, black-green, involucrellum not visible as dark disc through wet thallus, ascospores oblong or narrowly ellipsoid, 17–22 × 6–8 µm . . . . . ***Verrucaria pachyderma***

18. Average ascospores length ≤18 µm **19**

18*. Average ascospores length ≥20 µm **20**

19. Ascospores 15–17.5 × 6.5–8.5 µm, thallus almost absent or thinly superficial 25–50 µm thick, perithecia semi-immersed to prominent . . . . . ***Verrucaria dolosa***

19*. Ascospores 16–20 × 7–10 µm, thallus superficial 50–150 µm thick, perithecia immersed to semi-immersed . . . . . ***Verrucaria sublobulata***

20. Perithecia entirely immersed in thallus, ascospores 18–23 × 7–13 µm, involucrellum black, fused with excipulum . . . . . ***Verrucaria praetermissa***

20*. Perithecia half to three-quarters immersed, ascospores 18–22(–24) × 7–9 µm, involucrellum with a weaker coloration in basal parts, usually more or less spreading from the excipulum below . . . . . ***Verrucaria elaeina***

21. Involucrellum present **22**

21*. Involucrellum absent **44**

22. Ascospores globose to broadly ellipsoid ≤12 (–14) µm long **23**

22*. Ascospores ellipsoid to narrowly ellipsoid ≥12 µm long **24**

23. Involucrellum completely encircling the excipulum, thallus areolate to subsquamulose, ascospores globose to subglobose, 9–12 × 7.5–10 µm . . . . . ***Verrucaria sphaerospora***

23*. Involucrellum in upper half of excipulum, thallus cracked to minutely areolate, ascospores globose to broadly ellipsoid 8–10(–14) × 6–8.5 µm . . . . . ***Verrucaria tristis***

24. Average ascospores length ≥28 µm and width ≥15 µm . . . . . ***Verrucaria viridula***

24*. Average ascospores length <28 µm and width <15 µm **25**

25. Thallus hyphae K/I+ violet-blue or pinkish violet, at least by perithecia **26**

25*. Thallus hyphae K/I– **27**

26. Macrospheroids present, ascospores oblong, 12–18(–21) × (4–)5–7 µm . . . . . ***Verrucaria polonica***

26*. Macrospheroids absent, ascospores ellipsoid 14–17(–20) × 7–9 µm . . . . . ***Verrucaria amylacea***

27. Thallus endolithic or thinly superficial, less than 50 µm thick **28**

27*. Thallus superficial, more than 50 µm thick . . . **31**

28. Perithecia (as seen in surface view) 250–500 µm in diam. **29**

28*. Perithecia (as seen in surface view) 100–150(–180) µm in diam. **30**

29. Ascospores narrowly ellipsoid (20–)22–28(–32) × 7–9 µm, thallus endolithic, bluish, perithecia superficial, slightly pruinose at the base . . . . . ***Verrucaria cincta***

29*. Ascospores broadly ellipsoid 17–25(–27) × 9–14 µm, thallus partially superficial, dirty white, perithecia superficial to one-third immersed, not pruinose at the base . . . . . ***Verrucaria muralis***

30. Ascospores 15–17.5 × 6.5–8.5 µm, thallus almost absent or thinly superficial, pale to dark green or olive-brown, glossy, parapletenchymatous, excipulum colourless becoming throughout pale to dark-brown, perithecia not forming shallow pits in rock . . . . . ***Verrucaria dolosa***

30*. Ascospores (15–)18–22(–24) × (6–)8–9(–10) µm, thallus endolithic, yellowish to mouse-coloured, dull, prosoplectenchymatous, excipulum

colourless except for the upper part, perithecia forming shallow pits in rock . . . . . ***Verrucaria myriocarpa***

31. Thallus with well distinguished black basal layer **32**

31*. Thallus without black basal layer, sometimes some brown walled cells of medulla present in basal layer **34**

32. On siliceous rocks; ascospores ellipsoid, 16–18 × 6 µm . . . . . ***Verrucaria umbrinula***

32*. On calcareous rocks or bricks, ascospores larger **33**

33. Basal layer often occupies half or two-thirds of the thallus thickness, areoles similar in size, ascospores (17–)20–28(–30) × 8–15 µm, on calcareous rock . . . . . ***Verrucaria nigrescens***

33*. Basal layer thinner than half of the thallus thickness but often two layers present, areoles various in size, ascospores 18–24 × 10–12 µm, reported often from bricks . . . . . ***Verrucaria tectorum***

34. Thallus white-green, grey, bluish grey or grey-brown **35**

34*. Thallus pale brown, yellowish brown to dark brown or nearly black **37**

35. Thallus bluish grey to dull grey-brown, cracked-areolate, perithecia three-quarters to completely immersed in thallus, ascospores 13–17 × 5.5–7 µm . . . . . ***Verrucaria caerulea***

35*. Thallus white, pale grey or grey-green, cracked or not, perithecia one-third to three-quarters immersed in thallus or substrate, ascospores >17 µm long **36**

36. Thallus inconspicuous, finely cracked, perithecia sessile or one-third to half immersed, ascospores ellipsoid, 17–25(–27) × 9–14 µm . . . . . ***Verrucaria muralis***

36*. Thallus uncracked or with few cracks, perithecia half to three-quarters immersed, ascospores narrowly ellipsoid, 18–22(–24) × 7–9 µm . . . . . ***Verrucaria elaeina***

37. Ascospores ≤20 µm long **38**

37*. Ascospores >20 µm long **41**

38. Thallus pale brown to yellowish brown . . . **39**

38*. Thallus dark brown to black **40**

39. Thallus yellowish brown, 100–150 µm thick, often patchy or present as small flecks, continuous to cracked, glossy, perithecia half or one-quarter immersed, ascospores 14–18 × 7–9 µm . . . . . ***Verrucaria maculiformis***

39*. Thallus pale brown, 200–300 µm thick, often raised above surrounding rock, continuous to extensively cracked, dull, perithecia half immersed, ascospores 15–18 × 6– 8 µm . . . . . ***Verrucaria pinguicula***

40. Thallus granular, irregularly rimose-areolate, subgelatinous when wet, ascospores 12–17(–22) × 7.5–9(–10) µm . . . ***Verrucaria acrotella*** auct.

40*. Thallus continuous to irregularly rimose, some cracks present around the perithecia in thicker parts of thallus, non-gelatinous when wet, ascospores 16–25(–27) × 8–10(–13) µm . . . . . ***Verrucaria nigroumbrina***

41. Thallus ≥300 µm thick **42**

41*. Thallus <300 µm thick **43**

42. Areoles 0.4–1.5 × 0.6–1.8 mm, periphyses branched-anastomosing, thallus mid-brown, medulla white, ascospores (20–)25–32 × 10–15 µm . . . . . ***Verrucaria macrostoma***

42*. Areoles 0.2–0.4(–0.7) × (0.2–)0.4–0.6(–1) mm, periphyses not anastomosing, thallus dark brown to blackish, medulla in lower part reddish brown, ascospores 19–26 × 9–12 µm . . . . . ***Verrucaria procopii***

43. Brown basal layer of thalus present, white medulla well visible in cracks, thallus areolate cracked, 150–200(–300) µm thick, fertile areoles 3–4 times bigger than sterile, ascospores 23–25 × 8–10(–12) µm . . . . . ***Verrucaria cataleptoides***

43*. Brown basal layer of thalus absent, white medulla not visible in cracks, thallus continuous to discontinuous, not regularly areolate, 100–200(–300) µm thick, fertile areoles twice or less bigger than sterile, ascospores 16–25(–27) × 8–10(–13) µm . . . . . ***Verrucaria nigroumbrina***

44. Species growing on soil, mosses or soil-impregnated wood **45**

44*. Species growing on rocks or parasitic on lichens **46**

45. Ascospores narrowly ellipsoid, 19–25 × 6–7 µm, excipulum slightly paler at base, thallus grey-green . . . . . ***Verrucaria bryoctona***

45*. Ascospores ellipsoid, 15–20 × 5–7 µm, excipulum pigmented throughout, thallus brown . . . . . ***Verrucaria xyloxena***

46. Species initially parasitic on *Verrucaria nigrescens* gr., areoles with black sides, upper surface usually marked by dark lines, ascospores (11–)12–14 × 5.5–7.0 µm . . . . . ***Verrucaria polysticta***

46*. Species growing on rocks **47**

47. Thallus almost entirely immersed in calcareous rock, at most the upper part appearing at the surface as a very thin and inconspicuous covering **48**

47*. Thallus superficial, areolate-cracked **49**

48. Excipulum elongate 400–700 µm wide and 500–700(–800) µm high, ascospores (25–)30–32(–40) × 15–20(–23) µm . . . . . ***Verrucaria hochstetteri***

48*. Excipulum globose, 170–250 µm wide and high, ascospores 16–21 × 7–10 µm . . . . . ***Verrucaria viridicans***

49. Perithecia entirely immersed in the thallus; ascospores 16–26 × 10–13 µm . . . . . ***Verrucaria ochrostoma***

49*. Perithecia more or less prominent **50**

50. Thallus dark brown, perithecia (1–)8–18 per areole, excipulum pale brown to brown throughout, globose or slightly ellipsoid, 180–250 µm, ascospores 16–22 × 7–8 µm . . . . . ***Verrucaria obfuscans***

50*. Thallus dirty white, perithecia 1 per areole, excipulum mostly colourless but brown adjacent to ostiole, globose, 120–160 µm, ascospores 17–20(–24) × 9–10(–11) µm . . . . . ***Verrucaria policensis***

Verrucaria acrotella auct. Fig. 14

non Ach. Meth. Lich. Suppl.: 123. 1803.

Prothallus thin, brown, fimbriate. *Thallus* superficial, pale brown to dark brown or blackish, moderately thick, 70–200 µm thick, with granular verrucae, discontinuous, often present only around perithecia, irregularly rimose-areolate. Areoles subangular to irregularly shaped, 0.3–0.5(–1) mm wide, sometimes widely separated or in small groups, surface plane, matt. *Upper cortex* a pseudocortex, cells walls brown. *Algal* cells 6–10 µm in diam., dispersed throughout. *Medulla* paraplectenchymatous, 70–200 µm thick, without black basal layer. *Perithecia* immersed in areoles, 1 or 3 per areole in central part, at margin more superficial with basal part immersed in thallus, forming low to moderate or hemispherical projections 150–200(–250) µm wide. *Involucrellum* extending to excipulum base level and slightly incurved beneath, broadening to 40–60 µm thick at base. *Excipulum* brown, globose, 200–250 µm wide. *Periphysoids* up to 20 µm long. *Asci* 50–65 µm long, 10–17 µm wide. *Ascospores* simple, colourless, ellipsoid, colourless, 12–17(–22) × 7.5–9(–10) µm. *Conidiomata* not observed.

NOTE. This species is characterized by a dark brown and granular-verrucose to irregularly rimose-areolate thallus without a black basal layer. Perithecia are sessile on the substrate but they are surrounded by thalline granules at the base. *Verrucaria dolosa* also has superficial perithecia but differs in the presence of a non-gelatinous very thin thallus with a smooth and glossy upper surface. *Verrucaria acrotella* auct. is similar in appearance to *V. submauroides* auct., which also has a dark brown, discontinuous, granular thallus, disappearing in places, but the latter species differs by its freshwater habitat and larger ascospores (18–23 × 7–9 µm). *Verrucaria maculiformis* has a pale brown moderately thick and patchy thallus which is non-granular and rimose with a smooth and glossy upper surface.

HABITAT. On siliceous or non-calcareous stones, in open habitats, often on paths on pebbles embedded in the ground.

DISTRIBUTION IN POLAND. Reported from many localities in northern and central Poland, frequent at lower altitudes. Previously, it has been reported only from a few localities (Stein 1879; Eitner 1895; Cieśliński & Tobolewski 1988, 1989; Cieśliński 2003). A large and unpublished collection of *Verrucaria acrotella* auct. was gathered by M. Ceynowa-Gieldon (Toruń) in Central Poland. Her collection is deposited in the herbarium of Nicolaus Copernicus University, Toruń (TRN).

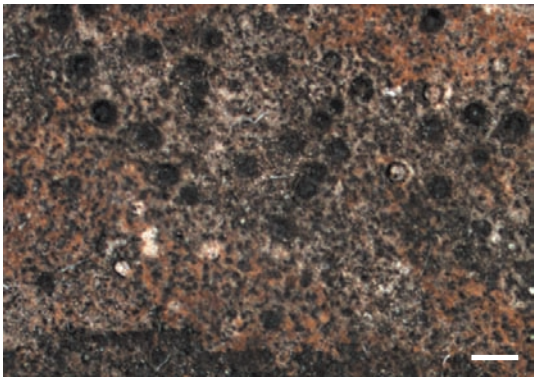

Fig. 14. *Verrucaria acrotella* auct. (*Stein*, WRSL). Scale bar = 0.5 mm.

WORLD DISTRIBUTION. Due to frequent misidentification and changing concept of this species the distribution is currently unknown.

REMARKS. Swinscow (1968) noted that the type material of *V. acrotella* Ach. (H) is in a poor condition and it consists of three small pieces of rock with scanty and depauperate growth of lichen on them. The type material is in such a poor condition that it sheds little light on distinguishing characters of the species. This is probably the reason why *V. acrotella* is characterized slightly differently in various countries (Zschacke 1933; Breuss 2007a) and at this moment it is recognized as *V. acrotella* auct. in Europe (Orange *et al.* 2009). The name is retained here, as it is likely that a published name exists for this taxon, but further taxonomic studies are needed.

SPECIMENS EXAMINED. CA-98 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Babi Dół near Kartuzy, 25 July 1935, *F. Krawiec* (POZ); DB-35 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE IŁAWSKIE LAKELAND: Stare Miasto near Dzierzgoń, 23 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DB-96 – POJEZIERZE CHEŁMIŃSKO-DOBRZYŃSKIE LAKELAND, POJEZIERZE BRODNICKIE LAKELAND: Mierzęcice near Nowe Miasto Lubawskie, 24 Sept. 1997, *M. Ceynowa-Giełdon* (TRN).

Verrucaria amylacea Hepp Fig. 15

in Arnold, Flora **41**: 537. 1858. TYPE: An Kalkfelsen in der Schlacht Steinleiten ober der Wöhrmühle bei Muggendorf (Arnold, Lich. Exs. Lich. Jur. 84B, W!, WRSL! – TOPOTYPES).

Verrucaria amylacea f. *compacta* Arnold, Flora **68**: 78. 1885. TYPE: An Grunde einer Kalkwand oberhalb der Bubenrother Mühle bei Breitenfurt, Eichstätt, *Arnold* (Arnold, Lich. Exs. Lich. Jur. 173, WRSL! – ISOTYPE). Synonymised here.

Prothallus indistinct, whitish. *Thallus* thin, superficial, non-gelatinous, white to pale grey or bluish grey, cracked into areoles. Sides of areoles not pigmented, surface of areoles matt, scabrid, uneven with large white crystals. *Upper cortex* a pseudocortex, prosoplectenchymatous, 30–50 µm thick, upper surface with crystals surrounded by hyphae, covered with dead cells, upper surface uneven and very scabrous, without brown pigment. *Algal* layer prosoplectenchymatous, clearly delimited, 100–150 µm thick, hyphae K/I+ pinkish violet, algal cells 15–20 µm in diam., scattered. *Medulla* weakly defined, prosoplectenchymatous. *Perithecia* half to three-quarters immersed in the thallus, forming black projections 150–200(–300) µm in diam., leaving shallow pits in rock. *Involucrellum* thin, 20–30 µm thick, appressed to excipulum and reaching to its base. *Excipulum* globose, colourless to pale brown in upper part, 150–200 µm wide. *Periphysoids* up to 20 µm long. *Asci* 45–60 µm long, 15–20 µm wide. *Ascospores* simple, colourless, ellipsoid 14–17(–20) × 7–9 µm. *Conidiomata* not observed.

NOTE. This species is characterized by a superficial whitish thallus cracked into areoles, a distinctly scabrid upper surface, and I+ vegetative hyphae. *Verrucaria polonica* also has an I+ thallus but differs in the presence of macrospheroids in the medulla and in the smaller ascospores [12–18(–21) × (4–)5–7 µm]. *Verrucaria caerulea* is similar in appearance but differs in the nearly completely immersed perithecia, narrower ascospores (13–17 × 5.5–7 µm) and the smooth thallus surface. *Verrucaria pinguicula* differs by the brownish thallus, distinctly raised above the surrounding rock, and the presence of an algal layer with cells arranged in vertical columns, and an I– thallus. *Verrucaria muralis* differs in larger perithecia forming conical-hemispherical projections (300–500 µm wide) and a more or less smooth upper surface not cracked into areoles. *Verrucaria elaeina* has ascospores of a similar size, but differs in the non-scabrid thallus. *Verrucaria cincta* differs in the endolithic thallus and superficial perithecia forming hemispherical to prominent projections 300–400(–500) µm in diam. *Verrucaria myriocarpa* has an immersed to partly superficial thallus visible as small dark spots and superficial perithecia forming prominent projecting without a thalline cover.

HABITAT. On limestone and dolomites, on exposed surface of rocks.

DISTRIBUTION IN POLAND. Recorded from the

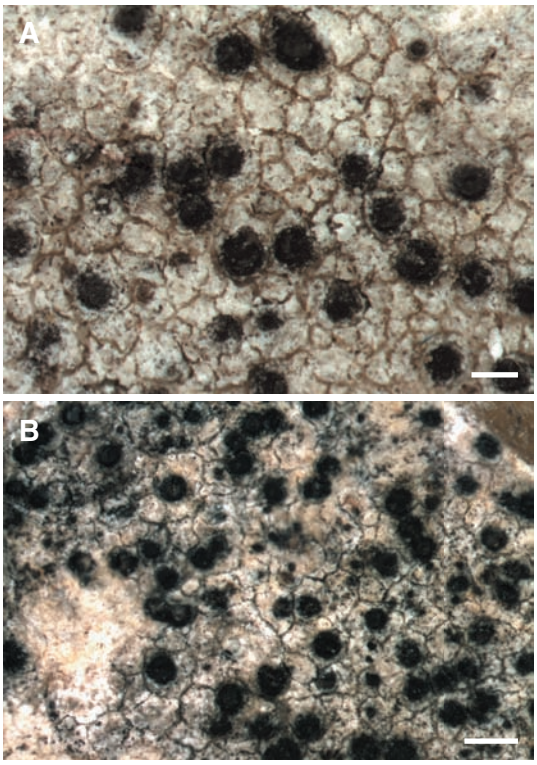

Fig. 15. *Verrucaria amylacea* Hepp. A & B – thallus (A – Arnold, Lich. Exs. Lich. Jur. 84B, WRSL, topotype; B – Arnold, Lich. Exs. Lich. Jur. 173, WRSL, as *Verrucaria amylacea* f. *compacta* Arnold, isotype). Scale bars: A = 250 μm; B = 0.5 mm.

Wyżyna Krakowsko-Częstochowska upland and in the Kujawy region. Probably it is more frequent but overlooked in the field as *V. muralis*. *Verrucaria amylacea* was noted more than one hundred years ago by Boberski (1892) in the Pieniny Mts and next by Eitner (1895) in Silesia. However, the material reported both from Silesia ('Kottlischowitz bei Tost') and from the Pieniny Mts belong to *V. muralis* (WRSL).

WORLD DISTRIBUTION. Poorly known in Europe, reported in Central Europe from several countries: Austria, Czech Republic, Germany, Italy (Nimis 1993; Vězda & Liška 1999; Scholz 2000; Hafellner & Türk 2001; Bruess 2008).

REMARKS. Ciurchea (1998) regarded *V. amylacea* as a synonym of *V. caerulea*, but according to Bruess (2008) and in my opinion both lichens are well separated at the species level.

The name *Verrucaria amylacea* f. *compacta* is proposed here as a synonym of *V. amylacea*. The material designated by Arnold as forma *compacta* (WRSL) is in fact a deformed morph of *V. amylacea*, as a result of parasite infestation.

SPECIMENS EXAMINED. CC-67 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE GNIEŹNIEŃSKIE LAKELAND: Kołuda Mała, 1 Aug. 1995, *M. Ceynowa-Giełdon* (TRN); DC-06 – POJEZIERZE CHEŁMIŃSKO-DOBRZYŃSKIE LAKELAND, DOLINA DRWĘCY VALLEY: Głęboczek near Brodnica, 22 Sept. 1997, *M. Ceynowa-Giełdon* (TRN).

Verrucaria andesiatica Servít Fig. 16.

Stud. Bot. Čech. **11**(1–2): 14. 1950. TYPE: Ucraina transcarpatica: Uzhorod. Velke Lazy, 150 m, ad saxa andesiatica, *Nádvorník* (PRM – HOLOTYPE).

Prothallus thin and dark or absent. *Thallus* superficial, subgelatinous, thin, 20–50 μm thick, glossy, smooth, more or less continuous, rimose, rarely almost areolate around the perithecia, green, olive-brown to dark brown. *Upper cortex* weakly-defined. *Algal* cells not arranged in vertical columns, algal cells 5–9 μm in diam. *Medulla* weakly differentiated, very thin, paraplectenchymatous, without black basal layer. *Perithecia* prominent, forming conical-hemispherical projections 280–350(–500) μm in diam., covered by a layer of thallus in lower part or rarely covered up to apex. *Involucrellum* black, thin, less than 35 μm thick, conical, spreading at base and not appressed to excipulum, unpigmented angle present between involucrellum and excipulum. *Excipulum* colourless in the lower part, pale brown at apex, (100–)200–230 μm wide. *Periphysoids* up to 25–30 μm long. *Asci* 60–80 μm long, 22–28 μm wide. *Ascospores* simple, colourless, elongate ellipsoid, narrower at one end (22–)24–27(–30) × 10–14 μm, not halonate. *Conidiomata* not observed in material examined.

NOTE. This amphibious species is distinguished by a very thin, green to dark brown continuous thallus lacking a black basal layer, prominent perithecia and large ascospores. *Verrucaria*

submauroides auct. also has prominent perithecia free of thallus above, and lacks a basal layer, but has shorter and more elongated ascospores [18–23 × 7–9 µm]. *Verrucaria margacea* differs in the smooth to cracked thallus and larger ascospores [up to 36(–41) µm] and longer asci (80–100 µm).

HABITAT. Amphibious species occurring on siliceous rocks in the splash zone of mountain streams in shady places.

DISTRIBUTION IN POLAND. This taxon has been recorded at two localities in the Carpathian Mts in the Tatra Mts and the Bieszczady Mts.

WORLD DISTRIBUTION. *Verrucaria andesiatica* has been recorded in Central Europe (Thüs & Schultz 2008) and probably in Britain (Orange *et al*. 2009) (see below comment).

REMARKS. According to Orange *et al*. (2009) *V*. *andesiatica* is widespread in N and W Britain, whereas Thüs and Schultz (2008) reported it only from two localities in Central Europe, in Poland and in Ukraine. However, it is most likely that the material from Britain and from the continent belongs to two different taxa. For example, some specimens from Britain have pycnidia, which have never been observed in the continental material [according to Orange *et al*. (2009) pycnidia are occasionally present in lines at the interfaces between neighbouring thalli; conidia are straight to slightly curved, 3–4.5 × 1–1.2 µm, additionally ascospores are halonate, halo up to 0.8 µm thick on some ascospores whereas on the continent only non-halonate ascospores were observed] also the black bordered line has never been observed in continental specimens and the ascus length which is regarded as a diagnostic character for *V*. *andesiatica* by Thüs and Schultz (following Servít's protologue for this species) has not been investigated for the British material.

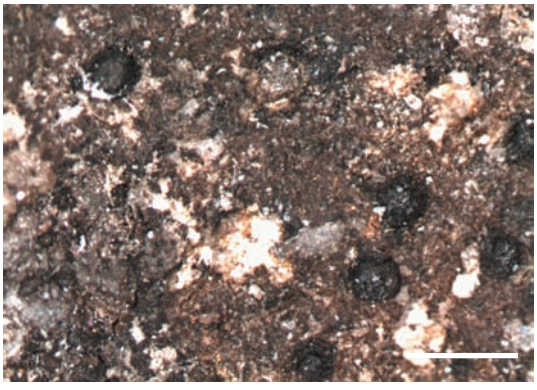

Fig. 16. *Verrucaria andesiatica* Servít (*Krzewicka*, KRAM). Scale bar = 0.5 mm.

Verrucaria andesiatica has an uncertain phylogenetic position which requires further studies. Thüs and Schultz (2008) included this taxon into the *V*. *margacea*-complex together with two other species: *V*. *elaeomelaena* and *V*. *margacea*.

SPECIMENS EXAMINED. DG-58 – TATRA MTS, WESTERN TATRA MTS: Dolina Chochołowska valley, Chochołowski Potok stream by Polana Chochołowska 1105 m, 16 July 2004, *B*. *Krzewicka 2719a* (KRAM); Dolina Chochołowska valley, in Chochołowski stream on granite boulders, 1010 m, 16 July 2004, *B*. *Krzewicka 2766c* (KRAM); FG-57 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Buk village, in stream, left of tributary of Solinka river, E slope of Jamy hill, 17 May 2008, *B*. *Krzewicka* (KRAM); FG-68 – Bieszczadzki National Park, valley of Górna Solinka stream, in water, 25 July 2000, *J*. *Kiszka* (KRAP).

Verrucaria aquatilis Mudd Fig. 17

Man. Brit. Lich.: 285. 1861. TYPE: [Great Britain, Northeast Yorkshire] In stream near Ayton, Cleveland, 1854, *Mudd* (BM! – LECTOTYPE, designated by Swinscow 1968). – *Lithoicea aquatilis* (Mudd) Stein, Cohn, Krypt.-Flora von Schles. **2**: 325. 1879.

Verrucaria aquatilis var. *aerimontana* Servít, Československé Lišenjníky Čeledi Verrucariaceae: 143. 1954. TYPE: Klášterce n. Oh. Útočiště, 390 m, 1952. *M*. *Servít* (PRM 858229! – LECTOTYPE designated here). Synonymized here.

Verrucaria atroviridis Servít *ex* J. Nowak & Tobol., Porosty Polskie: 1120. 1975. – *Verrucaria atroviridis* Servít, Československé Lišenjníky Čeledi Verrucariaceae: 145. 1954. *nom*. *inval*. TYPE: [Czech Republic] Bohemia: Kadaně, Pestyn nidolicko 500 m, 1951, *Servít* (PRM 32-807-p! – HOLOTYPE). Synonymized here.

?*Verrucaria maura* var. *memnonia* Körb., Syst. Lich. Germaniae: 340. 1855. TYPE: Ad saxa granitica (rarius schistose) in sylvis umbrosis vallis Hirschbergensis Silesiae, *G*. *Körber* (Körber, Lich. Sel. Germ. 173,

M – SYNTYPE). – *Verrucaria memnonia* (Körb.) Arnold, Flora **44**: 535. 1861.

Prothallus inconspicuous, dark brown or absent. *Thallus* superficial, subgelatinous, smooth or slightly roughened, thin, (10–)20–55 µm thick, greenish brown, brownish black or black, uncracked, continuous (or in herbarium cracked when thallus is dry). *Upper cortex* greenish brown to dull brown, sometimes covered by a transparent layer of dead cells. *Algal* cells uniformly scattered, 10–15 µm in diam. *Medulla* paraplectenchymatous, unpigmented, or with brown pigment sparse to extensive, but not forming a well-defined basal layer, sometimes with a few intensely pigmented punctae within thallus. *Perithecia* forming low to moderate conical-hemispherical projections, half or three-quarters immersed, 100–240 µm in diam., more or less concolorous with thallus, covered at least when young by a layer of thallus. *Involucrellum* dark brown, conical, reaching base of thallus. *Excipulum* colourless at side and base, globose, 80–160 µm wide, with ostiole inconspicuous, sometimes visible as a minute pit up to 20 µm wide. *Periphysoids* up to 15 µm long. *Asci* 30–35 µm long, 14–16 µm wide. *Ascospores* simple, colourless, broadly ellipsoid, 5.5–8.0(–10) × 4.5–7(–8.0) µm, without halo. *Conidiomata* not detected.

NOTE. This amphibious species is easily distinguished from the other freshwater species of *Verrucaria* by a thin, black thallus, half to completely immersed, small perithecia, a small excipulum, and very small broadly ellipsoid ascospores (17–22 × 6–8 µm). *Verrucaria pachyderma* also has a black thallus but differs in completely immersed perithecia and larger ascospores *Verrucaria madida* is similar in appearance but has larger perithecia and ascospores [9–13.5(–16) × 5.5–7.5 µm], 4-spored asci and a greenish black thallus with dark olive cortical pigment. *Hydropunctaria rheitrophila* differs in the green or brown thallus, completely immersed perithecia covered by involucrellum which is scabrous above, slightly larger ascospores [10–12(–15) × 4.5–7 µm], and conspicuous black punctae in the thallus.

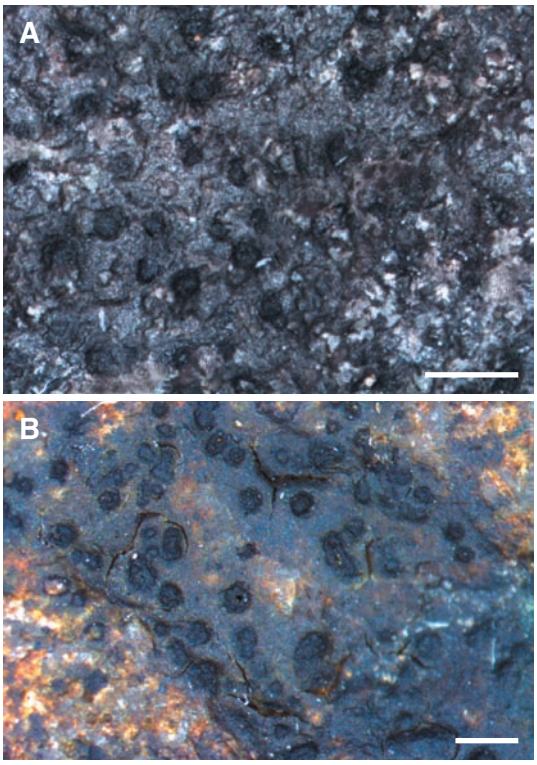

Fig. 17. *Verrucaria aquatilis* Mudd. A & B – thallus (A – *Nowak*, KRAM; B – *Mudd*, BM, lectotype). Scale bars = 0.5 mm.

HABITAT. Amphibious species occurring on submerged siliceous rocks but also tolerating basic substrates; the black thallus may be overlooked in the field as a dead lichen.

DISTRIBUTION IN POLAND. This is one of the commonest freshwater species in Poland. Reported from many scattered localities in clean streams and small rivers throughout the country, mainly from mountainous regions but also recorded at scattered sites in the lowlands. Probably even more frequent but often overlooked in the field.

WORLD DISTRIBUTION. Known throughout Europe, widespread in the world (Feuerer 2011).

REMARKS. Servít (1954) recognized a var. *aerimontana*, based on a slightly larger excipulum (100–150 µm wide) than the type and a dark olive thallus which is darker when moist. However, the type specimen of var. *aerimontana* (PRM) agrees

with var. *aquatilis* in the dark thallus, small and one-quarter to three-quarters immersed perithecia, broadly ellipsoid ascospores without a halo, 5.5–8.0 × 4.5– 6.2 μm, and 8-spored asci. This specimen grows together with *Bacidina inundata* and it is partially deformed by the hyphae of the latter which grows throughout its thallus [similar interactions were previously observed by Thüs (2002) in *B*. *inundata* and *V. denudata* (= *V*. *hydrela*)]. The colour of the thallus is variable, depending on humidity and sun exposure. Therefore, the name *Verrucaria aquatilis* var. *aerimontana* is proposed here as a synonym of *Verrucaria aquatilis*. The type specimen of var. *aerimontana* deposited in PRM (PRM 858229) and reported by Servít as '*sp*. *or*.' is designated here as a lectotype. Other specimens mentioned in the protologue and deposited in the Magnusson herbarium were not examined in this study.

The type material of *V*. *atroviridis* (PRM 32-807-p) is similar to *V*. *aquatilis* in appearance (Servít 1954). It has a black, smooth and subgelatinous thallus with perithecia forming low to moderate conical-hemispherical projections, similar to *V*. *aquatilis*. The type has ascospores mainly up to 7–10 μm long and 6–8 μm wide, with only a few reaching 12–14 μm as reported in the protologue. *Verrucaria atroviridis* possesses brown areas in the thallus but these are also more or less frequent in *V*. *aquatilis*. *Verrucaria atroviridis* is proposed here as a synonym of *V*. *aquatilis*.

The type material of *Verrucaria maura* var. *memnonia* (M) resembles *V*. *aquatilis* in the thin black thallus, small perithecia, and small globose excipulum. However, ascospores were not observed in the type material (M) during the study. Körber (1855) reported this variety as occurring in shaded places in mountain forests. He did not specify whether the specimens had been collected in a moist habitat or not. But the specimen of var. *memnonia* from M grew on rock together with moss *Schistidium apocarpum*-aggr. The moss is sterile and could not be clearly identified; some taxa of *S*. *apocarpum*-aggr. can grow in aquatic habitats but the others in terrestrial moist or dry habitats. Possibly examination of duplicates of Körber's collection (no. 173) in other herbaria could determine whether var. *memnonia* is a truly amphibious lichen.

Specimens examined. CA-89 – Pobrzeże Gdańskie coastland, Pobrzeże Kaszubskie coastland: Gdańsk Oliwa, Dolina Ewy valley, July 2000, *M. Kukwa* (UGDA); Trójmiejski Landscape Park, Źródliska w Dolinie Ewy nature reserve, in stream, 31 May 2003, *M. Kukwa 1821* (UGDA); CB-16 – Pojezierze Wschodniopomorskie lakeland, Pojezierze Kaszubskie lakeland: Kościerzyna, stream in Jarząbce forest, Aug. 1935, *F*. *Krawiec* (POZ); CB-68 – Pojezierze Południowopomorskie lakeland, Bory Tucholskie forest: 1 km E of Stara Rzeka village, on stones in water, 13 June 2004, *M. Kukwa 3292* (UGDA); DB-78 – Pojezierze Chełmińsko-Dobrzyńskie lakeland, Garb Lubawski hummock: Wzgórz Dylewskich Landscape Park, 1 km NW of Glaznoty, on stones in stream, 2 June 2001, *M. Kukwa 795* (UGDA); DD-67 – Wzniesienia Południowomazowieckie heights, Wzniesienia Łódzkie hills: Wzniesienia Łódzkie Landscape Park, on stones in Młynkówka stream, 27 Sept. 2006, *M. Hachułka* (LOD); DE 85 – Wyżyna Woźnicko-Wieluńska upland, Wyżyna Wieluńska upland: Mstów village, 4 July 1963, *J*. *Nowak* (KRAM); DF-57 – Wyżyna Krakowsko-Częstochowska upland, Rów Krzeszowicki depression: Filipowice near Krzeszowice, in stream, 19 June 1956, *J*. *Nowak* (KRAM); DF-95 – Western Beskidy Mts, Beskid Mały Mts: Wielki Cisownik, 550 m, 13 April 1961, *J*. *Nowak* (KRAM); DF-96 – in stream below Królewizna hill (Królowa Wyżnia), 550 m, 28 Aug. 1961, *J*. *Nowak* (KRAM); DG-06 – Beskid Żywiecki Mts: Pasmo Jałowieckie range, in Czerna stream, 500 m, 5 Sept. 1965, *J*. *Nowak* (KRAM); DG-09 – Beskid Średni Mts: Kaczanka stream below Kotoń near Pcim, 480 m, 15 April 1966, *J*. *Nowak* (KRAM); Skomielna Czarna, on N slope of Kokorzyk hill, in stream, 590 m, 4 Oct. 1996, *J*. *Nowak* (KRAM); DG-23 –Beskid Żywiecki Mts: Wielka Racza range, Góra Hutyrów by Rajcza, 600 m, 6 Aug. 1964, *J*. *Nowak* (KRAM); DG-58 – Tatra Mts, Western Tatra Mts: Dolina Chochołowska valley, in stream Chochołowski on granite boulders, near stream Wielkie Koryciska, 960 m, 16 July 2004, *B*. *Krzewicka 2727* (KRAM); DG-59 – Dolina Kościeliska valley, in the stream Kościeliski Potok below Jaskinia Mroźna cave, on submerged granite boulders, 990 m, 17 July 2004, *B*. *Krzewicka 2651* (KRAM); in stream Kościeliski Potok 23 Aug. 1927, *J*. *Motyka* (LBL); Kościeliski Potok stream by Hala Ornak, 1070 m, 22 May 1959, *J*. *Nowak* (KRAM); EB-42 – Pojezierze Mazurskie lakeland, Pojezierze Olsztyńskie lakeland: Olsztyn city, Las

Miejski, Wadąg river, Aug. 2009, *D. Kubiak* (KRAM); EE-97 – Wyżyna Kielecko-Sandomierska upland, Pogórze Szydłowskie upland: near Chańcza, July 1986 *A. Siwik* (KTC); Życiny in stream, 1984, *G. Sikora* (KTC); EF-90 – Western Beskidy Mts, Beskid Średni Mts: Pasmo Lubomira i Łysiny, Mizerówka by Pcim, in Krzywiczanka stream, 340 m, 22 Aug. 1996, *J. Nowak* (KRAM); EF-95 – Pogórze Środkowobeskidzkie foothills, Pogórzer Rożnowskie foothills: Majdan, N slope in stream, 400 and 480 m, 21 June 1971, *R. Kozik* (KRAP); valley of stream below Mogiła hill, 380 m, 22 June 1971, *R. Kozik* (KRAP); EF-99 – Pogórze Ciężkowickie foothills: Liwocz Mt. above Wróblowa, 400 m, 30 June 1972, *R. Kozik* (KRAP); EG-00 – Western Beskidy Mts, Beskid Średni Mts: Mizerów by Pcim, 340 m, 22 July 1996, *J. Nowak* (KRAM); Pasmo Lubomira i Łysiny, Kołki by Pcim, Mała Sucha stream, 420 m, 22 Aug. 1996, *J. Nowak* (KRAM); EG-02 – Beskid Wyspowy Mts: Łopień massif, stream above Czarna rzeka village, 630 m, 15 Aug. 1966, *J. Nowak* (KRAM); EG-10 – Niedźwiedź, Porębianka river, 500 m, 16 Sept. 1994, *J. Nowak* (KRAM); EG-11 – Gorce Mts: Gorce National Park: Dolina Kamienicy valley, in the stream, 710 m, 20 Aug. 1966, *K. Glanc* (KRAM); EG-20 – Gorce National Park, in stream below Obidowiec peak, 1100 m, 16 May 1995, *P. Czarnota* (GPN); EG-21 – Ustrzyk stream near Ustrzyk village, on submerged stones, 730 m, 7 Aug. 1968, *K. Glanc* (KRAM); EG-34 – Western Beskidy Mts, Beskid Sądecki Mts: Pasmo Radziejowej Mała Roztoka stream, 750 m, 19, Aug. 1960, *J. Nowak & J. Kiszka* (KRAM); EG-50 – Obniżenie Orawsko-Podhalańskie depression, Rów Podtatrzański depression: Las Brzeziny forest, in Chówańców stream, 1000 m, 7 July 1971, *J. Nowak* (KRAM); EG-50 – Tatra Mts, High Tatra Mts: Hala Gąsienicowa, stream by Dwoisty Stawek, Aug. 1925, *J. Motyka* (LBL); Kuźnice, 1100 m, 21 May 1959, *J. Nowak* (KRAM); Las Brzeziny forest, in Chowańcówka stream, 1000 m, 7 July 1971, *J. Nowak* (KRAM); FA-86 – Pojezierze Mazurskie Lakeland, Kraina Węgorapy Land: Park Krajobrazowy Puszczy Rominckiej, Bludzia river by Bludzie Małe village, 19 Aug. 2010, *D. Kubiak* (OLTC); FG-10 – Middle Beskidy Mts, Beskid Niski Mts: Świerzowa Ruska village near Świątkowa village, 460 m, 7 Sept. 1979, *J. Nowak* (KRAM); Ryjak river by Rostajne village, 440 m, 21 Sept. 1979, *J. Nowak* (KRAM); Nieznajowa village by the ruins of church, Zawoja river, 460 m, 9 Oct. 1979, *J. Nowak* (KRAM); Czarne village by Nieznajowa village, in stream, 470 m, 4 Oct. 1979, *J. Nowak* (KRAM); Żydowskie in stream, 420 and 550 m, 6 and 8 Oct. 1979 *J. Nowak* (KRAM); FG-21 – Ostryszne villege by Krempna village, on bank of Wisłok river, 350 m, 19 Sept. 1979, *J. Nowak* (KRAM); Olchowiec village near Polany village in stream, 450 m, 5 Oct. 1979, *J. Nowak* (KRAM); Krempna village, stream by Huta Krempska village, 390 m, 18 Sept. 1979, *J. Nowak* (KRAM); Polany village by Krempna village, 350 m, 19 Sept. 1979, *J. Nowak* (KRAM); Huta Krempska village by Krempna village, 420 m, 18 Sept. 1979, *J. Nowak* (KRAM); FG-23 – Wisłok river near Tarnawka village, 440 m, 13 Sept. 1974, *J. Nowak* (KRAM); stream between Dział Mt.by Szklary village and Obłaz Mt.near Daliowa village, 520 m, 11 Sept. 1974, *J. Nowak* (KRAM); FG-24 – in valley of Pielnica stream, Roztoki village near Wola Sękowa village, 445 m, 9 Oct. 1974, *J. Nowak* (KRAM); Pasmo Bukowicy Mts, Puławy village near Wisłok river, 12 Oct. 1974, *J. Nowak* (KRAM); FG-33 – Wola Wyżna village near Jaśliska village, Jasiołka stream, 510 m, 14 Sept. 1974, *J. Nowak* (KRAM); FG-44 – Wisłok Górny village, Wisłok river, near Kanasiówka Mt., 625 m, 22 June 1974, *J. Nowak* (KRAM); Dołżyca village near Komańcza village, stream between Średni Garb Mt. and Danawa Mt., 650 m, 20 June 1974, *J. Nowak* (KRAM); FG-47 – Eastern Beskidy Mts, Western Bieszczady Mts: between Polanki and Monaster villages, in stream, left of tributary of Solinka river, E slope of Korbania hill, 17 May 2008, *B. Krzewicka* (KRAM); FG-57 – Buk village, in stream, right of tributary of Solinka river, W slope of Bukowinka hill, 17 May 2008, *B. Krzewicka* (KRAM); Buk village, in stream, left of tributary of Solinka river, E slope of Jamy hill, 17 May 2008, *B. Krzewicka* (KRAM); FG-68 – Bieszczadzki National Park, stream by the Wielki Lutowy stream, 28 July 2000, *J. Kiszka* (KRAP); FG-69 – Bieszczadzki National Park, valley of Rzeczyca stream, on rocks in water, 30 Oct. 2000, *J. Kiszka* (KRAP); stream by the Wielki Lutowy stream, 28 July 2000, *J. Kiszka* (KRAP); GB-92 – Nizina Północnopodlaska lowland, Wysoczyzna Białostocka plateau: Puszcza Knyszyńska forest, nature reserve Budzisk. by the stream, 10 June 1999, *K. Czyżewska* (LOD); GC-55 – Nizina Północnopodlaska lowland, Równina Bielska plain: Białowieża National Park, forest area No 314, Orłówka, on submerged block of concrete in forest sream bed, 14 June 1999, *J. Motiejūnaite* (BILAS); on submerged roots of *Alnus glutinosa* in forest sream bed, 14 June 1999, *J. Motiejūnaite* (BILAS); GG-60 – Eastern Beskidy Mts, Western Bieszczady Mts: Bieszczadzki National Park, valley of the Zwór stream, 2 Oct. 2000, *J. Kiszka* (KRAP); GG-71 – Bieszczadzki National Park, Sianki, in stream, 25 Aug. 1999, *J. Kiszka* (KRAP).

Verrucaria bryoctona (Th.Fr.) Orange Fig. 18

Lichenologist **23**(1): 3. 1991. – *Thelidium bryoctonum* Th. Fr., Bot Notiser 1863: 11. 1863. TYPE: [Sweden] Kumla i Nerike, Ixhult, *P. J. Hellbom* (UPS! – HOLOTYPE).

Verrucaria psammophila Erichsen, Mitt. Inst. Allg. Bot., Hamb. **10**: 400. 1939. TYPE: [Denmark] Schleswig-Holstein, Apenrade, auf Erde zwischen Moos u. Steinchen im kurzen Strandrasen bei Felsbekhof, 10 September 1913, *C. F. E. Erichsen* (HBG – HOLOTYPE).

Prothallus indistinct, whitish. *Thallus* superficial, grey-green or whitish grey, granular-verrucose, composed of goniocyst-like units (15–)20–40(–50) µm in diam. *Upper cortex* absent. *Algal* layer organized of goniocysts, superficial cells of goniocysts isodiametric to shortly elongated, 3–10 µm, not pigmented. *Medulla* weakly differentiated, composed of dense hyphae. *Perithecia* spherical to broadly ovoid, half to three-quarters immersed in substrate, 200–300 µm wide, 220–300 µm high, black, often pale greyish when young due to thin unpigmented surface layer, ostiole pale grey or inconspicuous. *Involucrellum* absent. *Excipulum* dark brown to reddish brown, often slightly paler at base, 20–35(–40) µm thick at side and base. *Periphysoids* 25–30 µm long. *Asci* 50–75 µm long, 12–17 µm wide. *Ascospores* simple when mature, frequently 1(–3)-septate when overmature, narrowly ellipsoid, 19–25 × 6–7 µm, often truncate at the ends and with small gelatinous appendages. *Conidiomata* not observed.

NOTE. This species is easily distinguished by its terricolous habitat, unpigmented thallus, and spores which are apparently unique in the genus by the possession of minute gelatinous appendages. Only very few species of this genus were described from substrates than rock, for instance from lignum, bark or soil (Orange 1991; Breuss 1998a; Lendemer & Breuss 2009). *Verrucaria xyloxena* differs in the brown thallus and the more broadly ellipsoid ascospores without appendages. *Verrucaria viridigrana* Breuss (Breuss 1998b) is similar to *V. bryoctona* by the presence of goniocysts but differs in its occurrence on bark of *Ulmus*, *Fagus*, or *Quercus*; it has a pseudo-coralloid thallus, broader regularly ellipsoid ascospores which lack gelatinous appendages. Among the other terricolous species, *Verrucaria navarrense* Breuss & Etayo is unique in the combination of thin pale brown, minutely cracked-areolate thallus, immersed perithecia lacking an involucrellum but with a brown excipulum, and spores 12–15 × 6–7 µm (Breuss & Etayo 1995).

HABITAT. On basic soil among living or dead mosses; often with *Collema limosum*.

DISTRIBUTION IN POLAND. Reported from scattered localities in northern and Central Poland, including Pomerania, the Kujawy region and the Góry Świętokrzyskie Mts. In southern Poland recorded from a few sites in the Carpathian Mts and the Sudeten Mts. It is probably more frequent but overlooked.

WORLD DISTRIBUTION. Recorded from Great Britain, Finland, Sweden, Denmark, Austria, Poland (Orange 1991; Ceynowa-Giełdon 1998, 2001).

REMARKS. Only two non-saxicolous species of *Verrucaria* were confirmed in Poland (*V. bryoctona* and *V. xyloxena*). This result is so low because the revision is based on herbarium collections of *Verrucaria* which were gathered mainly from rock-substrates and only sporadically from soil and nearly never from tree bark. However, other corticolous and terricolous taxa should occur in the country. *Verrucaria viridigrana* was found in neighbouring Slovakia and Ukraine (Breuss 1998b) and it is very likely that this taxon also occurs in Poland. Many new corticolous species of *Verrucaria* have been described recently (Breuss 1994, 1998a, Lendemer & Breuss 2009) and it is most likely that they also occur in Poland.

SPECIMENS EXAMINED. AE-89 – WESTERN SUDETES, KARKONOSZE MTS: Karkonosze National Park, Równia Pod Śnieżką, 1430 m, *P. Czarnota* (GPN); by Kotki rock, 1 May 2002, *M. Kukwa* (UGDA); CB-15 – POJEZIERZE POŁUDNIOWOPOMORSKIE LKELAND, RÓWNINA CHARZYKOWSKA PLAIN: Łubiana near Kocierzyna, 25 Aug. 1997, *M. Ceynowa-Giełdon* (TRN); CB-57 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND, BORY TUCHOLSKIE FOREST: Szlachta near Czersk, 29 Aug.

1996, *M. Ceynowa-Giełdon* (TRN); CB-79 – Pojezierze Wielkopolskie lakeland, Pojezierze Kujawskie lakeland: Złotowo near Piotrków Kujawski, 22 Oct. 1995, *M. Ceynowa-Giełdon* (TRN); CC-08 – Dolina Dolnej Wisły valley, Dolina Fordońska valley: Kołdus near Chełmno, 19 July 1997, *M. Ceynowa-Giełdon* (TRN); CC-08 – Pojezierze Chełmińsko-Dobrzyńskie lakeland, Pojezierze Chełmińskie lakeland: Starogród, 19 July 1996, *M. Ceynowa-Giełdon* (TRN); CC-23 – Pradolina Toruńsko-Eberswaldzka spillway, Dolina Środkowej Noteci valley: Paterek near Nakło, 11 Oct. 1995, *M. Ceynowa-Giełdon* (TRN); CC-32 – Pojezierze Wielkopolskie lakeland, Pojezierze Gnieźnieńskie lakeland: Karmelita near Kcynia, 11 Oct. 1995, *M. Ceynowa-Giełdon* (TRN); CC-34 – Pradolina Toruńsko-Eberswaldzka spillway, Kotlina Toruńska basin: Szubin, 2 Oct. 1995, *M. Ceynowa-Giełdon* (TRN); CC-48 – Pojezierze Wielkopolskie lakeland, Równina Inowrocławska plain: Chrząstkowo near Gniewkowo, 8 Aug. 1995, *M. Ceynowa-Giełdon* (TRN); CC-55 –Pojezierze Gnieźnieńskie lakeland: Plebonka by Ostrawickie lake, 9 July 1995, *M. Ceynowa-Giełdon* (TRN); CC-56 – Mielno near Piechcina, 3 Aug. 1995, *M. Ceynowa-Giełdon* (TRN); CC-57 – Równina Inowrocławska plain: Łącko near Pakość, 28 Sept. 1994, *M. Ceynowa-Giełdon* (TRN); DB-35 – Pojezierze Wschodnio-pomorskie lakeland, Pojezierze Iławskie lakeland: Dzierzgoń, 23 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DB-76 – Iława, 24 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DB-77 – Pojezierze Chełmińsko-Dobrzyńskie lakeland, Dolina Drwęcy valley: Raczek near Iława, 24 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DB-80 – Kotlina Grudziądzka basin: Górna Grupa near Grudziądz, 16 Sept. 1996, *M. Ceynowa-Giełdon* (TRN); DB-86 – Pojezierze Brodnickie lakeland: between Bratnia and Nawra, 24 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DB-87 – Garb Lubawski hummock: Sampława, 24 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DB-96 – Dolina Drwęcy valley: Nielbark, 22 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DC-15 – Brodnica, 22 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DC-31 – Pradolina Toruńsko-Eberswaldzka spillway, Kotlina Toruńska basin: Grębocin near Toruń, 26 Sept. 1995, *M. Ceynowa-Giełdon* (TRN); DC-50 – Pojezierze Wielkopolskie lakeland, Równina Inowrocławska plain: Podgaj near Aleksandrów Kujawski, 21 July 1996, *M. Ceynowa-Giełdon* (TRN); DC-51 – Pradolina Toruńsko-Eberswaldzka spillway, Kotlina Toruńska basin: Stawki suburbs of Aleksander Kujawski, 23 Oct. 1996, *M. Ceynowa-Giełdon* (TRN); DC-73 – Kotlina Płocka basin: Włocławek, 18 June 1996, *M. Ceynowa-Giełdon* (TRN); DC-90 – Pojezierze Wielkopolskie lakeland, Pojezierze Kujawskie lakeland: Rybiny, 12 Sept. 1996, *M. Ceynowa-Giełdon* (TRN); DD-01 – Naczachowo near Izbica Kujawska, 19 June 1996, *M. Ceynowa-Giełdon* (TRN); DD-03 – Łysa Góra near Chodecz, 18 Oct. 1995, *M. Ceynowa-Giełdon* (TRN); DD-22 – Nizina Południowowielkopolska lowland, Wysoczyzna Kłodawska plateau: Kłodawa, 1 Oct. 1996, *M. Ceynowa-Giełdon* (TRN); EG-10 – Western Beskidy Mts, Gorce Mts: near Poręba Wielka, 570 m, *P. Czarnota* (GPN); EG-22 – Lubań Mt., 1210 m, 8 Aug. 1967, *J. Nowak* (KRAM).

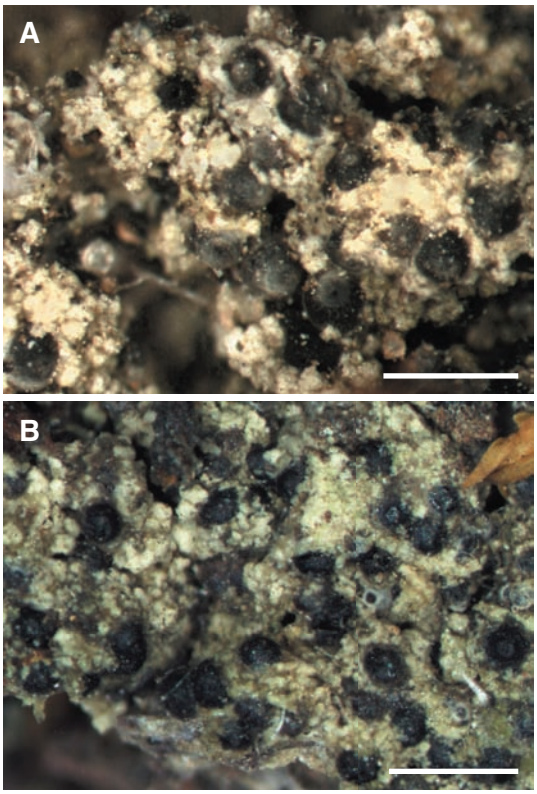

Fig. 18. *Verrucaria bryoctona* (Th.Fr.) Orange. A & B – thallus (A – *Ceynowa-Giełdon*, KRAM; B – *Hellbom*, UPS, as *Thelidium bryoctonum* Th.Fr., holotype). Scale bars = 0.5 mm.

Verrucaria caerulea DC. Fig. 19

in Lamarck & De Candolle, Fl. Franç., ed. 3, **2**: 318. 1805. Type: dans les Pyrenees, sur les roches calcaires, *C. Ramond* (G).

Verrucaria plumbea Ach., Lich. Univ.: 1810. – *Involucrothele plumbea* (Ach.) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 174. 1954.

Prothallus black. *Thallus* superficial, well-developed and often circular, 100–300 µm thick, or also partly immersed at base, margin often well-defined and raised above adjacent endolithic species or bare rock, pale grey to greyish-blue or dull grey-brown, closely and finely cracked, often into discrete areoles; surface of areoles with a slightly translucent appearance or often with a whitish compact pruina. *Upper cortex* weakly differentiated, paraplectenchymatous, when well-lit uppermost layer of cortical cells often with brownish pigment. Epinecral layer present. *Algal* layer continuous, 50–70 µm high, algal cells 5–7.5 µm in diam., scattered. *Medulla* paraplectenchymatous, without a dark basal layer, large crystals of calcium carbonate present, hyphae K/I–. *Perithecia* three-quarters to completely immersed in thallus, apex black, plane or appearing as a slightly convex projection 120–250 µm in diam. *Involucrellum* in upper half or extending to the base, appressed to excipulum, 50 µm thick. *Excipulum* globose, colourless or brown pigmented below, 120–190 µm wide, ostiole visible as a slightly paler dot or shallow pit. *Periphysoids* up to 20–30 µm long. *Asci* 45–55 µm long, 14–18 µm wide. *Ascospores* simple, colourless 13–17 × 5.5–7 µm, without halo. *Conidiomata* not observed.

NOTE. The colour of the thallus is variable. A well-illuminated thallus is darker: grey to greybluish, whereas shaded parts are paler: pale brown to nearly white. This species is distinguished by the superficial, closely and finely cracked thallus with a well-defined margin and rosette outline. Perithecia are immersed, with a thick involucrellum and a black, plane or slightly convex apex. Thallus at margin with a distinct zone without perithecia. *Verrucaria pinguicula* differs in the yellowish brown thallus and larger, more projecting perithecia.

HABITAT. It occurs on vertical surfaces of calcareous rocks in well-lit places.

DISTRIBUTION IN POLAND. It is reported in the Carpathians from the Tatra Mts and the Pieniny Mts and outside the Carpathians in the Wyżyna Krakowsko-Częstochowska upland and in the Góry Świętokrzyskie Mts in Central Poland.

WORLD DISTRIBUTION. In Europe known in Ireland and Great Britain (Orange *et al*. 2009), Fennoscandia (Santesson *et al*. 2004), in Central (Vězda & Liška 1999; Diederich & Sérusiaux 2000; Scholz 2000; Hafellner & Türk 2001; Fałtynowicz 2003; Clerck 2004; Lisická 2005) and southern Europe (Llimona & Hladun 2001; Nimis & Martellos 2003; Mayrhofer *et al*. 2005).

REMARKS. Following other authors of European checklists (e.g. Vězda & Liška 1999) Fałtynowicz (2003) incorrectly included the name *V. polysticta* into the synonyms of *V. caerulea*. According to Fröberg (1989), the name *V. glaucina* Ach. (but not *V. glaucina* auct.) is a synonym of *V. caerulea*. However, some authors mistakenly included the name *V. glaucina* auct. into the synonyms of *V. caerulea* togather with its existing synonyms (in this case also the name *V. polysticta*).

EXSICCATAE SEEN. Hepp, Flechten Eur. 223 (GFW).

SPECIMENS EXAMINED. DE-51 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Węże near Działoszyn, 30 May 1963, *J. Nowak* (KRAM); DE-73 – Biała near Kłobuck, 266 m, 21 May 1964, *J. Nowak* (KRAM); DF-59 – WYŻYNA OLKUSKA UPLAND: Tomaszowice near Kraków, ?, *A. Rehman* (KRAM) as *V. concinna*; Wąwóz Korytania near Ojców, 14 March 1957, *J. Nowak* (KRAM) as *V. fatrana;* DF-68 – Dolina Będkowska valley, 300 m, 20 Aug. 1958, *J. Nowak* (KRAM); DG-59 – TATRA MTS, WESTERN TATRA MTS: Długi Giewont Massie, 1350 m, 24 Aug. 1956, *Z. Tobolewski* (POZ); DG-59 – Dolina Kościeliska valley, Wąwóz Kraków gorge, 1500 m, 29 May 1959 and 10 June 1963, *J. Nowak* (KRAM); Wąwóz Kraków, 1500 m, below summit of Saturn Mt., 29 May 1959, *J. Nowak* (KRAM); Dolina Białego valley, 11 Aug. 1926, *J. Motyka* (LBL); DG-59 – Dolina Strążyska valley, 11 Aug. 1926, *J. Motyka* (LBL); DG-59 – Łysanki Mt. by Dolina Małej Łąki, 16 July 1926, *J. Motyka* (LBL); Dolina Białego, 11 Aug. 1926, *J. Motyka* (LBL); EE-83 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Góra Zelejowa nature reserve near Chęciny, 50 m, 3 Aug. 1976, *K. Toborowicz* (KTC); EG-32 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRES-

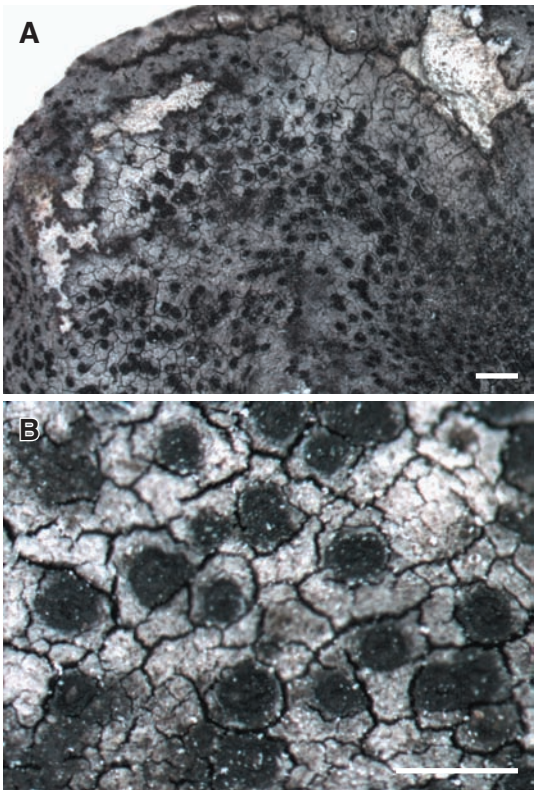

Fig. 19. *Verrucaria caerulea* DC. A & B – thallus (*Nowak*, KRAM). Scale bars: A = 1 mm; B = 0.5 mm.

SION, PIENINY MTS: Pieniny National Park, by road from Kroscienko by Dunajec river, 19 July 1998, *J. Kiszka* (KRAP); EG-33 – Trzy Korony massif, Wielka Pustelnica, 20 July 1998, *J. Kiszka* (KRAP); EG-33 – Wąwóz Sobczański gorge, on calcareous rocks, 4 May 1957, *J. Nowak* (KRAM); EG-50 – TATRA MTS, WESTERN TATRA MTS: on calcareous rock between Hala Kondratowa and Hala Kalacka, 1300 m, 10 July 1957 and 24 May 1959, *J. Nowak* (KRAM).

Verrucaria cataleptoides (Nyl.) Nyl. Fig. 20

Lich. Scand.: 272. 1861. – *Verrucaria margacea* var. *cataleptoides* Nyl., Prodr. Lich.: 182. [428]. 1857. TYPE: Pyrenean, Barèges, ad calc. transit., *W. Nylander* (H-Nyl 2865). – *Lithoicea cataleptoides* (Nyl.) Arnold, Flora **68**: 70. 1885.

Verrucaria catalepta var. *alutacea* Hepp, Flechten Eur.: No. 942. 1867. TYPE: [Switzerland] An Granitfelsen bei Amsteg (Kant. Uri), *Prof. Gisler* (GFW! – ISOTYPE). [*non Verrucaria alutacea* Wallr., Flora Cryptog. German. **3**: 308. 1831). – *Lithoicea cataleptoides* f. *alutacea* (Hepp) Arnold, Flora **68**: 70. 1885. – *Verrucaria cataleptoides* var. *alutacea* (Hepp) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 113. 1954.

Verrucaria alutacea sensu Körb., Syst. Lich. Germaniae: 349. 1855. [*non Verrucaria alutacea* Wallr., Flora Cryptog. German. **3**: 308. 1831].

Prothallus dark, discontinuous. *Thallus* superficial, yellowish brown, grey-brown or pale brown, 150–200(–300) µm thick, irregularly cracked-areolate, areoles 0.2–0.4 × 0.1–0.4 (–0.6) mm wide, pale spaces between areoles easily visible (where the white medulla is visible). Fertile areoles 3-4 times taller and wider than neighbouring sterile areoles. *Upper cortex* 20–30 µm thick, usually without pigment, rarely with dilute brown pigment. *Algal* layer 100 µm thick, continuous, cells arranged in more or less distinct columns, paraplectenchymatous, algal cells 4–8 µm in diam. *Medulla* whitish, 100 µm thick, paraplectenchymatous, in lower part often dilute brown or rarely with brown flecks under perithecia only. *Perithecia* immersed in centre of areoles, mainly one per areole, sometimes two or three. *Involucrellum* in upper half of excipulum or reaching to the base, 50–80 µm thick, black, appressed to excipulum. *Excipulum* 200–250 µm wide, dark brown throughout. *Periphysoids* up to 40 µm long. *Asci* 50–75 µm long, 20–25 µm wide. *Ascospores* colourless, simple, ellipsoid, 23–25 × 8–10(–12) µm. *Conidiomata* not observed, according to Breuss (2008) pycnidia completely immersed in thallus 100–150 µm in diam., conidia oblong 6–8 µm long.

NOTE. This species is characterized by the pale brown cracked-areolate thallus with conspicuous pale spaces between areoles. Fertile areoles surrounded by thinner and smaller areoles. *Verrucaria barrandei* is similar in appearance but differs in lacking a brown basal layer and in the smaller ascospores (16–24 × 10–12 µm). *Verrucaria nigrescens* and *V. tectorum* differ by having a distinct black basal layer and a dark brown thallus without pale cracks visible on upper surface. *Verrucaria maculiformis* is similar in the colour of

the thallus but it is thinner, without a brown basal layer and has distinctly smaller ascospores (14–18 × 7–9 µm). *Verrucaria pinguicula* differs by the thallus raised above surrounding rock with a well-delimited margin and distinctly smaller ascospores (15–18 × 6– 8 µm).

HABITAT. On calcareous rocks, in both shady and sunny places. Zschacke (1933) noted it also from moist calcareous rocks.

DISTRIBUTION IN POLAND. Reported from the Carpathians (the Gorce Mts and the Pieniny Mts) and from scattered localities in North Poland.

WORLD DISTRIBUTION. The distribution of this species is poorly known at present; it was reported from Fennoscandia and Germany (Feuerer 2011).

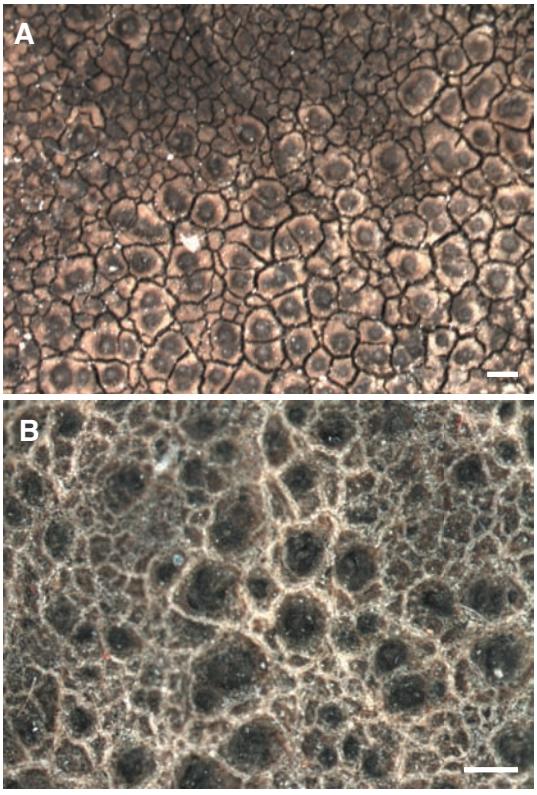

Fig. 20. *Verrucaria cataleptoides* (Nyl.) Nyl. A & B – thallus (A – *Kiszka*, KRAM; B – Hepp, Flechten Eur. 942, GFW, as *Verrucaria catalepta* var. *alutacea* Hepp, isotype). Scale bars = 0.5 mm.

REMARKS. The name *V. cataleptoides* for a long time was mistakenly treated as a synonym of *V. aethiobola* on European checklists (see Vězda & Liška 1999; Hafellner & Türk 2001; Fałtynowicz 2003; Clerc 2004). The specimens of this taxon were also recognized as *V. barrandei* (Bielczyk 2003) a similar in appearance and probably closely related species.

Zschacke (1933) included the variety *V. catalepta* var. *alutacea* in the synonymy of *V. cataleptoides*. Servít (1954) distinguished this taxon at variety level within *V. cataleptoides* species, but mistakenly regarded this variety as growing on non-calcareous substrata, and used this as a character in a key, although the type specimens inGFW-) grow on a calcareous substratum.

EXICCATAE SEEN. Hepp, Flechten Eur. 433 (as *Verrucaria catalepta*) (GFW).

SPECIMENS EXAMINED. BB-75 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE POZNAŃSKIE LAKELAND: Lubosina, 27 April 1934, *F. Krawiec* (POZ); CB-59 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND, BORY TUCHOLSKIE FOREST: Osiek, 26 July 1933, *F. Krawiec* (POZ); EG-22 – WESTERN BESKIDY MTS, GORCE MTS: S slope of Twarogi hill, 650 m, 9 Sept. 1960 and 14 July 1966, *K. Glanc* (KRAM); EG-23 – Tylmanowa, rocks by Dunajec river, 10 and 12 May 1959, *K. Glanc* (KRAM); EG-31 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, KOTLINA ORAWSKO-NOWOTARSKA BASIN: Skalice Nowotarskie, Frydman, 20 Oct. 1998, *J. Kiszka* (KRAP); EG-34 – PIENINY MTS: Szczawnica, July 1891, *W. Boberski* (KRAM); Wąwóz Homole near Jaworki, 12 Sept. 1959, *J. Nowak* (KRAM).

Verrucaria cernaensis Zschacke Fig. 21

Hedwigia **67**: 64. 1927. TYPE: Südkarpathen: in der Cerna bei Herkulesbad (Lojka, Lich. Hung. 160, W – ISOTYPE).

Verrucaria aethiobola auct., *non* Ach., Meth. Lich. Suppl.: 17. 1803.

Prothallus occasionally present, black. *Thallus* superficial, non-gelatinous, rather well-developed (50–)100–300 µm thick, strongly cracked, often into discrete areoles, greyish brown, dark brown or reddish brown. *Upper cortex* colourless or with

dark pigment, paraplectenchymatous, 20–25 µm thick. *Algal* cells scattered. *Medulla* paraplectenchymatous, without black basal layer, but lower part of thallus often with ill-defined areas of brown pigment. *Perithecia* black, completely or two-thirds immersed, forming low to moderate projections (120–)200–400 µm in diam., at the base covered with the thallus, apex blackish, early exposed. *Involucrellum* dark brown, usually well-developed, reaching to base of excipulum, rarely present only in the upper part, often more or less appressed to excipulum and sides steeply conical or even vertical, 100–200 µm high, 280–400 µm wide and 50–70 µm thick. *Excipulum* brown, or rarely colourless in the lower part, globose, 140–280 µm wide. *Periphysoids* up to 20 µm long. *Asci* 50–60 µm long, 20–24 µm wide. *Ascospores* simple, colourless, ellipsoid, 18–22(–25) × 8–14 µm, without halo. *Conidiomata* not observed in the material examined, according to Orange *et al*. (2009) pycnidia often present, scattered, visible as brown dots 0.04–0.06 µm wide, conidia straight or slightly curved 4–8 × *ca* 1 µm.

NOTE. This amphibious species is distinguished from the other freshwater species of *Verrucaria* by a brown, strongly cracked thallus, two-thirds or completely immersed perithecia, a brown excipulum, medium and narrow ascospores. *Verrucaria aethiobola* similar in appearance but differs in the presence of distinctly bigger ascospores [(21.5–)24–29(–35) × (8.5–)10.5–12.5(–14.5) µm] with halo up to 2 µm thick. Some morphs of *V. latebrosa* are similar to *V. cernaensis* in appearance, but they differ in larger spores [(20–)24–29(–36) × 8.5–12.5(–14) µm] and a colourless excipulum. *Verrucaria praetermissa* is distinguished by a pinkish or greenish thallus with a well-developed black basal layer, completely immersed perithecia and a colourless excipulum at least at the basal part [but sometimes the distinction of excipulum and black basal layer can be very difficult and in this case *V. praetermissa* is distinguished by the less prominent perithecia forming low projections visible as pinkish or brownish points (60–130 µm in diam.) on upper surface]. *Verrucaria margacea* differs by larger ascospores (26–36 × 11–15 µm),

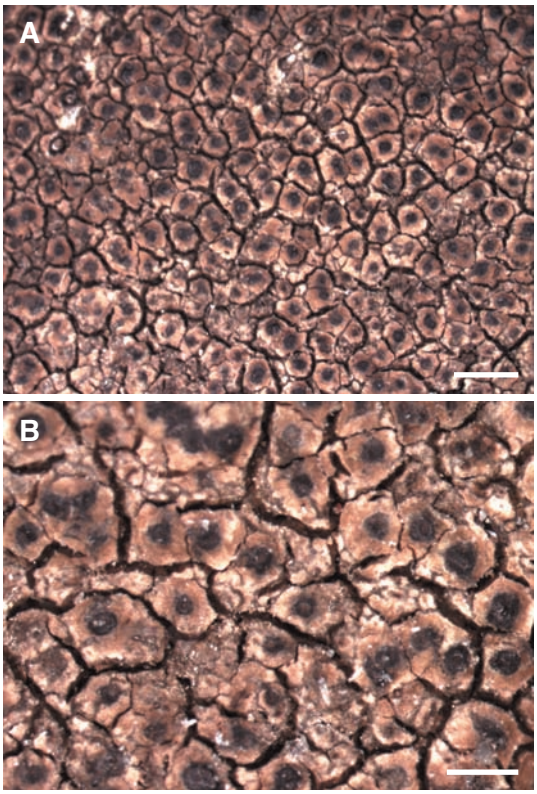

Fig. 21. *Verrucaria cernaensis* Zschacke. A & B – thallus (*Glanc*, KRAM). Scale bars: A = 1 mm; B = 0.5 mm.

more prominent perithecia forming moderate to distinct projections [(280–)350–800 µm in diam.], and a distinctly conical involucrellum. *Verrucaria submersella* has a light-coloured thallus, a colourless excipulum, and an involucrellum present only in the upper part of the excipulum.

HABITAT. Amphibious species occurring on submerged rock and on seeping sandstones and siliceous rocks beside mountain lakes and rivers. Reported by Orange *et al*. (2009) on limestone and concrete.

DISTRIBUTION IN POLAND. *Verrucaria cernaensis* is confirmed at scattered localities in southern Poland in the Western Carpathian Mts in many mountains ranges, such as the Tatra Mts, the Beskid Żywiecki Mts, the Beskid Sądecki Mts, the Beskid Niski Mts, the Gorce Mts and in the Eastern Carpathian Mts, where it was found in the

Bieszczady Mts. Species new to Poland. Previously, specimens of this taxon were identified as *V. aethiobola*. In Poland *V. aethiobola* has been regarded as one of the most frequent species (e.g. Fałtynowicz 2003) but these records refer mainly to *V. cataleptoides* Nyl. and *V. cernaensis.*

WORLD DISTRIBUTION. In Europe *V. cernaensis* has been reported from N and W Britain (Orange *et al*. 2009), and in continental Europe from the Carpathians (Thüs 2002; Thüs & Schultz 2008; as a synonym of *V. aethiobola*).

REMARKS. *Verrucaria cernaensis* was included in the synonymy of *V. aethiobola* by Thüs (2002; Thüs & Schultz 2008). However according to Orange *et al*. (2009), based on the size of ascospores and presence of halo *V. cernaensis* should be treated as a separate taxon at species level.

SPECIMENS EXAMINED. DG-07 – WESTERN BESKIDY MTS, BESKID ŻYWIECKI MTS: Pasmo Jałowieckie range, Skawica, stream Delajówka by Gołyńka stream, 520 m, 22 Sept. 1965, *J. Nowak* (KRAM); DG-16 – Pasmo Jałowieckie range, Hala Kamińskiego, Góra Kolisty Groń, 1090 m, 14 July 1965, *J. Nowak* (KRAM); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa village, 26 July 1926, *J. Motyka* (LBL); EG-21 – WESTERN BESKIDY MTS, GORCE MTS: stream Ustrzyk in Ustrzyk village by Ochotnica Górna, 730 m, 7 Aug. 1968, *K. Glanc* (KRAM) as *V. anziana*; Gorce National Park, in Łopuszanka stream, 850 m, 12 Nov. 1997, *P. Czarnota* (GPN); EG-33 – WESTERN BESKIDY MTS, BESKID SĄDECKI MTS: Pasmo Radziejowej range, valley of Szczawny Potok stream, on rocks by Dziki spring, 500 m, 13 Sept. 1959, *J. Nowak* (KRAM); EG-34 – Pasmo Radziejowej Mała Roztoka stream, 750 m, 19, Aug. 1960, *J. Nowak* & *J. Kiszka* (KRAM); Jaworzynka stream by Prehyba, 900 m, 18 Aug. 1960, *J. Nowak* & *J. Kiszka* (KRAM); EG-36 – Żebracze nature reserve, 710 m, 1 July 2005, *P. Czarnota* (GPN); EG-50 – TATRA MTS, HIGH TATRA MTS: Hala Gąsienicowa, stream by Dwoisty stawek, 19 Aug. 1925, J. Motyka (LBL); FG-09 – POGÓRZE ŚRODKOWOBESKIDZKIE FOOTHILLS, POGÓRZER PRZEMYSKIE FOOTHILLS: Rybotycze, on bank of Wiar river, 7 Sept. 1993, *J. Nowak* (KRAM); FG-23 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: N slope of Jawornik hill by Rymanów Zdrój, 650 m, 21 Aug. 1974, *J. Nowak* (KRAM); FG-34 – Wisłok Górny village, stream on W slope of Jasienina peak falls into the Izwor stream, 550 m, 23 June 1974, *J. Nowak* (KRAM); Wisłok Górny village, Wisłok stream below Bieszczad hill, 550 m, 22 June 1974, *J. Nowak* (KRAM); FG-59 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Dwerniczek by bank of San, 500 m, 15 Aug. 1958, *K. Glanc* (KRAM); FG-69 – Bieszczadzki National Park, Brzegi Górne, in stream, 13 July 2003, *J. Kiszka* (KRAP).

Verrucaria cincta Hepp Fig. 22

in Arnold, Flora **41**(33): 238. 1858. TYPE: [Germany] an Dolomitfelsen des steinigen und kahlen Abhanges im Tiefenthale bei Eichstätt, *F. Arnold* (Hepp, Flechten Eur. 687, GFW! – ISOTYPE).

Verrucaria amylacea f. *evanida* Arnold *in* Krempelhuber, Denkschrift. K. Bayer. Bot. Gesellsch. **4**(2): 291. 1861. TYPE: An einer Dolomitwand oberhalb Weischenfeld bei Muggendorf im Franken-Jura, *Arnold* (Arnold, Lich. Exs. Lich. Jur. 172, WRSL! – ISOTYPE). Synonymized here.

Verrucaria subcincta Nyl., Flora **64**: 536. 1881. TYPE: [Hungaria] Supra saxa calcarea in Hungaria prope pagum Teplicska, *Lojka* (Lojka, Lichenoth. Reg. Hung. Exs. 98, M! – ISOTYPE). – *Verrucaria cincta* var. *subcincta* (Nyl.) Servít, Stud. Bot. Čech. **11**(3): 109. 1950.

Prothallus not observed. *Thallus* endolithic, appearing as a bluish white pruina on the rock surface. *Upper cortex* poorly delimited. *Algal* layer discontinuous, 100 µm high, cells 10–12 µm in diam. *Medulla* loose, irregularly oriented hyphae, prosoplectenchymatous. *Perithecia* superficial, forming hemispherical projections 300–400(–500) µm in diam., not covered by a thallus layer except rarely at base, slightly pruinose at base. *Involucrellum* thick, 50 µm wide, appressed to excipulum except at the base, reaching to base-level of excipulum. *Excipulum* dark brown 200–250(–300) µm wide. *Periphysoids* short, branched, 20–30 µm long. *Asci* 60–70 µm long, 18–20 µm wide. *Ascospores* simple, colourless, narrowly ellipsoid, (20–)22–28(–32) × 7–9 µm. *Conidiomata* not observed.

NOTE. This species is characterized by an endolithic whitish thallus with superficial perithecia forming hemispherical projections. *Verrucaria myriocarpa* also lacks a superficial thallus but differs in the smaller perithecia and the presence of a dark brown flecks of thallus visible at the rock surface. *Verrucaria amylacea*, *V. caerulea* and *V. polonica*

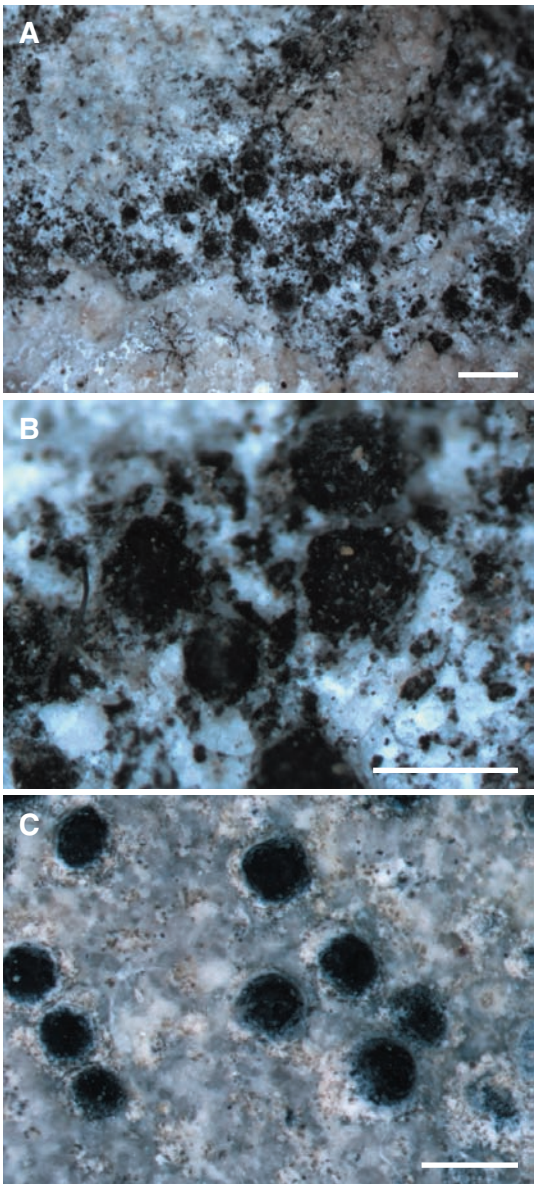

Fig. 22. *Verrucaria cincta* Hepp. A – habit (Hepp, Flechten Eur. 687, GFW, isotype); B & C – perithecia (B – Hepp, Flechten Eur. 687, GFW, isotype; C – Lojka, Lichenoth. Reg. Hung. Exs. 98, W, as *Verrucaria subcincta* Nyl., isotype). Scale bars: A = 1 mm; B & C = 0.5 mm.

differ in the more or less superficial and areolate thallus. *Parabagliettoa* also has an endolithic thallus and sessile perithecia but the perithecia are larger with a distinctly thicker involucrellum in *P. dufourii* and *P. disjuncta* and smaller ascospores (12–17 × 6–8 µm) in *P. cyanea;* additionally *V. cincta* differs by the K/I– medulla.

HABITAT. On limestone and dolomites in open habitats such as on natural calcareous outcrops.

DISTRIBUTION IN POLAND. *Verrucaria cincta* occurs in the small massif in the Carpathians, the Pieniny Mts. Only historical data provided by Eitner (1901) from the Sudeten Mts (reported as *V. subcincta*) were not confirmed. This herbarium specimen was not available for study; it may have been destroyed during the war.

WORLD DISTRIBUTION. Reported from Central Europe, in Austria, Germany, and Slovakia (Nimis 1993; Scholz 2000; Hafellner & Türk 2001; Lisická 2005).

REMARKS. The name *Verrucaria amylacea* f. *evanida* is proposed here as a synonym of *Verrucaria cincta*. The form *evanida* was distinguished by Arnold to differentiate a morph of *V. amylacea* without a thallus and with sessile perithecia. The size and shape of the perithecia and ascospores (19–20 × 7 µm) of the type specimen of form *evanida* (WRSL) are the same as in *V. cincta*; both taxa have a prosoplectenchymatous medulla.

This species was not correctly distinguished in Poland for a long time because it was mistakenly regarded as a taxon with immersed perithecia (see Nowak & Tobolewski 1975) whereas the type material of *V. cincta* (GFW) has distinctly superficial perithecia (see also Breuss 2008).

SPECIMENS EXAMINED. EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Wąwóz Gorczyński gorge, 3 Sept. 1998, *J. Kiszka* (KRAM).

Verrucaria denudata Zschacke Fig. 23

Hedwigia **67**: 74. 1927. TYPE: [Germany] Niedersachsen, Hasbruch bei Oldenburg, *Sandstede* (Arnold, Lich. Ex. 1712B, BM! – SYNTYPE).

Verrucaria hydrela auct., *non* Ach., Synops. Lich.: 94. 1814.

Verrucaria subhydrela Servít, Vest. Kr. Ces. Spol. Nauk **4**: 6. 1951. TYPE: [Czech Republic] Bohemia: Rudohoří:

Hassenbach pr. p. Volyň, saxa schist., 650 m, 1950, *M. Servít* (PRM).

Prothallus absent. *Thallus* more or less subgelatinous, thin, 25–60 µm thick, continuous, smooth, bright green (when wet) to mid brown (when dry), cracks absent or few. *Upper cortex* weakly defined with dull green to dull brown pigment. *Algal* layer 40–60 µm thick, paraplectenchymatous, algal cells 3–5 µm in diam. *Medulla* weakly defined or absent, dark basal layer absent. *Perithecia* rather inconspicuous on upper surface, completely covered with thallus at first and (cover transparent when wet) sometimes eroded later to reveal the black apex, perithecia and thallus-cover forming broadly conical-hemispherical mounds 240–560 µm in diam. *Involucrellum* conical, often reaching base of thallus, on dry thalli visible as black points, on wet thalli visible as a black disc within the transparent thallus. *Excipulum* colourless to brown at apex, 200–300 µm wide. *Periphysoids* up to 20 µm long. *Asci* 60–70 µm long, 18–22 µm wide. *Ascospores* simple, colourless, ellipsoid, 20–25(–26) × 10–12(–15) µm, without halo. *Conidiomata* not observed.

NOTE. This amphibious species is distinguished by a smooth uncracked, continuous, subgelatinous thallus without a black basal layer, perithecia covered by a layer of thallus and a conical involucrellum reaching the base. This species so far, was recognized in Europe as *Verrucaria hydrela* with *V. denudata* as synonym. However, *V. denudata* has a smooth subgelatinous thallus and transparent upper cortex when wet and fresh while *V. hydrela* has an uneven, continuous thallus with a few cracks, non-gelatinous thallus and less transparent upper cortex. *Verrucaria pachyderma* is similar in the presence of smooth subgelatinous thallus but differs in the less transparent black thallus and the ascospores 17–22 × 6–8 µm.

HABITAT. A freshwater species occurring on permanently submerged siliceous rocks, in well-lit places. It has been observed as a pioneer species colonizing bare rock (Keller 2005; Krzewicka & Galas 2006).

DISTRIBUTION IN POLAND. It occurs at many localities in mountainous regions of Poland: widespread in the Carpathian Mts where it was recorded in many ranges (the Beskid Mały Mts, the Beskid Żywiecki Mts, the Beskid Średni Mts, the Beskid Niski Mts, the Bieszczady Mts, the Tatra Mts). It was also recorded outside the Carpathian Mts in the Sudeten Mts, Central Poland (the Góry Świętokrzyskie Mts, the Wzniesienia Łódzkie hills) and northen Poland in the Pobrzeże Szczecińskie coastland, the Pobrzeże Gdańskie coastland, the Bory Tucholskie forest, the Pojezierze Kaszubskie lakeland, the Pojezierze Mazurskie lakeland.

WORLD DISTRIBUTION. The species is widespread in Europe (Thüs 2002) usually known under the name *V. hydrela*.

REMARKS. Thüs (2002) included *Verrucaria denudata* in the synonymy of *V. hydrela*. Orange *et al*. (2009) regarded *V. denudata* as the correct name, with *V. hydrela* auct. as a synonym, following Zschacke (1927) who believed that *V. hydrela* Ach. *non* auct. is a Scandinavian taxon which has not been found again after its original collection in Sweden. The type material of *V. hydrela* (Ach-H!) has a non-gelatinous and cracked thallus with uneven upper surface whereas *V. hydrela* auct. has a subgelatinous thallus without cracks.

SPECIMENS EXAMINED. BF-47 – EASTERN SUDETES, THE MASSIF OF ŚNIEŻNIK MT.: stream below Czarna Góra, 900 m, 5 July 1960, *J. Nowak* (KRAM); CA-48 – POBRZEŻE SZCZECIŃSKIE COASTLAND, WYSOCZYZNA ŻARNOWIECKA PLATEAU: stream by Wielka Piaśnica, 16 July 1935, *F. Krawiec* (POZ); CA-86 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: 1 km N of Mirachówka village, on siliceous stone in stream bed, 15 May 1995, *J. Motiejūnaite* (BILAS); CA-89 – POBRZEŻE GDAŃSKIE COASTLAND, POBRZEŻE KASZUBSKIE COASTLAND: Gdańsk Oliwa, Dolina Ewy valley, July 2000, *M. Kukwa* (UGDA); Trójmiejski Landscape Park, Źródliska w Dolinie Ewy nature reserve, in stream, 31 May 2003, *M. Kukwa 1821* (UGDA); CA-89 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Trójmiejski Landscape Park, Dolina Ewy valley, in stream, 4 April 2004, *M. Kukwa 3002* (UGDA); CB-16 – Kościerzyna, stream in Jarząbce forest, Aug. 1935, *F. Krawiec* (POZ); CB-68 – POJEZIERZE POŁUDNIOWOPOMORSKIE, BORY TUCHOLSKIE

FOREST: 1 km E of Stara Rzeka village, on stones in water, 13 June 2004, *M. Kukwa 3293*, (UGDA); DB-53 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE IŁAWSKIE LAKELAND: valley of Liwa river, by Borkowo village, April 2000, *M. Kukwa* (UGDA); DD-67 – WZNIESIENIA POŁUDNIOWOMAZOWIECKIE HEIGHTS, WZNIESIENIA ŁÓDZKIE HILLS: Wzniesienia Łódzkie Landscape Park, on stones in Młynkówka stream, 27 Sept. 2006, *M. Hachułka* (LOD); DF-95 – WESTERN BESKIDY MTS, BESKID MAŁY MTS: Wielka Puszcza in stream, 400 m, 7 Aug. 1960, *J. Nowak* (KRAM); DF-96 – in stream below Królewizna hill (Królowa Wyżnia), 550 m, 28 Aug. 1961, *J. Nowak* (KRAM); in stream below Jaroszowicka Góra hill, 340 m, 18 April 1961, *J. Nowak* (KRAM); Sikorówka stream near Targoszów by Krzeszowa, 26 Aug. 1962, *J. Nowak* (KRAM); DF-97 – BESKID ŚREDNI MTS: Dąbrówka, 6 Sept. 1995, *J. Kiszka* (KRAM); DG-06 – BESKID MAŁY MTS: Krzeszów in stream, 600 m, 10 May 1960, *J. Nowak* (KRAM); DG-23 – BESKID ŻYWIECKI MTS: Wielka Racza range, Góra Hutyrów by Rycerka Dolna, 600 m, 6 Aug. 1964, *J. Nowak* (KRAM); DG-58 – TATRA MTS, WESTERN TATRA MTS: Dolina Chochołowska, in Chochołowski stream, 1130 m, 16 July 2004. *B. Krzewicka* (KRAM); DG-59 – Dolina Kościeliska, Mała Polana Ornaczańska, in stream, 1100 m, 22 May 1959, *J. Nowak* (KRAM); in the stream Kościeliski Potok 23 Aug. 1927, *J. Motyka* (LBL); DG-68 – Staroboclańska Rówień, in stream, 1400 m, 11 July 1959, *J. Nowak* (KRAM); DG-69 – Dolina Chochołowska, Staroboclański Potok, 1400 m, 11 July 1959, *J. Nowak* (KRAM); EB-37 – POJEZIERZE MAZURSKIE LAKELAND, POJEZIERZE MRĄGOWSKIE LAKELAND: by NW part of Lake Kiersztanowskie, valley of a small temporal brook, deciduous forest, 4 July 2006, *M. Kukwa 5256* (UGDA); EB-62 – POJEZIERZE OLSZTYŃSKIE LAKELAND: Nowe Rumaki forest Łyna river near Ustrych damp, Aug. 2009, *D. Kubiak* (KRAM); EE-97 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, POGÓRZE SZYDŁOWSKIE UPLAND: near Chańcza, July 1986 *A. Siwik* (KTC); EF-90 – WESTERN BESKIDY MTS, BESKID ŚREDNI MTS: Pasmo Lubomira i Łysiny, Mizerówka by Pcim, Krzywiczanka stream, 340 m, 22 Aug. 1996, *J. Nowak* (KRAM); EF-95 – POGÓRZE ŚRODKOWOBESKIDZKIE FOOTHILLS, POGÓRZER ROŻNOWSKIE FOOTHILLS: Majdan, N slope in stream, 400 m, 21 June 1971, *R. Kozik* (KRAP); EG-00 – WESTERN BESKIDY MTS, BESKID ŚREDNI MTS: Pcim Mała Suszanka stream, 390 m, 24 Aug. 1996, *J. Nowak* (KRAM); EG-11 – GORCE MTS: Gorce National Park, in Kocie Młaki stream, 780 m, 26 Oct. 1995, *P. Czarnota* (GPN 392); EG-17

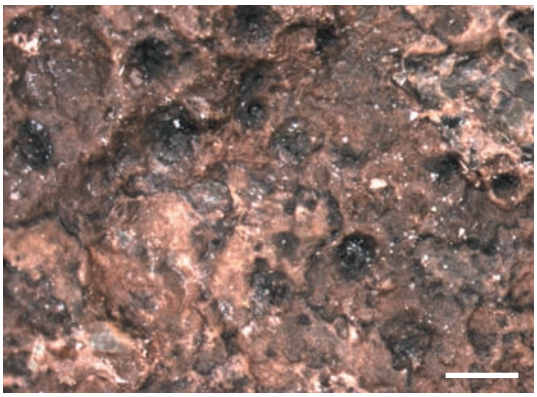

Fig. 23. *Verrucaria denudata* Zschacke (*Krzewicka*, KRAM). Scale bar = 0.5 mm.

– MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa village, 11 and 20 July 1926, *J. Motyka* (LBL); EG-20 – WESTERN BESKIDY MTS, GORCE MTS: Gorce National Park, in stream below Obidowiec peak, 1100 m, 16 May 1995, *P. Czarnota* (GPN); EG-50 – TATRA MTS, HIGH TATRA MTS: Dolina Pańszczyca valley, on granite rock in stream, 1530 m, 13 Aug. 1971, *J. Nowak* (KRAM); Dolina Kondratowa, on rocks in stream, 1300 m, 21 May 1959, *J. Nowak* (KRAM); EG-60 – in stream by Morskie Oko lake, 17 Sept. 1969, *J. Nowak*, *K. Czyżewska* (LOD); FA-86 – POJEZIERZE MAZURSKIE LAKELAND, KRAINA WĘGORAPY LAND: Park Krajobrazowy Puszczy Rominckiej, Bludzia river by Bludzie Małe village, 19 Aug. 2010, *D. Kubiak* (OLTC); FG-20 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Nieznajowa village by the ruins of church, 460 m, 9 Oct. 1979, *J. Nowak* (KRAM); FG-58 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Bieszczadzki National Park, stream on S slope of Jaworniki hill near Suche Rzeki, 25 Aug. 1995, *J. Kiszka* (KRAP); FG-68 – Bieszczadzki National Park, Dział Mts, in stream, 7 Aug. 2001, *J. Kiszka* (KRAP); Wielki Lutowy stream, 830 m, 3 July 2002, *J. Kiszka* (KRAP); Przełęcz nad Berehami pass, in stream, 8 July 2003, *J. Kiszka* (KRAP); valley of Wielki Lutowy in stream, 27 and 28 July 2000, *J. Kiszka* (KRAP); N slope of Dział, 780 m, 8 Aug. 2001, *J. Kiszka* (KRAP); FG-69 – Bieszczadzki National Park, stream by the Wielki Lutowy stream, 28 July 2000, *J. Kiszka* (KRAP); GC-55 NIZINA PÓŁNOCNOPODLASKA LOWLAND, RÓWNINA BIELSKA PLAIN: Białowieża National Park, forest area No 314, Orłówka, on submerged roots of *Alnus glutinosa* and on bricks in forest sream bed, 14 June 1999, *J. Motiejūnaite* (BILAS); GG-60 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Bieszczadzki National Park, valley

of the Zwór stream, 2 Oct. 2000, *J. Kiszka* (KRAP); GG-71 – Bieszczadzki National Park, Sianki, in stream, 25 Aug. 1999, *J. Kiszka* (KRAP).

Verrucaria dolosa Hepp Fig. 24

Flecht. Eur. No. 689. 1860. TYPE: [Switzerland] An beschatteten Alpenfündlingen bei Zürich, *P. Hepp* (Hepp, Flechten Eur. 689, GFW! – ISOTYPE).

Verrucaria subdolosa auct. sensu pol. *non* Servít, Sbor. Nar. Mus. **5B**(9; Bot.): 44. 1949

Prothallus inconspicuous, brownish. *Thallus* almost absent or thinly superficial, non-gelatinous, 25–50 µm thick, green to olive-brown, more or less smooth, glossy, continuous, never areolate, sometimes with a few cracks. *Upper cortex* a pseudocortex, one-layered. *Algal* layer thin, algal cells scattered or aggregated in small group, 5–10 µm in diam. *Medulla* thin, paraplectenchymatous, consisting of larger cells, 15–20 µm in diam. *Perithecia* forming low to moderate projections 100–150(–180) µm wide, semi-immersed to prominent, often in lower part covered by thallus. *Involucrellum* conical, 20–25 µm thick, black, extending to excipulum base level, 150–200 µm wide. *Excipulum* colourless, becoming pale to dark-brown in older perithecia, 120–250 µm wide. *Periphysoids* 20–30 µm long. *Asci* 45–55 µm long, 11–18 µm wide. *Ascospores* simple, colourless, 15–17.5 × 6.5–8.5 µm. *Conidiomata* not observed.

NOTES. Characterised by a very thin smooth thallus, pale to dark green or olive-brown in colour, small and semi-immersed perithecia, a colourless excipulum and small ascospores. *Verrucaria maculiformis* is similar in the presence of a thin thallus but differs in larger perithecia forming moderate projections 150–250 µm in diam. *Verrucaria acrotella* auct. differs in the presence of a dark brown granular to rimose-areolate thallus and the presence of larger perithecia immersed in areoles, 1 or 3 per areole in central part, at margin more superficial with basal part immersed in thallus, forming low to moderate hemispherical projections 150–200(–250) µm.

HABITAT. On siliceous rock, limestone and concrete, terrestrial species but also noted in moist habitats by freshwater watercourses, e.g. in the splash zone.

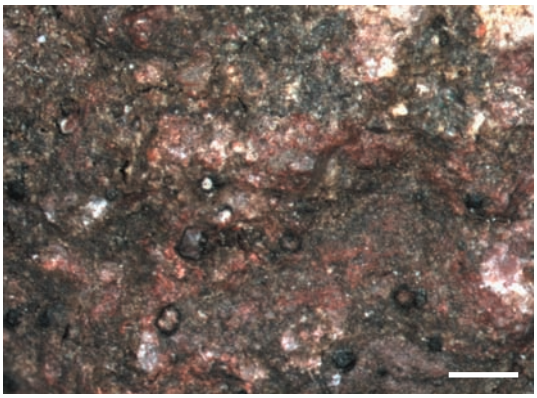

Fig. 24. *Verrucaria dolosa* Hepp (Hepp, Flechten Eur. 689, GFW, isotype). Scale bar = 0.5 mm.

DISTRIBUTION IN POLAND. It has been confirmed in the Carpathians and in Northern and Central Poland at scattered localities.

WORLD DISTRIBUTION. Species reported from many countries (Feuerer 2011); however its distribution should be revised.

REMARKS. To date it has been reported throughout the country (Fałtynowicz 2003); however this species is less frequent than reported. A revision of herbarium specimens of *V. dolosa* shows that specimens were often misidentified and belong to poorly known species such as *V. acrotella* auct. and *V. maculiformis*. Specimens named as *V. subdolosa* belonged to *V. dolosa.*

SPECIMENS EXAMINED. BC-78 – PRADOLINA NOTECKA VALLEY, KOTLINA GORZOWSKA BASIN: Oborniki, 7 May 1935, *F. Krawiec* (POZ); CA-98 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Babi Dół near Kartuzy, 25 July 1935, *F. Krawiec* (POZ); DD-67 – WZNIESIENIA POŁUDNIOWOMAZOWIECKIE HEIGHTS, WZNIESIENIA ŁÓDZKIE HEIGHTS: Wzniesienia Łódzkie Landscape Park, Grabina, on graveyard, 8 May 2008, *M. Hachułka* (LOD); DF-96 – WESTERN BESKIDY MTS, BESKID MAŁY MTS: Rzyki by Andrychów, by stream 420 m, 9 May 1962, *J. Nowak* (KRAM); EG-02 – BESKID WYSPOWY MTS: Łopień massif, stream above Czarna rzeka village, 630 m, 15 Aug. 1966, *J. Nowak* (KRAM); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa,

500 m, 20 July 1920 and 16 July 1926, *J. Motyka* (LBL); FG-06 – Pogórze Środkowobeskidzkie foothills, Pogórze Przemyskie foothills: Dobra by San river, 2 Aug. 1988, *J. Kiszka* (KRAP); FG-17 – Eastern Beskidy Mts, Góry Sanocko-Turczyńskie Mts: Góry Słonne Mts, Hołuczków by strem, 27 June 1990, *J. Kiszka* (KRAM).

Verrucaria elaeina Borrer Fig. 25

in Hooker, English Botany Supplement **1**: text to Plate 2623, fig. 2. 1831. Type: Ireland, Hutchins, fragments of the original English Botany plate no. 2455, specimen ex herb. W. Borrer, (BM! – holotype).

Verrucaria guestphalica auct. sensu pol. *non* Servít Československé Lišenjníky Čeledi Verrucariaceae: 146. 1954.

Prothallus white, or black between contiguous adjacent thalli. *Thallus* crustose, superficial, non-gelatinous, thin to moderately thick, 25–90(–105) µm thick, rimose, cracks few in young and poorly developed areas or numerous on mature parts, light grey-green to pale brownish green, rarely mid-brown. *Upper cortex* weakly-defined, 5–10(–15) µm thick, colourless, matt, never glossy. *Algal* layer paraplectenchymatous, 20–50 µm thick, algal cells 5–9 × 5–7 µm in diam., uniformly scattered. *Medulla* absent or weakly developed as a more or less alga-free zone, cells of thallus irregularly arranged or in very weak vertical columns, colourless, without black basal layer. *Perithecia* one-quarter to three-quarters immersed, rarely completely immersed in the thallus, usually varying in the same specimen, forming moderate projections 220–400 µm in diam., sometimes covered with thallus to near apex. *Involucrellum* well-developed, darkly pigmented, weaker colored in basal parts, conical-hemispherical to conical, usually more or less spreading from the excipulum below, 350–500(–700) µm wide. *Excipulum* 160–280 µm wide, colourless, only ostiolar region pale brown. *Periphysoids* thin, weakly branched, up to 30–40 µm long. *Asci* 55–65 µm long, 19–23 µm wide. *Ascospores* simple, colourless, ellipsoid to narrowly ellipsoid or oblong-ellipsoid, 18–22(–24) × 7–9 µm, without halo. *Conidiomata* not detected.

Note. This species is characterized by a whitish or grey-green rimose thallus with semi-immersed perithecia. It is similar to *V. praetermissa* in appearance but differs in the absence of a black basal layer, the more weakly developed involucrellum and more exposed perithecia. However morphs of *V. praetermissa* without a black basal layer were observed by Orange (2000) and Thüs and Schultz (2008), and here *V. praetermissa* is easly distinguished by the more widely spreading involucrellum and entirely immersed perithecia. *Verrucaria submersella* differs in the larger ascospores (up to 20–32 µm long), and *V. sublobulata* has smaller perithecia forming low projections 80–120 µm in diam., and a greenish thallus.

Habitat. Facultatively amphibious species occurring on a variety of substrates such as limestone, sandstone, concrete; in shady places both in moist and dryer habitats but never sunny and xerothermic sites. By watercourses it can occurs in

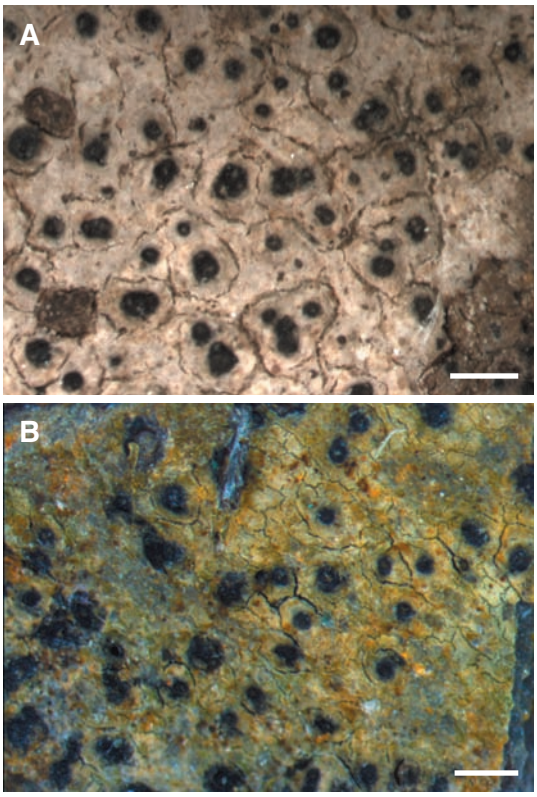

Fig. 25. *Verrucaria elaeina* Borrer. A & B – thalus (A – *Nowak*, KRAM; B – *Borrer*, BM, holotype). Scale bars = 0.5 mm.

splash zones or more often in the upper part where it is submerged only sporadically; it never has been recorded on permanently submerged sites.

DISTRIBUTION IN POLAND. It is a very common species in the Polish Carpathian Mts, where it occurs at many localities on both moist habitats located by mountain springs, streams and rivers and on dryer and more shady places on terrestrial habitats on rocks in forests, by roads and in grasslands in moist places. Specimens of *V. elaeina* were previously recorded mainly as *V. guestphalica* in Poland because the name *V. elaeina* was incorrectly used by Körber (1855) for the specimens currently distinguished as *V. praetermissa*.

WORLD DISTRIBUTION. This species known in Europe: Great Britain, Ireland, Norway, Switzerland, Austria (Orange 2000), the Czech Republic (Guttová & Palice 2001) and Poland (Krzewicka 2009b).

REMARKS. Thüs (2002) included *Verrucaria guestphalica* into the synonymy of *V. praetermissa* but specimens named in Poland as *V. guestphalica* belong to *V. elaeina*. They lack a black basal layer and have a usually pale and cracked non-gelatinous thallus with perithecia which are never entirely immersed and often only half immersed. The involucrellum is more or less conical but not as widely spreading as in *V. praetermissa*. For this reason in Poland *V. guestphalica* auct. is included to *V. elaeina*.

SPECIMENS EXAMINED. DF-96 – WESTERN BESKIDY MTS, BESKID MAŁY MTS: in stream below Królewizna hill (Królowa Wyżnia), 550 m, 28 Aug. 1961, *J. Nowak* (KRAM); DG-06 – BESKID ŻYWIECKI MTS: Pasmo Jałowieckie range, in Czerna stream, 500 m, 5 Sept. 1965, *J. Nowak* (KRAM); Pasmo Jałowieckie range, Stryszawa, valley of Stryszawka stream, 520 m, 16 July 1965, *J. Nowak* (KRAM); DG-15 – Pasmo Jałowieckie, valley of Cicha stream, 750 m, 3 Sept. 1964, *J. Nowak* (KRAM); Pasmo Jałowieckie range, Koszarawa, valley of Bystra stream, 700 m, 21 July 1965, *J. Nowak* (KRAM); DG-16 – Pasmo Jałowieckie range, Hala Kamińskiego, Góra Golisty Groń, 1090 m, in stream, 14 July 1965, *J. Nowak* (KRAM); Pilsko range, valley of Rokitniak stream, 600 m, 26 Sept. 1964, *J. Nowak* (KRAM); Zawoja, 470 m, 29 July 1974, *J. Nowak* (KRAM); Pasmo Jałowieckie range, Hala Kamińskiego on Kolisty Groń hill, in stream, 1090 m, 14 July 1965, *J. Nowak* (KRAM); DG-33 – Pasmo Wielkiej Raczy range, Rycerki in Rycerka stream, 650 m, 26 Sept. 1986, *J. Nowak* (KRAM); S slope of Oźna Mt. in stream, 880 m, 5 Aug. 1964, *J. Nowak* (KRAM); DG-34 – valley of Urwisko strem near Sobolówki, 700 m, 12 Oct. 1966, *J. Nowak* (KRAM); DG-58 – TATRA MTS, WESTERN TATRA MTS: Dolina Chocholowska, Polana Wyznia Chochołowska, 1300 m, on siliceous rocks in stream, 12 Aug. 1982, *K. Toborowicz* (KTC) as *V. subhydrela*; DG-59 – by stream in Dolina Strążyska, 27 July 1924, *J. Motyka* (LBL) as *V. laevata*; EE-83 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Góra Zelejowa nature reserve near Chęciny, 29 July 1951, *J. Rydzak* (LBL); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa village, 20 July 1926 and 1954, *J. Motyka* (LBL); EG-22 – WESTERN BESKIDY MTS, GORCE MTS: in stream Gorcowy by Ochotnica Dolna, 670 m, 12 July 1966, *K. Glanc* (KRAM); FG-10 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Majdan between Bartne and Swierzowa Ruska, 540 m, 7 Sept. 1979, *J. Nowak* (KRAM); FG-14 – Odrzechowa village, Czernisławka river, 23 Oct. 1974, *J. Nowak* (KRAM); near Mymoń by Rymanów, 305 m, 23 Aug. 1974, *J. Nowak* (KRAM); FG-20 – Żydowskie village near Krempna village, 570 m, 6 Oct. 1979, *J. Nowak* (KRAM); FG-21 – Olchowiec village near Polany village in stream, 450 m, 5 Oct. 1979, *J. Nowak* (KRAM); stream in Wielki Las forest near Krempna village, 390 m, 18 Sept. 1979, *J. Nowak* (KRAM); FG-23 – Rudawa stream near Królik Polski village, 500 m, 21 Aug. 1974, *J. Nowak* (KRAM); Tarnawk, in spring near Wisłoczek river, 440 m, 13 Sept. 1974, *J. Nowak* (KRAM); FG-24 – Puławy village by Wisłok river, valley of stream between Kiczera Mt. and Kiczerka Mt., 450 m, 10 Oct. 1974, *J. Nowak* (KRAM); FG-25 – Pasmo Bukowicy Mts, Nagorzany village near Bukowsko village, Sanoczek stream, 425 m, 24 Oct. 1974, *J. Nowak* (KRAM); FG-44 – Dołżyca village near Komańcza village, stream between Średni Garb Mt. and Danawa Mt., 650 m, 20 June 1974, *J. Nowak* (KRAM); FG-45 – Dołżyca village near Komańcza village, Zlewnia stream on Średni Garb Mt., 540 m, 20 June 1974, *J. Nowak* (KRAM); Osławica village, on bank Osławica river, 520 m, 21 June 1974, *J. Nowak* (KRAM); FG-58 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Bieszczadzki National Park, N slope of Połonina Wetlińska, below Średni Wierch, in stream, 26 Aug. 1995, *J. Kiszka* (KRAP); FG-59 – Bieszczadzki National Park, Dwerniczek, by San river on sandstone, 500 m, 15 Aug. 1958,

K. Glanc (KRAM); FG-69 – Bieszczadzki National Park, Przełęcz Wyżniańska, in stream, 794 m, 13 July 2003, *J. Kiszka* (KRAP).

Verrucaria elaeomelaena (A. Massal.) Arnold
Fig. 26

Verh. Zool.-Bot. Ges. Wien **18**: 958. 1868. – *Lithoicea elaeomelaena* A. Massal., Att. Ist. Veneto, Ser. 3, **2**: 380. 1856. TYPE: [Germany], Bayern, Oberfranken, bei Streitberg, *F. Arnold* (TUR-V – LECTOTYPE; see Thüs 2002).

Prothallus not distinct, whitish or pinkish, non-fimbriate. *Thallus* superficial, 50–250 µm thick, light brownish green to olive-brown or mid brown, subgelatinous, usually uncracked or with a few cracks, thallus surface dull, smooth, or uneven, with conical-hemispherical mounds. *Upper cortex* weakly developed, cortical pigment yellow, brown or absent. *Algal* layer arranged in strongly marked columns, paraplectenchymatous, algal cells 6–12 µm in diam. *Medulla* paraplectenchymatous, consisting of cells of thallus weakly arranged in columns, black basal layer absent but brown pigmented areas in lower part of medulla present, continuous or discontinuous and then appearing as punctae in section. *Perithecia* forming very low to moderate projections 320–500 µm in diam., at first completely covered by thallus layer but later becoming erumpent in thalline warts, apex often somewhat exposed and blackish. *Involucrellum* black, variable, conical, present in upper half of excipulum or reaching to base of thallus, or more or less appressed to excipulum, apical part usually covered by a thin thallus layer. *Excipulum* 200–400 µm wide, colourless at side and base. *Periphysoids* up to 25–40 µm long. *Asci* 70–90 µm long, 25–30 µm wide. *Ascospores* simple, colourless, broadly ellipsoid to ovoid, rounded at both ends, 22–30 × 12–16 µm, with or without halo. *Conidiomata* not detected.

NOTE. This amphibious species is distinguished from *V. funckii*, a species similar in appearance, by a thicker and paler thallus and larger, broadly ellipsoid ascospores [*V. funckii* has ascospores ellipsoid to narrowly ellipsoid, rounded at apices (the other end of spore distinctly narrower), 18–25 × 6–8(–10) µm, halonate or not]. It can usually be identified by its substrate preference in the field as it occurs on calcareous rocks in basic streams whereas *V. funckii* occurs exclusively on siliceous rock.

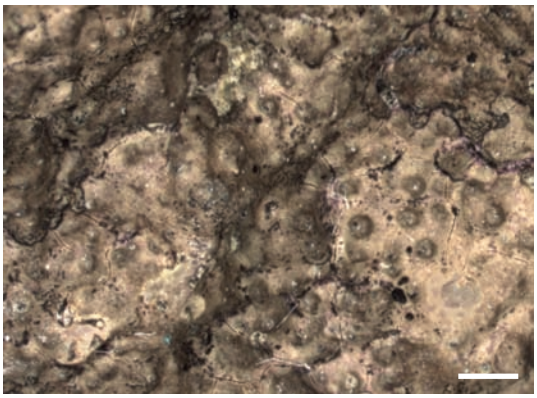

Fig. 26. *Verrucaria elaeomelaena* (A. Massal.) Arnold (Nowak, Lich. Polon. Merid. Exs. 244, KRAM). Scale bar = 1 mm.

HABITAT. Amphibious species occurring on calcareous rocks, or rarely on sandstone or siliceous rocks under calcareous influence on inundated or submerged rocks and pebbles in springs, streams and rivers mainly in lowlands and uplands, less frequently in mountains.

DISTRIBUTION IN POLAND. *Verrucaria elaeomelaena* occurs in larger limestone areas, for example in streams in the Western Tatra Mts and in the Pieniny Mts and in basic streams in the Wyżyna Krakowsko-Wieluńska upland. It has been confirmed outside large calcareous areas on sandstone in the Beskid Żywiecki Mts, the Beskid Niski Mts, the Bieszczady Mts, and the Sudeten Mts where it grows on rock with calcium carbonate. It is known also from a few sites at lower altitude in northern Poland in the Pojezierze Kaszubskie lakeland. This species was recently revised by Krzewicka and Kiszka (2007). New data from the Carpathian Mts were added in this study.

WORLD DISTRIBUTION. Known from Europe, Asia, North America (Orange *et al*. 2009).

REMARKS. This species was often confused with a more frequent species, *V. funckii*. The

taxonomic and nomenclatural problems associated with both species were discussed by Hawksworth (1989), Thüs (2002), Thüs and Schultz (2008) and Krzewicka and Kiszka (2007).

EXSICCATAE SEEN. Rabenhorst, Lich. Europ. Exs. 333D (KRAM); Nowak, Lich. Polon. Merid. Exs. 244 (KRAM).

SPECIMENS EXAMINED. BF-25 – MIDDLE SUDETES, GÓRY STOŁOWE MTS: Polanica near Kłodzko, N slope of Piekielna Dolina, 24 April 1962, *J. Nowak* (KRAM); CB-16 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Kościerzyna, stream in Jarząbce forest, Aug. 1935, *F. Krawiec* (POZ); DE-74 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Mstów, 250 m, 4 July 1963, *J. Nowak* (KRAM); DE-85 – near Będkowice, on limestone pebbles in stream, 400 m, 26 July 1986, *J. Nowak* (KRAM); DF-16 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA CZĘSTOCHOWSKA UPLAND: Jeziorki near Kroczyce, 5 May 1958, *J. Nowak* (KRAM); DF-48 – WYŻYNA OLKUSKA UPLAND: Ojców, Dolina Sąspowska in water on limestone, 9 Aug. 1957, *J. Nowak* (KRAM); Dolina Będkowska, near Rudawa, on submerged limestone boulders in the stream, 19 May 1976, *J. Nowak* (KRAM, LBL); DF-68 – RÓW KRZESZOWICKI DEPRESSION: Dolina Będkowska valley, on submerged limestone rocks in spring, 7 Sept. 1956, *J. Nowak* (KRAM); DG-06 – WESTERN BESKIDY MTS, BESKID ŻYWIECKI MTS: Pasmo Jałowieckie range, in Czerna stream, 500 m, 5 Sept. 1965, *J. Nowak* (KRAM); DG-16 – Massif Babiej Góry range, below Sulowa Cyrhla in Stonów stream, 750 m, 23 June 1961, *J. Nowak* (KRAM); DG-58 – TATRA MTS, WESTERN TATRA MTS: Dolina Chochołowska valley, in stream Chochołowski on calcareous rock, in stream Wielkie Koryciska, 960 m, 16 July 2004, *B. Krzewicka 2709a* (KRAM); Polana Huciska, in a stream on calcareous rocks, 975 m, 16 July 2004, *B. Krzewicka 2755a* (KRAM); EE-97 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, POGÓRZE SZYDŁOWSKIE UPLAND: Życiny in stream, 1984, *G. Sikora* (KTC); EG-00 – WESTERN BESKIDY MTS, BESKID ŚREDNI MTS: Pasmo Lubomira i Łysiny, Kołki by Pcim, Mała Sucha stream, 420 m, 22 Aug. 1996, *J. Nowak* (KRAM); EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Potok Limbargowy in a stream on calcareous rocks, 650 m, 16 July 1997, *J. Kiszka* (KRAP); EG-50 – TATRA MTS, WESTERN TATRA MTS: Kopieniec, 1220 m, 12 July 1971, *J. Nowak* (KRAM); FG-21 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Dołżyca village near Komańcza village, stream between Średni Garb Mt. and Danawa Mt., 650 m, 20 June 1974, *J. Nowak* (KRAM); Huta Krempska village by Krempna village, 420 m, 18 Sept. 1979, *J. Nowak* (KRAM); FG-57 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Buk village, in stream, right of tributary of Solinka river, W slope of Bukowinka hill, 17 May 2008, *B. Krzewicka* (KRAM).

Verrucaria funckii (Spreng.) Zahlbr. Fig. 27

Cat. Lich. Univ. **1**: 41. 1921. – *Pyrenula funckii* Spreng. *in* Funck, Krypt. Gewächse **32**: 5. 1826. TYPE: '658, *Pyrenula Funckii* Spreng., Sprengel. *in litt*. Auf Steinen in klaren Gebirgs-Bächen'[1826], (FR! – SYNTYPE).

Verrucaria denudata var. *mougeotii* Zschacke, Hedwigia **67**: 74. 1927. TYPE: Rabenhorst, Lich. Europ. Exs. 344b (KRAM! – SYNTYPE); Hepp, Flechten Eur. 435A (GFW! – SYNTYPE). The original spelling, *mougeoti*' is treated as an orthographic error. – *Verrucaria denudata* f. *mougeotii* Servít, Stud. Bot. Čech. **11**(1–2): 20. 1950. – *Verrucaria mougeotii* (Zschacke) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 156. 1954.

Verrucaria nuda Zschacke, Rabenh. Kryp. Fl. **9**(1/1): 240. 1934. TYPE: [Germany] Erzgebirge: im Bett der Groβen Mittweida unterhalb der 1. Katzensteiner Brücke, *Lange* (B! – ISOTYPE).

Verrucaria aethioboloides Zschacke, Rabenh. Krypt.-Fl. **9**(1/1): 241. 1934. TYPE: [Germany], Harz, auf Steinen am trocken liegenden Rande der Zorge', *Zschacke* (B – SYNTYPE).

Verrucaria denudata f. *dissulta* Servít, Československé Lišenjníky Čeledi Verrucariaceae: 148. 1954. TYPE: An Porphyrsteinen im Quellbache bei der Alpe Val Maor oberhalb Predazzo in Südtirol, 1900 m, 13 Aug. 1879, *F. Arnold* (Arnold, Lich. Exs. Lich. Jur. 686C, KRAM! – SYNTYPE). Synonymized here.

Verrucaria silicea Servít, Československé Lišenjníky Čeledi Verrucariaceae: 156. 1954. – BASIONYM: *Verrucaria elaeomelaena* f. *silicicola* Zschacke, Hedwigia **67**: 71. 1927. TYPE: hb. ? (see Thüs 2002: 64). – *Verrucaria silicicola* (Zschacke) Servít, Stud. Bot. Čech. **11**(1–2): 35. 1950. [*non Verrucaria silicicola* Fink *in* Hedrick, Mycologia **25**(4): 305. 1933].

Prothallus indistinct, cream, non-fimbriate. *Thallus* superficial, 50–160 μm thick, grey-green, greenish brown or dark brown, subgelatinous, usually well-developed, uncracked, rarely with a few cracks, smooth, ± glossy. *Upper cortex* weakly developed, colourless or pigmented, paraplectenchymatous, 10–15 μm thick. *Algal* layer arranged in

strongly marked columns, paraplectenchymatous, 70–120 µm thick, algal cells 2.5–10 µm in diam. *Medulla* paraplectenchymatous, cells arranged in strongly marked columns with a well-visible and continuous, rarely discontinous, black basal layer. *Perithecia* immersed, completely covered by the thallus, immersed in thallus mounds, only the ostiole visible in young perithecia as pale, in mature perithecia as black points or sometimes eroded later to reveal a black apex; forming low to moderate projections (120–) 200–300 µm in diam. *Involucrellum* dark brown to black, well-developed, thick, completely covered by thallus, reaching to the base of excipulum, often fusing with a black basal layer, appressed to excipulum, 100–250 µm high, 280–600 µm wide and 30–70 µm thick. *Excipulum* 180–390 µm wide, colourless at side and base, often dilute brown at ostiole. *Periphysoids* up to 20–30 µm long. *Asci* 60–75 µm long, 20–27 µm wide. *Ascospores* simple, colourless, ellipsoid to narrowly ellipsoid, rounded at upper pole, narrowed to lower pole), 18–25 × 6–8(–10) µm, halonate or not. *Conidiomata* not detected.

NOTE. This amphibious species is characterized by a smooth, usually uncracked, grey-green, greenish brown to dark brown thallus, with a black basal layer and perithecia completely covered by the thallus visible as black dots in thallus mounds, and narrowly ellipsoid ascospores. *Verrucaria pachyderma* differs from *V. funckii* in the smaller ascospores (17–22 × 6–8 µm), green pigment in the cortex, and lack of a black basal layer, although morphs with brown areas in the medulla occur. Thüs and Schultz (2008) and Orange *et al*. (2009) observed specimens without a black basal layer in *V. funckii* in Great Britain and Central Europe. However, specimens without this layer have not been observed in Poland. *Verrucaria funckii* was often confused with *V. elaeomelaena*, which was recently discussed by Hawksworth (1989), Thüs (2002), and Krzewicka and Kiszka (2007).

HABITAT. Amphibious species occurring on frequently or permanently submerged siliceous rocks in streams and springs. The colour of the thallus depends on sun exposure and the altitude; it is darker when UV is stronger. Individuals with a chocolate brown thallus were observed at high altitudes above 1500 m, for example in the Tatra Mts. But when individuals grow at lower altitudes or in shady places, the colour of the thallus is paler, for instance yellowish green.

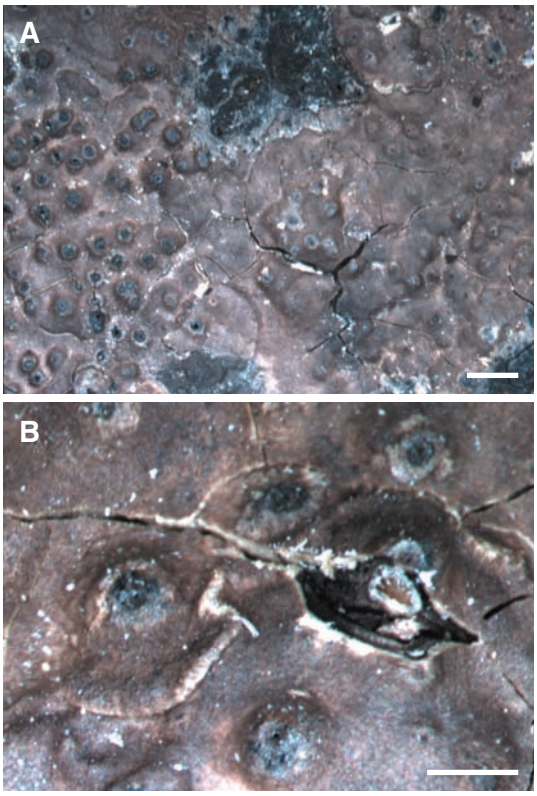

Fig. 27. *Verrucaria funckii* (Spreng.) Zahlbr. A – thallus (Nowak, Lich. Polon. Merid. Exs. 245, KRAM); B – perithecia (*Nowak*, KRAM). Scale bars: A = 1 mm; B = 0.5 mm.

DISTRIBUTION IN POLAND. This species occurs in mountain streams at many scattered localities in southern Poland in the Carpathian Mts and the Sudeten Mts. It has also been recorded at a few sites in the lowlands in northern Poland, in the Pojezierze Południowopomorskie lakeland and the Pojezierze Chełmińsko-Dobrzyńskie lakeland, and in the central part in the Wzniesienia Południowomazowieckie hills. This species was recently revised by Krzewicka and Kiszka (2007). Further localities of *V. funckii* in Central and northern Poland were recorded in this study.

WORLD DISTRIBUTION. Species widespread in Europe, also known in North America (Thüs 2002, Orange *et al*. 2009).

REMARKS. The synonyms listed here follow Thüs (2002) and Thüs & Schultz (2008) except for the name *Verrucaria denudata* f. *dissulta*, which is proposed here as a synonym of *V*. *funckii*. This form is characterized by a dark brown thallus with a well-developed black basal layer and perithecia completely covered by the thallus; ascospores are the same size (18–25 × 6–8 μm) and shape as in *V. funckii*.

EXSICCATAE SEEN. Arnold, Lich. Exs. Lich. Jur. 686D (as *Verrucaria chlorotica*) (KRAM); Nowak, Lich. Polon. Merid. Exs. 245 (as *Verrucaria silicea*) (KRAM).

SPECIMENS EXAMINED. BF-25 – MIDDLE SUDETES, GÓRY STOŁOWE MTS: Polanica near Kłodzko, N- slope of Piekielna Dolina, 24 April 1962, *J. Nowak* (KRAM); BF-47 – EASTERN SUDETES, THE MASSIF OF ŚNIEŻNIK MT.: stream below Czarna Góra, 1 July 1960, *J. Nowak* (KRAM); CB-68 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND, BORY TUCHOLSKIE FOREST: 1 km E of Stare Rzeki, on stones in water, 13 June 2004, *M. Kukwa 3294* (UGDA); DB-78 – POJEZIERZE CHEŁMIŃSKO-DOBRZYŃSKIE LAKELAND, GARB LUBAWSKI HUMMOCK: Wzgórz Dylewskich Landskape Park, 1 km NW of Glaznoty, on stones in stream, 2 June 2001, *M. Kukwa 795* (UGDA); DD-68 – WZNIESIENIA POŁUDNIOWOMAZOWIECKIE HEIGHTS, WZNIESIENIA ŁÓDZKIE HEIGHTS: Wzniesienia Łódzkie Landscape Park, on stones in Grzmiąca stream, 10 June 2006, *M. Hachułka* (LOD); DF-94– WESTERN BESKIDY MTS, BESKID MAŁY MTS: Wielka Puszcza sream by Miherda hill, 370 m, 8 May, 1962, *J. Nowak* (KRAM); DF-95 – valley of stream below Potrójna hill, in water, 650 m, 9 May 1962, *J. Nowak* (KRAM); DG-03 – BESKID ŚLĄSKI MTS: Szczyrk, in a stream by a forest, 560 m, 28 June 1964, *J. Kiszka* (KRAP); DG-05– BESKID MAŁY MTS: Kocierz Moszczanicki, in stream 450 m, 8 Aug. 1960, *J. Nowak* (KRAM); Zakocierz, 650 m, 10 Aug. 1960, *J. Nowak* (KRAM); DG-33 – BESKID ŻYWIECKI MTS: Wielka Racza range, valley of Danielka stream, 650 m, 8 Aug. 1964, *J. Nowak* (KRAM); EG-50 – TATRA MTS, HIGH TATRA MTS: Dolina Pańszczyca, on granite rockin stream, 1310 m, 10 Aug. 1971, *J. Nowak* (KRAM); DG-58 – WESTERN TATRA MTS: Dolina Chochołowska, Polana Chochołowska, on rock in stream, 1100 m, 10 July 1959, *J. Nowak* (KRAM); DG-59 – Dolina Kościeliska valley, in the stream Kościeliski Potok 19 July 1923 and 23 Aug. 1927, *J. Motyka* (LBL); in a stream above Ornak hut, 1100 m, 15 July 2004, *B. Krzewicka 2621a* (KRAM); by Hala Pisana in stream, 1050 m, 29 May 1959, *J. Nowak* (KRAM); Kościeliski Potok stream by Hala Ornak, 1070 m, 22 May 1959, *J. Nowak* (KRAM); DG-68 – Dolina Jarząbcza, Jarząbczy strem, 1320 m, 10 Oct. 1987, *J. Nowak* (KRAM); DG-69 – Dolina Chochołowska, Starobociański Potok, 1400 m, 11 July 1959, *J. Nowak* (KRAM); EF-95 – POGÓRZE ŚRODKOWOBESKIDZKIE FOOTHILLS, POGÓRZE ROŻNOWSKIE FOOTHILLS: N slope of Majdan Mt., on pebbles in a stream, 400 m, 21 June 1971, *R. Kozik* (KRAP); EF-95 – POGÓRZER CIĘŻKOWICKIE FOOTHILLS: Majdan, N slope in stream, 400 m, 21 June 1971, *R. Kozik* (KRAP); EG-11 – WESTERN BESKIDY MTS, BESKID WYSPOWY MTS: Polana Skalne below Hala Jasień, on sandstone pebbles in a stream, 1000 m, 18 Aug. 1966, *J. Nowak* (KRAM); EG-21 – GORCE MTS: Turbacz Nature Reserve, in Turbacz stream on sandstone pebbles, 920 m, 1996, *P. Czarnota* (GNP); EG-50 – TATRA MTS, HIGH TATRA MTS: Dolina Pańszczyca valley, on granite rock in stream, 1520 m, 13 Aug. 1971, *J. Nowak* (KRAM); FG-44 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Wisłok Górny village, Wisłok river, near Kanasiówka Mt., 625 m, 22 June 1974, *J. Nowak* (KRAM); GB-92 – NIZINA PÓŁNOCNOPODLASKA LOWLAND, WYSOCZYZNA BIAŁOSTOCKA PLATEAU: Puszcza Knyszyńska forest, nature reserve Budzisk, by the stream, 10 June 1999, *K. Czyżewska* (LOD); GG-70 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Bieszczadzki National Park, Rozsypaniec Mt. in stream, 1042 m, 13 July 2005, *J. Kiszka* (KRAP).

Verrucaria hochstetteri Fr. Fig. 28

Lich. Eur. Reform.: 435. 1831. – TYPE: Ad rupes calcareas Blabyrae in regno Würtembergiae, *Z. Hochstetter* (UPS). – *Amphoridium hochstetteri* (Fr.) A. Massal., Memor. Lichenogr.: 146. 1853.

Amphoridium saprophilum A. Massal., Symmict. Lich.: 79. 1855. TYPE: [Italy] Ad saxa eocenica corrupta et erratica Prov. Veronensis in oppido Avesa, *M. Ongarine* (VER). – *Verrucaria saprophila* (A. Massal.) Trevisan, Conspect. Verrc.: 8. 1860.

?*Verrucaria leightonii* var. *carnea* Arnold *in* Zwackh, Flora **47**: 87. 1864. – *Verrucaria carnea* (Arnold) Servít, Stud. Bot. Čech. **9**: 77. 1948. – *Amphoridium carneum* (Arnold) sensu Servít, Československé Lišenjníky Čeledi Verrucariaceae: 23. 1954.

?*Amphoridium ionospicarpum* J. Nowak, Acta Mycologica **2**: 3. 1966. TYPE: [Poland] Wyżyna Wieluńska, Węże koło Działoszyna, około 190 m, 30 May 1963, *J. Nowak* (KRAM! – HOLOTYPE). Synonymised here.

?*Amphoridium dolomiticum* A. Massal., Symmict. Lich.: 80. 1855. – *Verrucaria dolomitica* (A. Massal.) Kremp., Denkschr. Kgl. Bayer. Bot. Ges., Abt. 2 **4**: 238. 1861.

?*Verrucaria foveolata* (Flörke) A. Massal., Rich Auton. Lich.: 172. 1852.

Amphoridium mastoideum A. Massal., Symmict. Lich.: 82. 1855. – *Verrucaria mastoidea* (A. Massal.) Trevisan, Conspect. Verruc.: 8. 1860.

Amphoridium praecellens Arnold, Verh. Zoll. Bot. Ges. **19**: 651. 1869. – *Verrucaria praecellens* (Arnold) Servít, Stud. Bot. Čechoslav. **9**: 100. 1948.

Prothallus absent in single thalli or visible as thin black lines separating contiguous conspecific thalli. *Thallus* endolithic, continuous, not cracked, whitish to light grey, matt. *Upper cortex* a litocortex, prosoplectenchymatous. *Algal* layer discontinuous, 100–150 µm high, photobiont cells in clusters 25–30 µm in diam., or scattered, cells rounded, 5–12 µm diam. *Medulla* prosoplectenchymatous, formed by loose hyphae intermingled with microcrystals. *Perithecia* entirely immersed in the thallus in well-defined pits in rocks, often surrounded by a collar of thallus. *Involucrellum* absent. *Excipulum* brown pigmented throughout, K+ darker brown, 400–700 µm wide, 500–700(–800) µm high, upper part plane, 300–500 µm wide. *Periphysoids* 60 µm long. *Asci* 90–120 µm long, 27–32 µm wide. *Ascospores* simple, colourless, ellipsoid to broadly ellipsoid, (25–)30–32(–40) × 15–20(–23) µm, with halo, 0.8–1.2 µm thick, surface compact, often with a distinct fine ornamentation of short simple or branched ridges. *Conidiomata* not observed.

NOTE. This species is characterized by the whitish to light grey endolithic thallus with immersed perithecia without involucrellum, large ascospores, and a dark excipulum which is distinctly thicker and plane at the apex. Perithecia often are surrounded by collar of thallus. *Bagliettoa calciseda* also has a whitish endolithic thallus with immersed perithecia that lack an involucrellum but differs in the smaller perithecia and ascospores (19–27 × 8–13 µm); the excipulum is more or less equally thick throughout and has a distinctly elongated ostiolar canal.

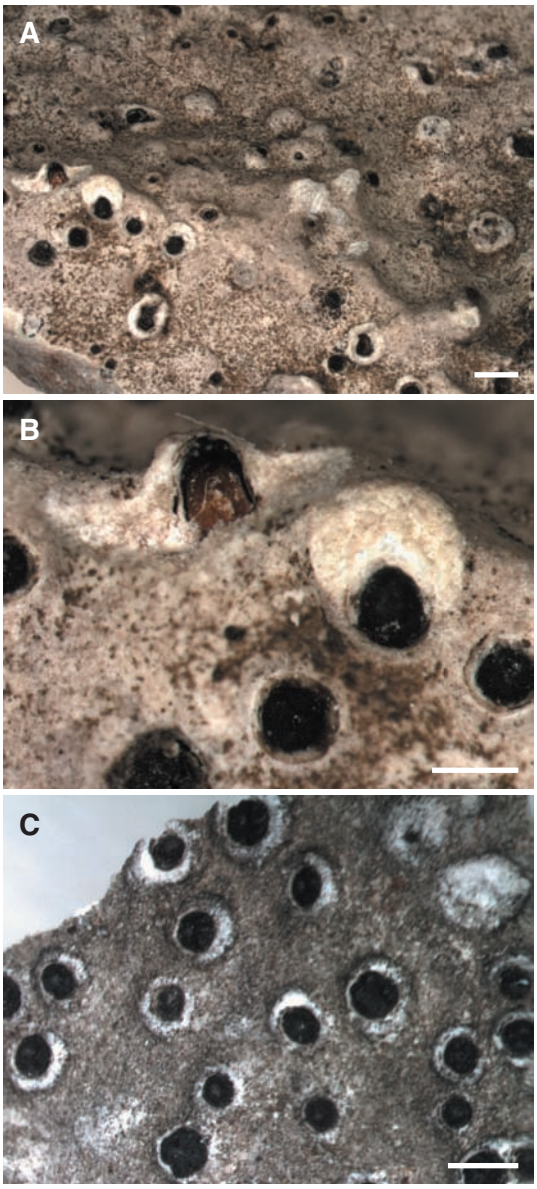

Fig. 28. *Verrucaria hochstetteri* Fr. A – habit (*Nowak*, KRAM); B & C – perithecia (*Nowak*, KRAM). Scale bars: A & C = 1 mm; B = 0.5 mm.

HABITAT. On limestone.

DISTRIBUTION IN POLAND. Known from a few

localities (in the Pieniny Mts and the Tatra Mts). Specimens of *V. hochstetteri* in KRAM were sometimes named as *V. hiascens*.

WORLD DISTRIBUTION. Known mainly in southern Europe and British Isles (Feuerer 2011).

REMARKS. Zschacke (1933) distinguished the species *Verrucaria arnoldii*, *V. hochstetteri*, *V. mastoidea* and *V. saprophila* based mainly on differences in the colour of the thallus, the shape of the thalline collar surrounding the peritheciuma, and the shape of the upper part of the excipulum. These all had an endolithic thallus with perithecia completely immersed in warts and a dark brown excipulum, and ascospores *ca* 30 × 15 µm. The supposed differences between these taxa are however the result of differing substrate composition, and differing stages of development. Such variations are frequent in pyrenocarpous endolithic species, for examplea in *Bagliettoa* Halda (2003). Thus most authors treat these species as synonyms of *V. hochstetteri* (Pišút *et al*. 1996; Vězda & Liška 1999).

The type specimens (KRAM) described by Nowak (1966) as *Amphoridium ionospicarpum* are a very similar to *Amphoridium carneum* (Servít 1954). Both taxa are characterized by dirty white, semi-endolithic thallus with lager immersed perithecia without involucrellum and large ascospores (*A. carneum* 25–35 × 13–17 µm, *A. ionospicarpum* 23–33 × 12–15 µm). For this reason *A. ionospicarpum* is treated as a synonym of *A. carneum.* Furthermore the specimens of both mentioned taxa seems to be pigment deficient mutants of *Verrucaria hochstetteri.* They are characterized by the same characters as *V. hochstetteri* except the pigmentation of the excipulum.

EXSICCATAE SEEN. Hepp, Flechten Eur. 432 (as *Verrucaria hochstetteri*) (GFW); Arnold, Lich. Exs. 771 (KRAM); Arnold, Lich. Exs. Lich. Jur. 178 (as *Amphoridium saprophilum*) (W); Arnold, Lich. Exs. Lich. Jur. 55 (as *Amphoridium mastoideum*) (W).

SPECIMENS EXAMINED. DG-59 – TATRA MTS, WESTERN TATRA MTS: Kończysta Turnia Mt., above Dolina Miętusia valley, 1100 m, 29 May 1959, *J. Nowak* (KRAM); Giewont Mt., 25 Aug. 1956, *J. Motyka* (LBL); Łysanki Mt. by Dolina Małej Łąki, 30 July 1925, *J. Motyka* (LBL); Wąwóz Kraków, 1300 m, 29 May 1959, *J. Nowak* (KRAM); EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Pieniny National Park, Wąwóz Gorczyński gorge, 2 Sept. 1998, *J. Kiszka* (KRAM); Wąwóz Sobczański, on calcareous rocks, 2 and 4 May 1957, *J. Nowak* (KRAM); Wąwóz Sobczański gorge, on calcareous rocks, 11 Sept. 1967, *K. Glanc* (KRAM); EG-50 – TATRA MTS, WESTERN TATRA MTS: Kopa Magury Mt. above Dolina Jaworzynka valley, 3 km SE of Kuźnice, 1690 m, 24 July 1975, *J. Nowak* (KRAM) as *Verrucaria hiascens*; Kalacka Turnia in Dolina Bystrej valley 1350 m, 21 May 1959, *J. Nowak* (KRAM); and 1400 m, 9 July 1957, *J. Nowak* (KRAM).

Verrucaria latebrosa Körb. Fig. 29

Syst. Lich. Germaniae: 349. 1855. TYPE: [Poland] Sudeten, Kleine Schneegrube [Mały Śnieżny Kocioł], an feuchten versteckt gelegenen Wänden des Basalt, zusammen mit *Zeora wimmeriana*, 27.07.1853 (L – HOLOTYPE).

Verrucaria basaltica Servít, Stud. Bot. Čech. **11**(1–2): 15. 1950. TYPE: [Poland] Silesia: Kleine Schneegrube, 1200–1300, Basalt, 1928. *J. Suza* (PRM).

Verrucaria anziana Garov., Tentam. Dispos. Lich. Lang.: 20. 1865. TYPE: Ad rupem micaceam aqua nivali, et pluviali identidem irroratam in alpe Tresér (praealpium Comoniarum) 2000 m, circiter supra mare (Anzi, Lich. Rar. Langob. Exs. 488, TO!, W! – SYNTYPES).

Prothallus whitish. *Thallus* superficial, non-subgelatinous, well-developed, 135–200(–480) µm thick, grey-green, yellow-brown or dark brown, to pale grey-brown, reddish grey or rarely orange-brown, cracks few to numerous, surface smooth, matt to slightly glossy. *Upper cortex* weakly developed, with brown pigment. *Algal* layer 60–100 µm thick, algal cells small, 6–18 µm in diam., scattered. *Medulla* para- to prosoplectenchymatous, cells irregularly arranged or at most in very weak and local columns, dark basal layer absent. *Perithecia* forming low to moderate projections, 250–500 µm in diam., mostly covered bythallus except for the uppermost part with a black exposed convex apex; perithecia one or rarely two per areole. *Involucrellum* well-developed, thick, present only around the apex of the excipulum or spreading outwards and downwards in upper half, rarely reaching to the base. *Excipulum* colourless

below or only locally and thinly with brown pigment, 190–300(–380) µm wide. *Periphysoids* up to 25 µm long. *Asci* 70–90 µm long, 18–25 µm wide. *Ascospores* simple, colourless, ellipsoid, (18–)24–29(–36) × 8.5–12.5(–14) µm, with halo in fresh material. *Conidiomata* not observed.

NOTE. Characterized by a non-subgelatinous, well-developed thallus with many cracks or regularly areolate and almost completely immersed perithecia with a well-developed (thick) involucrellum present only around the apex or spreading outwards and downwards in the upper part. *Verrucaria submersella* differs in the more prominent perithecia, half or three-quarters immersed in thallus and forming shallow pits in the substratum, and the non-halonate ascospores. *Verrucaria cernaensis* differs in the well-developed involucrellum reaching to the base of the dark pigmented excipulum, and smaller ascospores [18–22(–25) × 8–14 µm]. *Verrucaria margacea* differs in the prominent perithecia forming moderate to distinct projections (280–)350–800 µm in diam., at first covered by thallus and later partly exposed, and a conical involucrellum reaching to the base of the excipulum.

HABITAT. An amphibious species occurring on siliceous rocks beside streams and lakes, often above the water level but in splash or aerosol zones, in sunny or partially shady places.

DISTRIBUTION IN POLAND. *Verrucaria latebrosa* occurs in southern Poland in the Sudeten Mts and the Carpathian Mts, mainly in the Tatra Mts.

WORLD DISTRIBUTION. In Europe it has been reported from Cenral Europe (Thüs 2002) and from Britain, including North Wales, Northern England, Central and West Scotland (Orange *et al*. 2009).

REMARKS. In his revision of freshwater *Verrucaria* Thüs (2002) included two morphs into *V*. *latebrosa*: one with a well developed involucrellum in the upper half of the excipulum (previously recognized as *V*. *latebrosa*) and another with a thick and short involucrellum present only around the apex of the excipulum (recognized as *V*. *anziana*). The latter species was accepted by (Orange *et al*. 2009), based in part on molecular

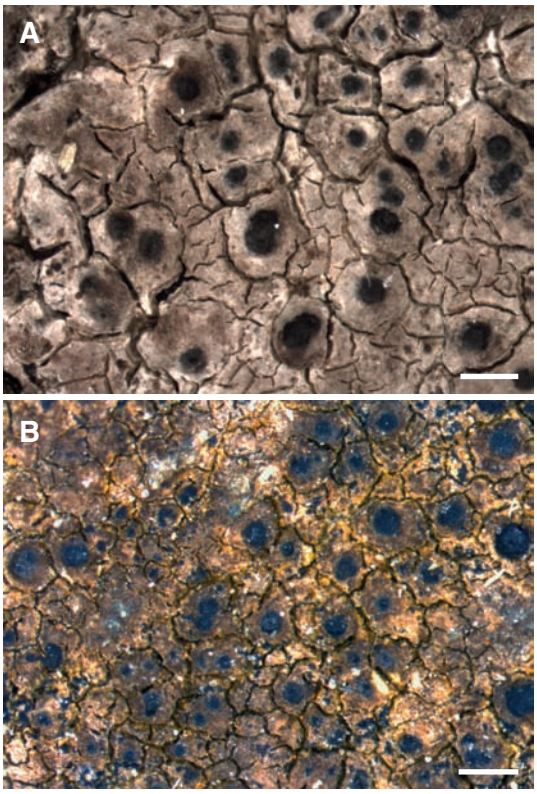

Fig. 29. *Verrucaria latebrosa* Körb. A & B – thallus (*Nowak*, KRAM; B – Anzi, Lich. Rar. Langob. Exs. 488, W, as *Verrucaria anziana* Garov., syntype). Scale bars = 0.5 mm.

evidence. However, further studies of the *V*. *anziana* – *V*. *latebrosa* group need to be carried out before they can be fully understood.

Following H. Thüs (*in litt*.), *V*. *basaltica* is included here in the synonymy of *V*. *latebrosa*. Servít (1950) designated the type specimen of *V*. *basaltica* from material previously named as *V*. *latebrosa* (PRM), but the type is a typical morph of *V*. *latebrosa*.

SPECIMENS EXAMINED. DF-99 – WESTERN BESKIDY MTS, BESKID ŚREDNI MTS: roks by Raba river near Stróża, 13 April 1965, *J*. *Nowak* (KRAM); DG-06 – BESKID ŻYWIECKI MTS: Pasmo Jałowieckie range, in Czerna stream, 500 m, 5 Sept. 1965, *J*. *Nowak* (KRAM); DG-07 – Pasmo Jałowieckie range, in Grzechynka stream, 575 m, 3 Sept. 1965, *J*. *Nowak* (KRAM); Skawica, in stream, 450 m, 26 July 1974, *J*. *Nowak* (KRAM); DG-58 – TATRA MTS, WESTERN TATRA MTS: Dolina Chochołowska, in Starobociański

Potok, 1350 m, 11 July 1959, *J. Nowak* (KRAM); DG-68 – Dolina Jarząbcza, Jarząbczy strem, 1310 m and 1400 m, 10 Oct. 1987, *J. Nowak* (KRAM); DG-69 – Dolina Chochołowska, Starobociański Potok, 1400 m, 11 July 1959, *J. Nowak* (KRAM); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa, 1954, *J. Motyka* (LBL); EG-50 – TATRA MTS, HIGH TATRA MTS: Dolina Pańszczyca, 1570 m and 1600 m, 13 Aug. 1971, *J. Nowak* (KRAM); between Żółta Turnia Mt. and Koszysta Mt. in stream, 1570 m, 13 Aug. 1971, *J. Nowak* (KRAM); Dolina Suchej Wody valley, in strem, 1130 m, 9 Aug. 1971, *J. Nowak* (KRAM); Dolina Pańszczyca, 1570 and 1600 m, 13 Aug. 1971, *J. Nowak* (KRAM); between Żółta Turnia Mt. and Koszysta Mt. in stream, 1570 m, 12 Aug. 1971, *J. Nowak* (KRAM); Hala Gąsienicowa, stream by Czarny Staw Gąsienicowy, 8 July 1927, *J. Motyka* (LBL); Hala Gąsienicowa, stream by Dwoisty Stawek, 22 Aug. 1925, *J. Motyka* (LBL); EG-51 – Dolina Białki valley, in Białka river, 12 July 1926, *J. Motyka* (LBL); FG-10 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Bednarka stream, between Bednarka and Cieklin villages, 370 m, 7 Oct. 1977, *J. Nowak* (KRAM); FG-12 – bank of Jasionka stream near Dukla village, 340 m, 10 Sept. 1974, *J. Nowak* (KRAM); FG-21 – Krempna village, stream by Huta Krempska village, 390 m, 18 Sept. 1979, *J. Nowak* (KRAM); Huta Krempska village by Krempna village, 420 m, 18 Sept. 1979, *J. Nowak* (KRAM); FG-22 – Wilsznia stream near Tylawa village, 490 m, 5 Oct. 1975, *J. Nowak* (KRAM); FG-23 – valley of Wisłoczek river, 490 m, 21 Aug. 1974, *J. Nowak* (KRAM); FG-44 – Dołżyca village near Komańcza village, stream on slope of Średni Garb Mt., 540 m, 20 June 1974, *J. Nowak* (KRAM); FG-45 – Osławica village, on bank Osławica river, 520 m, 21 June 1974, *J. Nowak* (KRAM); FG-59 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Bieszczadzki National Park, Przełęcz nad Berehami pass, in stream, 789 m and 760 m, 8 July 2003, *J. Kiszka* (KRAP); FG-69 – Bieszczadzki National Park, Przełęcz Wyżniańska, in stream, 794 m, 13 July 2003, *J. Kiszka* (KRAP); valley below Krzemieniec Mt., in stream, 25 July 2000, *J. Kiszka* (KRAP).

Verrucaria macrostoma Dufour *ex* DC. Fig. 30

in Lamarck & De Candolle, Flore Francaise 3 ed., **2**: 319. 1805.

Verrucaria macrostoma var. *detersa* Kremp., Denkschr. Bayer. Bot. Ges. Regensburg **4**(2): 234. 1861. TYPE: [Germany] Dolomitfelsen bei Eichstätt, 1856, *F. Arnold* (M-0124002! – LECTOTYPE designated by Breuss and Berger 2010, Arnold, Lich. Exs. Lich. Jur. 101, W! – SYNTYPE). – *Verrucaria detersa* (Kremp.) Stizenb., Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1889–90: 208. 1891. – *Lithoicea macrostoma* var. *detersa* (Kremp.) Stein, Kryptogamen-Flora von Schlesien: 322. 1879. – *Amphoridium detersum* (Kremp.) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 42. 1954.

Verrucaria murorum auct. sensu pol. [*non Verrucaria murorum* (A. Massal.) Lindau, Die Flecht.: 5. 1913. – *Thrombium murorum* A. Massal., Rich Auton. Lich.: 157. 1852].

? *Verrucaria velana* (A.Massal.) Zahlbr., Ann. Naturh. Mus. Wien **25**: 211. 1900.

Prothallus inconspicuous, black. *Thallus* superficial, well-developed, 300–600 µm thick, areolate, pale brown to olive-green (typically mid-brown); areoles angular to irregular in outline, 0.4–1.5 mm in diam., flat to convex, smooth to verruculose; blastidia absent to abundant, 40–80 µm diam., arising from the margins of the areoles. *Upper cortex* paraplectenchymatous, 20–30 µm thick, uppermost layer with cell walls dark pigmented, epinecral layer often present, to 15 µm thick. *Algal* layer paraplectenchymatous, algal cells 5–8 µm in diam. *Medulla* subparaplectenchymatous, colourless to pale brown in patches, without black basal layer. *Perithecia* completely to half or three-quarters immersed, forming low to moderate conical-hemispherical projections 300–520 µm wide, black, not covered by a thalline layer, not forming pits or only very shallow pits in the rock, excipulum ellipsoid, up to 600 µm high and 500 µm wide. *Involucrellum* black, 60–80 µm thick well-developed, often more or less reaching base of excipulum, appressed to the excipulum, slightly spreading to more or less conical. *Excipulum* dark brown to black, globose, 250–400(–500) µm wide. *Periphysoids* branched-anastomosing 35–45 × 3–4 µm. *Asci* 85–100 µm long, 27–30 µm wide. *Ascospores* simple, colourless, ellipsoid, (20–)25–32 × 10–15 µm, without halo. *Conidiomata* present, pycnidia immersed, conidia bacilliform 4 × 1 µm.

NOTE. This species is characterized by an areolate mid-brown thallus without a black basal layer, a darkly pigmented excipulum with branched-anastomosing periphyses. It differs from *V. nigrescens*

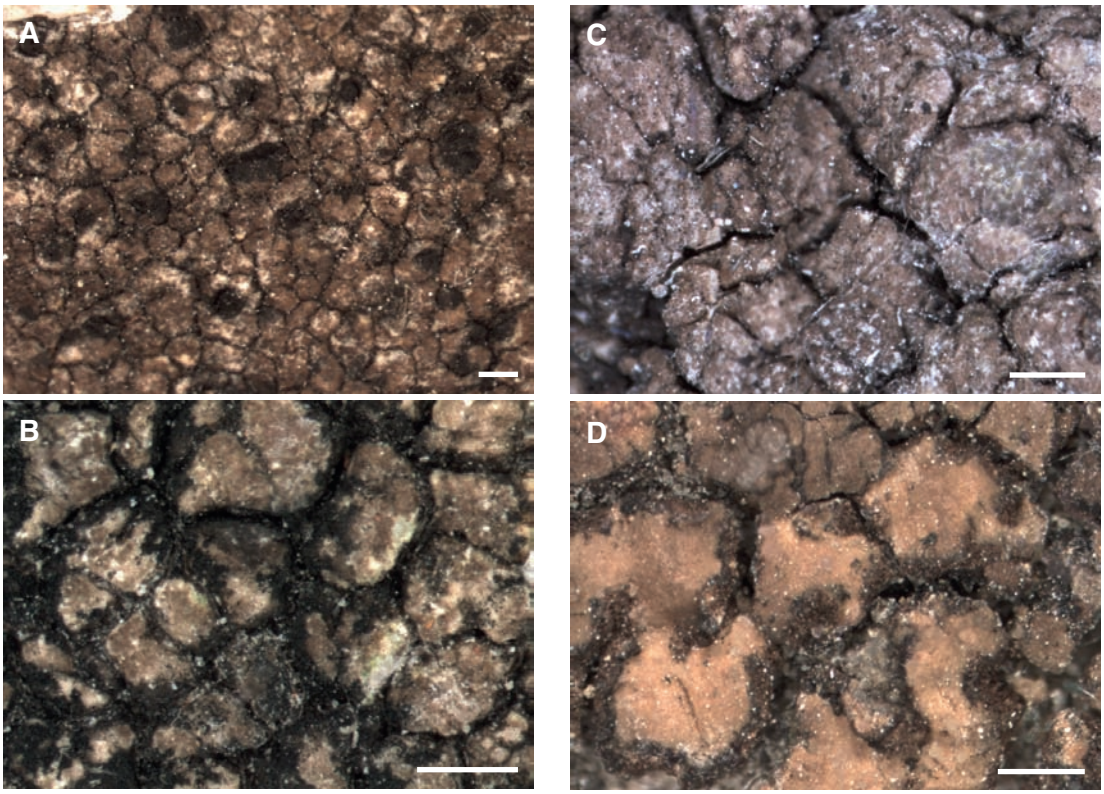

Fig. 30. *Verrucaria macrostoma* Dufour *ex* DC. A – habit (*Arnold*, M, as *Verrucaria macrostoma* var. *detersa* Kremp., lectotype); B–D – thallus (B – Hepp, Flechten Eur. 943, GFW; C – Arnold, Lich. Exs. Lich. Jur. 101; D – *Kiszka* & *Piórecki,* KRAM). Scale bars: A = 1 mm; B–D = 0.5 mm.

and *V. tectorum* by lacking a black basal layer, from *V. maculiformis* by the thick thallus and larger ascospores. *Verrucaria nigroumbrina* differs by the presence of smaller areoles and smaller ascospores [16–25(–27) × 8–10(–13) µm].

HABITAT. It occurs on sunny calcareous rocks, in moderately eutrophic environments; present in anthropogenic habitats.

DISTRIBUTION IN POLAND. It is recorded in mountainous regions with large calcareous outcrops such as in the Pieniny Mts, the Western Tatra Mts and at lower altitudes in the Wyżyna Krakowsko-Częstochowska upland. It is quite frequent in Poland and abundant locally. *Verrucaria macrostoma* var. *detersa* has been reported from Silesia (Körber 1863); however, this material was not revised. The specimens of *V. macrostoma* in Polish herbaria were previously determined mainly as *V. murorum* or *V. velana*. Previously it was reported only from the Gorce Mts (Bielczyk 2003).

WORLD DISTRIBUTION. In Europe reported from many countries, but according to Breuss and Berger (2010) *V. macrostoma* is probably less frequent than it has been reported.

REMARKS. Specimens of *V. macrostoma* have often been incorrectly determined as *V. murorum*. Zschacke (1933) treated the following as synonyms of *V. murorum* Lindau: *Lithoicea murorum* Arnold, *V. macrostoma* var. *detersa* and *L. macrostoma* var. *detersa*. He observed that Hepp's exsiccatae material no. 943 (*V. macrostoma* var. *detersa*) and Arnold's exsiccatae material no. 101 (*L. murorum*) belonged to the same species. For this reason Zschacke (1933) treated this material as

V. murorum; however, these exsiccatae collections belong to *V. macrostoma* because Krempelhuber (1861) reported specimens no. 101 from Arnold's exsiccatae collection as the type material of *V. macrostoma* var. *detersa* (the taxon currently recognized as *V. macrostoma*). Arnold's material no. 101 is not similar to the material recognized by Massalongo as *V. murorum* (= *Thrombium murorum* A. Massal.) (M-0123985!). For this reason Breuss and Berger (2010) recognize *V. macrostoma* and *V. murorum* as a separate species. They included the name *V. macrostoma* var. *detersa* Kremp. into the synonyms of *V. macrostoma*. Additionally they reported *V. velana* (A.Massal.) Zahlbr. as a probable synonym of *V. macrostoma*.

EXSICCATAE SEEN. Hepp, Flechten Eur. 943 (as *Verrucaria macrostoma* var. *detersa*) (GFW).

SPECIMENS EXAMINED. DE-52 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Zalesiaki near Działoszyn, 1 June 1963, *J. Nowak* (KRAM); DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Pieskowa Skała near Olkusz, 2 May 1958, *J. Nowak* (KRAM); rock boulder in Dolina Sąspowska valley, 16 Aug. 2004, *J. Kiszka* (KRAP); DF-58 – Dolina Kluczwody, 7 Aug. 1957, *J. Nowak* (KRAM); DF-58 – Dolina Kluczwody near Wierzchowie, 2 Aug. 1957, *J. Nowak* (KRAM); DF-67 – GARB TENCZYŃSKI HUMMOCK: Brodła, Skały Godunowskie rock, 12 April 1970, *J. Diak* (KRAM); DF-68 – RÓW KRZESZOWICKI DEPRESSION: Dolina Brzoskwinki near Brzoskwinia, 12 Oct. 1971, *J. Nowak* (KRAM); DF-68 – GARB TENCZYŃSKI HUMMOCK: Rudawa, 14 March 1957, *J. Nowak* (KRAM); EG-04 – WESTERN BESKIDY MTS, BESKID WYSPOWY MTS: Ujanowice, 285 m, 27 June 1967, *J. Nowak* (KRAM); EG-32 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Wąwóz Homole near Jaworki, 9 Sept. 1959, *J. Nowak* (KRAM); EG-34 – Małe Pieniny Mts, Biała Woda nature reserve near Jaworki, 3 June 1999, *J. Kiszka* (KRAP); GE-22 – WESTERN BESKIDY MTS, GORCE MTS: Lubań, NE slope of Baszta, 420 m, 27 Aug. 1967, *K. Glanc* (KRAM); Tworogi by Ochotnica, 680 m, 6 Sept. 1960 and 17 July 1966, *K. Glanc* (KRAM); GE-23 – Rzeki by the road to Tylmanowa, 450 m, 11 July 1966, *K. Glanc* (KRAM); GG-00 – POGÓRZE ŚRODKOWOBESKIDZKIE FOOTHILLS, POGÓRZE PRZEMYSKIE FOOTHILLS: Skała Dubin rock in Nowe Sady, 26 July 1984, *J. Kiszka* & *J. Piórecki* (KRAM); FG-27 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Pasmo Żuków massif, Myczkowce, 4 Aug. 1990, *R. Kościelniak* (KRAP).

Verrucaria maculiformis Kremp. Fig. 31

Flora **41**: 303. 1858. TYPE: An umherliegenden Kalksteinen im Laubwalde oberhalb Wasserzell bei Eichstätt (Baiern), *F. Arnold* (Hepp, Flechten Eur. 685, GFW!, WRSL! – ISOTYPES). – *Involucrothele maculiformis* (Kremp.) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 182. 1954.

Prothallus inconspicuous, brownish. *Thallus* superficial, moderately-thick, 100–150 µm thick, non-gelatinous, glossy, smooth to rarely finely roughened and minutely uneven, often patchy or present as small flecks, yellowish green to brown, dark brown to unaided eye. *Upper cortex* a pseudocortex, cells with brownish pigmented walls. *Algal* layer continuous, 20–40 µm thick, algae cells 7–10 µm in diam., surrounded by paraplectenchymatous hyphae. *Medulla* paraplectenchymatous, colourless, formed by loose hyphae, surrounded by crystals visible in polarized light, without black basal layer. *Perithecia* half or one-quarter immersed, forming moderate projections 150–250 µm in diam., usually without a distinct covering of thallus or with a very thin layer of thallus in lower part. *Involucrellum* present around upper half of excipulum, conical, dark brown, 20 µm thick. *Excipulum* colourless, later brown, 150–200 µm wide. *Hymenium* colourless, becoming pale- to dark-brown in older perithecia. *Periphysoids* thick, unbranched 15–20 µm long. *Asci* 45–60 µm long, 15–20 µm wide. *Ascospores* simple, colourless, 14–18 × 7–9 µm. *Conidiomata* not observed.

NOTE. This species is characterized by a yellowish green to pale brown moderately-thick thallus with the upper surface glossy and smooth, rarely finely roughened. The thallus is often cracked into small flecks but never regularly areolate. *Verrucaria dolosa* differs in less prominent perithecia forming low to moderate projections (100–150 µm wide) and almost absent or thinly superficial thallus (25–50 µm thick). *Verrucaria acrotella* auct. has a discontinuous superficial dark brown granular thallus.

HABITAT. On more or less calcareous pebbles, especially in rather shaded sites but also noted at sun-exposed localities.

DISTRIBUTION IN POLAND. It occurs at scattered localities mainly in lowlands (in the Pojezierze Wielkopolskie lakeland, the Pradolina Toruńsko-Eberswaldzka spillway, the Dolina Dolnej Wisły valley, the Pojezierze Południowopomorskie lakeland, the Pojezierze Chełmińsko-Dobrzyńskie lakeland). It was also reported from a few localities at average height in mountainous regions (the Góry Świętokrzyskie Mts, the Beskidy Mts and the Bieszczady Mts). It is probably more common but was not previously distinguished in Poland. *Verrucaria maculiformis* was collected over one hundred years ago by Eitner (1895; WRSL) and Stein (1879) in Silesia. However the material reported by Stein (1879) belongs to *V. acrotella* auct. (WRSL). This species was not distinguished afterwards for a long time and was neglected by Polish lichenologists until 1983 when Toborowicz (1983) reported this taxon from the Góry Świętokrzyskie Mts. Previously specimens of this species were identified as *V. dolosa* or *V. subdolosa*.

WORLD DISTRIBUTION. Poorly known, reported from North and Central Europe, recorded in Fennoscandia, Germany, Poland, Czech Republic (Vězda & Liška 1999; Scholz 2000; Fałtynowicz 2003; Pykälä 2007; Santesson *et al*. 2004).

REMARKS. Species poorly distinguished by contemporary scientists; some new records of this species have been added recently, for example from Finland (Pykälä 2007).

EXSICCATAE SEEN. Arnold, Lich. Exs. Lich. Jur. 687 (W, WRSL – TOPOTYPES).

SPECIMENS EXAMINED. CA-99 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Kolbudy near Gdańsk, 10 July 2000, *M. Ceynowa-Giełdon* (TRN); CB-16 – Kościerzyna, Leśn. Jastrzębce, Aug. 1935, *F. Krawiec* (POZ); CB-27 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND, BORY TUCHOLSKIE FOREST: Chwarzno near Stara Kiszewa, 24 Aug. 1997, *M. Ceynowa-Giełdon* (TRN); CC-08 – DOLINA DOLNEJ WISŁY VALLEY, DOLINA FORDOŃSKA VALLEY: Szymbarno near Chełmno, 21 July 1984, *M. Ceynowa-Giełdon* (TRN); CC-08 – Topolno, 26 Sept. 1996, *M. Ceynowa-Giełdon* (TRN); CC-08 – Zbocza Płutowskie nature reserve in Starogród near Chełmno, 19 July 2001, *M. Ceynowa-Giełdon* (TRN); Kiełp in Zbocza Płutowskie nature reserve, 1 Sept. 2003, *M. Ceynowa-Giełdon* (TRN); CC-08 – KOTLINA GRUDZIĄCKA BASIN: Nowa Wieś near Grudziądz, 15 Oct. 1998, *M. Ceynowa-Giełdon* (TRN); CC-09 – DOLINA FORDOŃSKA VALLEY: Kiełp near Chełmno, 26 June 2001, *M. Ceynowa-Giełdon* (TRN); CC-24 – PRADOLINA TORUŃSKO-EBERSWALDZKA SPILLWAY, KOTLINA ŚRODKOWEJ NOTECI BASIN: Gorzeń near Nakło nad Notecią, 11 Oct. 1995, *M. Ceynowa-Giełdon* (TRN); CC-39 – KOTLINA TORUŃSKA BASIN: Toruń Lotnisko-Bielany, 30 Aug. 1999, *M. Ceynowa-Giełdon* (TRN); CC-56 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE GNIEŹNIEŃSKIE LAKELAND: by Piechcin, 23 July 1996, *M. Ceynowa-Giełdon* (TRN); CC-89 – POJEZIERZE KUJAWSKIE LAKELAND: Zagorzyce near Piotrków Kujawski, 22 Sept. 1995, *M. Ceynowa-Giełdon* (TRN); Sadłużek near Piotrków Kujawski,

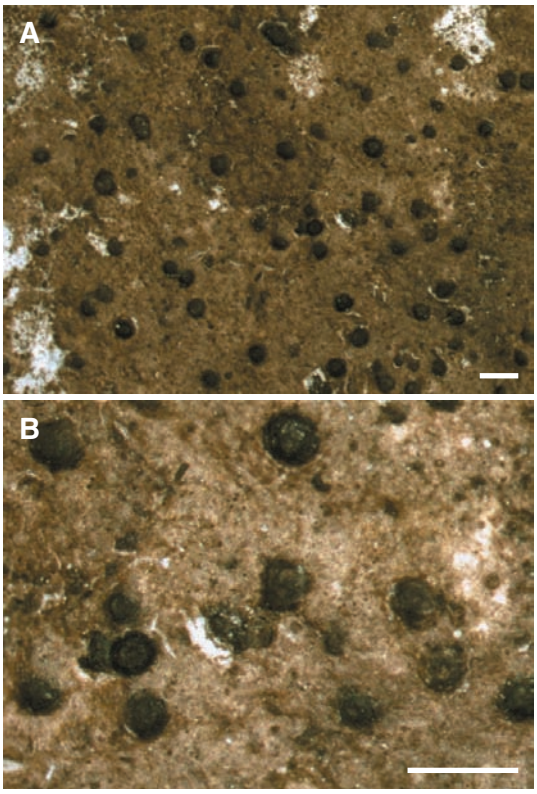

Fig. 31. *Verrucaria maculiformis* Kremp. A & B – thallus (Hepp, Flechten Eur. 685, WRSL, isotype). Scale bars = 0.5 mm.

22 Nov. 1995, *M. Ceynowa-Giełdon* (TRN); CC-90 – Rybiny, 12 Sept. 1996, *M. Ceynowa-Giełdon* (TRN); CC-98 – Mielnica by Gopło river, 20 June 1996, *M. Ceynowa-Giełdon* (TRN); DB-80 – Dolina Dolnej Wisły valley, Kotlina Grudziącka basin: Górna Grupa near Grudziądz, 16 Sept. 1996, *M. Ceynowa-Giełdon* (TRN); DB-81 – Nowa Wieś near Grudziądz, 15 Oct. 1998, *M. Ceynowa-Giełdon* (TRN); DC-06 – Pojezierze Chełmińsko-Dobrzyńskie lakeland, Pojezierze Dobrzyńskie lakeland: Głęboczek near Brodnica, 22 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DD-42 – Pojezierze Wielkopolskie lakeland, Pojezierze Kujawskie lakeland: Niemojewo near Chodecz, 19 June 1996, *M. Ceynowa-Giełdon* (TRN); DE-51 – Wyżyna Woźnicko-Wieluńska upland, Wyżyna Wieluńska upland: Góra Św. Genowefy near Bobrowniki, 17 Sept. 1997, *J. Kiszka* (KRAP); DF-48 – Wyżyna Krakowsko-Częstochowska upland, Wyżyna Olkuska upland: rocks in Wąwóz Sąspowski near Olkusz, 6 May 2004, *J. Kiszka* (KRAP); DG-59 – Tatra Mts, Western Tatra Mts: Dolina Białego, 11 July 1926, *J. Motyka* (LBL); EG-31 – Obniżenie Orawsko-Podhalańskie depression, Kotlina Orawsko-Nowotarska: Skalice Nowotarskie, Kramnica, 3 Sept. 1998, *J. Kiszka* (KRAP); FE- 23 – Wyżyna Lubelska upland, Małopolski Przełom Wisły water gap: Kazimierz Dolny, 5 July 1931, *F. Krawiec* (POZ); FF-98 – Pogórze Środkowobeskidzkie foothills, Pogórze Przemyskie foothills: Krzeczkowa, 22 May 1986, *J. Kiszka* & *J. Piórecki* (KRAM); FF-99 – Kruhel Mały by Przemyśl, on calcareous rocks by road, 2 April 1985, *J. Kiszka* & *J. Piórecki* (KRAP); FG-09 – Rybotycze by Wiar river, 10 Sept. 1985, *J. Kiszka* (KRAP).

Verrucaria madida Orange Fig. 32

Lichenologist **36**(6): 349. 2004. Type: France, west of Murat, 1.8 km west of Fraisse-Haute, 45°6'N, 2°44'E, 1000 m, shallowly submerged on sloping rocks in stream in woodland, lightly shaded, with *Verrucaria rheitrophila*, 16 May 1990, *A. Orange* 7959 (NMW.C90.13.74 – holotype).

Prothallus absent. *Thallus* superficial, subgelatinous, thin, 40–60 µm thick, dark green or dark greenish grey to blackish green, smooth, uncracked (or on dry herbarium material some cracks by perithecia). *Upper cortex* with dull green pigment which is K–, HCl+ brownish, and then dull greenish but faded with addition of further K, or in part with brownish pigment. *Algal* layer proso- paraplectenchymatous, weakly arranged in columns, algal cells 2.5–5 µm in diam. *Medulla* absent, black basal layer absent. *Perithecia* forming low to moderate conical-hemispherical projections 200–420 µm in diam., concolorous with thallus, covered by a layer of thallus at first, this layer sometimes partly lost later. *Involucrellum* conical, or somewhat spreading at sides and then curved down slightly. *Excipulum* colourless to brown below, 140–290 µm wide. *Periphysoids* up to 10–15 µm long. *Asci* (3–)4(–5)-spored, 30–35 µm long, 14–17 µm wide. *Ascospores* simple, colourless, ellipsoid, 9–13.5(–15) × 5.5–7.5 µm, not halonate. *Conidiomata* not observed.

Note. This amphibious species is easily distinguished by 4-spored asci which are unique in the genus. *Verrucaria aquatilis* is similar in appearance but differs in the smaller perithecia and smaller ascospores [5.5–8.0(–10) × 4.5–7(–8.0) µm]. *Verrucaria pachyderma* also has a dark thallus but differs in larger ascospores (17–22 × 6–8 µm). *Hydropunctaria rheitrophila* differs in the completely immersed perithecia and usually carbonaceous punctae in the thallus visible as black dots on the upper surface. *Verrucaria denudata* differs in larger perithecia and larger ascospores [10–12(–15) × 4.5–7 µm], a conical involucrellum which is very well visible as a dark disc through wet thallus. Most of the other freshwater species of *Verrucaria* have a regularly areolate thallus and distinctly larger ascospores (longer than 15 µm), or a paler-coloured thallus.

Habitat. Amphibious species occurring on frequently immersed siliceous rocks in streams, in slightly shady places, in woodland; grows together with *Hydropunctaria rheitrophila* and *V. aquatilis* (Krzewicka & Hachułka 2008; Thüs & Schultz 2008, Thüs & Wirth 2009).

Distribution in Poland. It occurs at a few scattered localities at lower altitudes, such as in the Beskid Mały Mts and the Beskid Wyspowy Mts, where it is locally abundant, and at a few scattered localities in Central Poland in the Wzniesienia Łódźkie hills and the Góry Świętokrzyskie Mts.

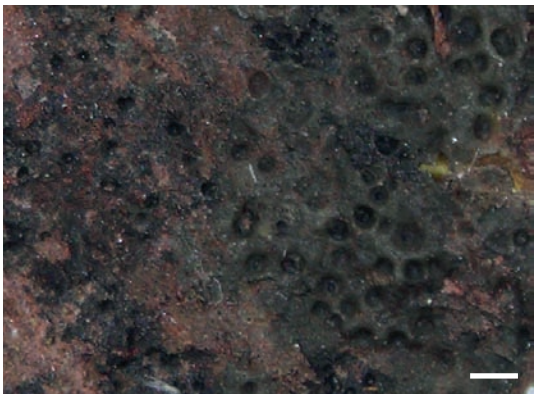

Fig. 32. *Verrucaria madida* Orange (*Orange*, NMW, paratype). Scale bar = 0.5 mm.

Verrucaria madida was previously reported only from Central Poland in the Wzniesienia Łódźkie hills (Krzewicka & Hachułka 2008). Earlier records of this species were reported in Poland mainly under the name *V. atroviridis* (see Fałtynowicz 2003). These specimens are similar to typical material by the presence of dull green pigment in cortex which is turning brownish in HCl. But 4-spored asci were difficult to observe in the studied material, which may explain why the specimens were mistaken for *V. atroviridis*.

WORLD DISTRIBUTION. In Europe it has been recorded in France, Germany, Great Britain, Poland (Orange 2004b; Krzewicka & Hachułka 2008; Thüs & Wirth 2009).

REMARKS. Morphs from Central Poland (Krzewicka & Hachułka 2008) have slightly longer spores than the ones described in the protologue by Orange (2004b) but the individuals from other regions of Poland have the same size of ascospores as these reported in the diagnosis and the asci are typical, 4(–5)-spored.

REFERENCE MATERIAL. GREAT BRITAIN: Wales: V.C. 42, Breconshire: Brecon Beacons, west of Beacons Reservoir, by Nant Pennig, 22/977190, alt. 510 m, in calcareous streamlet on rocky bank on Old Red Sandstone, 1994, *A. Orange* 9986 (NMW.C.1999.011.159! – PARATYPE).

SPECIMENS EXAMINED. DD-67 – WZNIESIENIA POŁUDNIOWOMAZOWIECKIE HEIGHTS, WZNIESIENIA ŁÓDZKIE HILLS: Wzniesienia Łódzkie Landscape Park, on stones in Młynkówka stream, 27 Sept. 2006, *M. Hachułka* (LOD); DF-96 – WESTERN BESKIDY MTS, BESKID MAŁY MTS: in valley of Glinki stream, below Królewizna hill (Królowa Wyżnia), 550 m, 28 Aug. 1961, *J. Nowak* (KRAM); EE-77 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Łysogóry hill, stream on N slope, above Hucisko village, 310 m, 20 Aug. 1971, *J. Nowak* (KRAM); EG-02 – WESTERN BESKIDY MTS, BESKID WYSPOWY MTS: in Potok Rybny strem on N slope of Łopień, 685 m, 15 Aug. 1966, *J. Nowak* (KRAM) as *V. atroviridis*.

Verrucaria margacea (Wahlenb.) Wahlenb.

Fig. 33

Flora Lappon.: 465. 1812. – *Thelotrema margaceum* Wahlenb. *in* Acharius, Meth. Lich. Suppl.: 30. 1803. TYPE: Finmarkiae Norvegicae in petris aqua nivali irrigatis ad Konsamfjället juxta Altenfjord, *Wahlenberg* (UPS! – HOLOTYPE). – *Lithoicea margacea* (Wahlenb.) A. Massal., Memorie lichenografiche: 145. 1853. – *Involucrothele margacea* (Wahlenb.) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 189. 1954.

Verrucaria leightonii Hepp, Flechten Eur. No. 95. 1853. TYPE: Auf Granit in Gletscherbächen in Gesellschaft von Thelat fissum u colopimum bei St. Moritz u Pantresina (GFW! – ISOTYPE).

Verrucaria alpicola Zschacke, Hedwigia **67**: 75. 1927. BASIONYM: *Lithoicea elaeomelaena* var. *alpina* Arnold, Verh. K.K. Zool.-Bot. Ges. Wien **23**: 100. 1873. [*non Verrucaria alpina* (Bagl. & Carestia) Stizenb., Ber. Tät. St Gall. Naturw. Ges.: 505. 1882]. TYPE: Auf Steinen im Quellbache beim Aufstiege zum Rossgrubkogel, *F. Arnold* (Arnold, Lich. Exs. Lich. Jur. 129B).

Prothallus whitish. *Thallus* superficial, subgelatinous or rarely non-gelatinous, thin to moderately thick, 25–70 µm thick, light brown to brown-black or greyish, continuous and uncracked to rarely rimose or areolate around ascomata. *Upper cortex* weakly developed, colourless or pigmented. *Algal* layer paraplectenchymatous, cells not arranged in columns, algal cells scattered, 5.5–8 µm in diam. *Medulla* weakly defined, proso- to paraplectenchymatous, dark basal layer absent. *Perithecia* forming moderate to distinct projections (280–)350–800 µm in diam., often covered with thallus but partly exposed later. *Involucrellum* thin, 12–40 µm thick, conical, reaching

to base of perithecium, spreading, up to 1350 µm wide, angle between involucrellum and base of excipulum often with dark pigment evenly distributed throughout cell walls. *Excipulum* colourless to brown, 180–330 µm wide. *Periphysoids* up to 30 µm long. *Asci* 80–100 µm long, 25–35 µm wide. *Ascospores* simple, colourless, sporadically also uniseptate, 26–36 × 11–15 µm, without or rarely with thin halo. *Conidiomata* not observed.

NOTE. Distinguished from other freshwater species by the non-areolate thallus, lack of carbonaceous structures (such as punctae, columns and/or a black basal layer), and by the large ascospores and large perithecia with a conical and widely spreading involucrellum. Many taxa have ascospores shorter than 25 µm long, for example *V. aquatilis*, *V. cernaensis*, *V. dolosa*, *V. madida*, *V. pachyderma*, and *V. sublobulata*. *Verrucaria margacea* is differs from *V. andesiatica* in the larger ascospores and larger asci (up to 60–80 × 22–28 µm in *V. andesiatica*). *Verrucaria latebrosa* has an areolate thallus with immersed perithecia and an involucrellum developed mostly in the upper part of the excipulum. *Verrucaria submersella* differs in the superficial to semi-endolitic thallus, half or three-quarters immersed perithecia, forming moderate projections [(150–)250–350 µm in diam.], which form shallow pits in the substrate.

HABITAT. An amphibious species occurring on acidic rocks or rarely on basic rocks; in acidic streams in the splash zone of cool streams and rivers in montane and alpine regions, rarely at low altitudes.

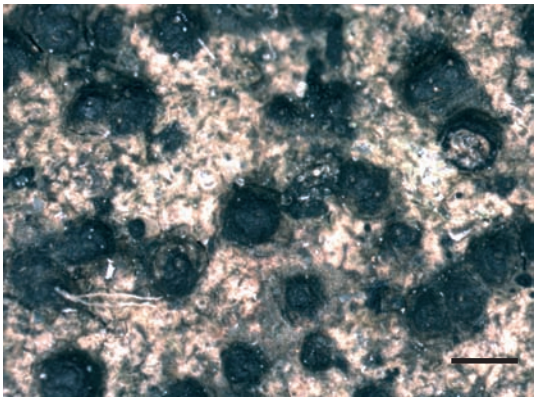

Fig. 33. *Verrucaria margacea* (Wahlenb.) Wahlenb. (*Nowak*, KRAM). Scale bar = 0.5 mm.

DISTRIBUTION IN POLAND. It is widespread in the Carpathian Mts, where it has been recorded in many mountain ranges (the Beskid Mały Mts, the Beskid Żywiecki Mts, the Beskid Średni Mts, the Beskid Niski Mts, the Bieszczady Mts, the Tatra Mts). It has also been recorded outside the Carpathian Mts in Central and N Poland (in the Wzniesienia Łódzkie hills, Bory Tucholskie forest, and the Pojezierze Kaszubskie Lakeland). This species is probably quite frequent in Poland but it was overlooked in the field. *Verrucaria margacea* was previously reported only from the Beskid Mały Mts (Nowak 1965) and the Tatra Mts (Motyka 1926; Alstrup & Olech 1992).

WORLD DISTRIBUTION. Widespread in Europe; also known in Asia, Australia, Greenland, South and North America, New Zealand (Orange *et al*. 2009).

REMARKS. The concept of *V. margacea* presented in this paper follows Thüs and Schultz (2008) rather than the concept of Orange *et al*. (2009), where *V. margacea* is restricted to cracked and non-gelatinous specimens. The concept of *V. andesiatica* used by Orange *et al*. corresponds to *V. margacea* s.str. in the sense of Thüs and Schultz (2008).

Following Swinscow (1968) *Verrucaria alpicola* is reported here as a synonym of *V. margacea* due to the similar ascospore size (25–30 µm × 12–18 µm) and shape of the involucrellum.

Swinscow (1968) observed that the specimen of *V. leightonii* from Hepp's exsiccatae deposited in BM (Flechten Eur. No. 95) looks like a darker morph of *V. margacea* with a wide spreading involucrellum and large spores (32–37 × 15–17 µm). However, he did not include this name into the synonyms of *V. margacea* although Körber (1863) had done so. However, this synonymization was confirmed by later researchers (Clauzade & Roux 1985; Thüs 2002), and confirmed during this study.

SPECIMENS EXAMINED. CB-16 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KA-

SZUBSKIE LAKELAND: Kościerzyna, stream in Jarząbce forest, Aug. 1935, *F. Krawiec* (POZ); CB-68 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND, BORY TUCHOLSKIE FOREST: 1 km E of Stare Rzeki, on stones in water, 13 June 2004, *M. Kukwa 3294* (UGDA); DD-68 – WZNIESIENIA POŁUDNIOWOMAZOWIECKIE HEIGHTS, WZNIESIENIA ŁÓDZKIE HILLS: Wzniesienia Łódzkie Landscape Park, on stones in Grzmiąca stream, 23 Sept. 2006, *M. Hachułka* (LOD); DF-96 – WESTERN BESKIDY MTS, BESKID MAŁY MTS: in stream Glinki below Królewizna hill (Królowa Wyżnia), 550 m and 570 m, 12 May 1960, *J. Nowak* (KRAM); in stream below Królewizna hill, 550 m, 28 Aug. 1961, *J. Nowak* (KRAM); DG-05 – valley of stream on W slope of Madohora, 700 m, 11 April 1961, *J. Nowak* (KRAM); DG-06 – Żurawnica hill in Potok Mikowy stream, 425 m, 5 May 1967, *J. Nowak* (KRAM); DG-07 – BESKID ŻYWIECKI MTS: Pasmo Jałowieckie range, valley of Grzechynka stream, 575 m, 3 Sept. 1965, *J. Nowak* (KRAM); DG-07 – Pasmo Jałowieckie range, Przełęcz Klekociny pass, in spring, 890 m, 13 July 1965, *J. Nowak* (KRAM); DG-16 – Massif Babiej Góry range, below Sulowa Cyrhla, 750 m, 23 June 1961, *J. Nowak* (KRAM); Massif Babiej Góry in stream, 6 June 1927, *J. Motyka* (LBL); DG-23 – Pasmo Wielkiej Raczy, Rycerka Dolna, in stream on slope of Hutrynów hill, 680 m, 6 Aug. 1964, *J. Nowak* (KRAM); DG-25 – Grupa Pilska, Studziański stream, 635 m, 17 July 1966, *J. Nowak* (KRAM); DG-33 – Wielka Racza range, valley of Sucha Nieledwienka stream, 520 m, 23 Sept. 1966, *J. Nowak* (KRAM); DG-58 – TATRA MTS, WESTERN TATRA MTS: Dolina Chochołowska valley, in Chochołowski stream, 960 m and 1130 m, 16 July 2004, *B. Krzewicka* (KRAM); DG-58 – Polana Chochołowska, on rock in stream, 1100 m, 10 July 1959, *J. Nowak* (KRAM); EE-97 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, POGÓRZE SZYDŁOWSKIE UPLAND: near Chańcza, July 1986, *A. Siwik* (KTC); EF-90 – WESTERN BESKIDY MTS, BESKID ŚREDNI MTS: Pasmo Lubomira i Łysiny, Działy in Wielka Sucha sream, 23 July 1996, *J. Nowak* (KRAM); EF-95 – POGÓRZE ŚRODKOWOBESKIDZKIE FOOTHILLS, POGÓRZER ROŻNOWSKIE FOOTHILLS: valley of stream below Mogiła hill, 380 m, 22 June 1971, *R. Kozik* (KRAP); EG-50 – TATRA MTS, HIGH TATRA MTS: Hala Gąsienicowa, stream by Dwoisty Stawek, 19 Aug. 1925, *J. Motyka* (LBL); Hala Gąsienicowa, stream by Czarny Staw Gąsienicowy, 16 Sept. 1949, *J. Motyka* (LBL); Dolina Pańszczyca, on granite rock in stream, 1310 m, 10 Aug. 1971, *J. Nowak* (KRAM); FG-20 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Nieznajowa village near Świątkowa village, Las Spełzły forest, 640 m, 4 Oct. 1979, *J. Nowak* (KRAM); FG-21 – Olchowiec village near Polany village, in stream, 450 m, 5 Oct. 1979, *J. Nowak* (KRAM); FG-44 – Wisłok Wielki Górny village, Jamiska stream, W slope of Pasika Mt., 675 m, 22 June 1974, *J. Nowak* (KRAM); FG-57 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Buk village, in stream, right of tributary of Solinka river, W slope of Bukowinka hill, 17 May 2008, *B. Krzewicka* (KRAM); FG-68 – Bieszczadzki National Park, stream on hill between Wielki Lutowy stream and Solinka stream, 710 m, 1 July 2002, *J. Kiszka* (KRAP); N slope of Dział, 840 m, 7 Aug. 2001, *J. Kiszka* (KRAP); Wielki Lutowy stream, 830 m, 3 July 2002, *J. Kiszka* (KRAP); Przełęcz nad Berehami 781 m, 8 July 2003, *J. Kiszka* (KRAP); Lutowy stream, 750 m, 18 Aug. 1958, *K. Glanc* (KRAM); GG-50 – Bieszczadzki National Park, in Syhła stream, 19 July 2001, *J. Kiszka* (KRAP); GG-60 – Bieszczadzki National Park, Szeroki Wierch Mt., in stream, 893 m, 15 July 2005, *J. Kiszka* (KRAP).

Verrucaria muralis Ach. Fig. 34

Meth. Lich.: 115. 1803. TYPE: [Sweden] ad muros antiquos (Upsaliae) calce illitos, *Swartz* (H-ACH).

Verrucaria rupestris Schrader, Spicil. Fl. German.: 109. 1794.

Prothallus present, white. *Thallus* continuous and partially immersed to thinly superficial, finely cracked to areolate mainly by perithecia, grey-white to white, matt. *Upper cortex* a pseudocortex, one layered, 15–25 µm, usually without pigment, or with dilute brown pigment. *Algal* layer consisting of algal cells 5–10 µm in diam. uniformly scattered, hyphae K/I–. *Perithecia* superficial or one-third immersed, forming shallowly convex to conical-hemispherical projections (250–)300–500 µm wide, 250 µm high, black or greyish below from particles of substrate, not covered by a layer of thallus or covered in lower part, apex rounded to slightly flattened, sometimes shallowly depressed; perithecia not in pits, but sometimes forming rather shallow pits in rock. *Involucrellum* 25–40(–50) µm wide, black, present around upper half of excipulum, or reaching to base-level of excipulum, more or less hemispherical or sometimes spreading. *Excipulum* 200–380 µm wide, colourless to pigmented at base. *Periphyses* 10–20

× 1–1.5 µm, and sparsely branched periphysoids 25–35 µm long. *Asci* 62–80 µm long, 20–26 µm wide. *Ascospores* simple, colourless, 17–25(–27) × 9–14 µm. *Conidiomata* not detected.

NOTE. This species is characterised by the inconspicuous dirty white to white thallus, relatively large perithecia forming shallowly convex to conical-hemispherical projections, and moderately large broadly ellipsoid ascospores. *Verrucaria myriocarpa* differs in smaller perithecia forming prominent projections (120–200 µm in diam.) and a mostly colourless excipulum pigmented only in the upper part. Specimens with a developed superficial thallus are similar in appearance to *V. elaeina* which has a superficial, grey-green, often cracked thallus and half to ¾ immersed perithecia and narrowly ellipsoid ascospores 18–22(–24) × 7–9 µm.

HABITAT. On calcareous and non-calcareous substrates, sometimes also on siliceous rock: on limestone, sandstone, concrete, stone walls, and brick; frequent on pebbles embedded in the ground. A terrestrial species but also noted in moist habitats by freshwater watercourses.

DISTRIBUTION IN POLAND. Widespread and frequent, reported throughout the country. One of the most frequently recorded species of *Verrucaria* in Poland (see Fałtynowicz 2003); in herbaria recorded also under the name *V. confluens*.

WORLD DISTRIBUTION. Cosmopolitan. Known from Europe, Asia, North America, Brazil, Hong Kong, Taiwan, Africa, India, South Georgia and SE Australia (Feuerer 2010).

REMARKS. The name *Verrucaria rupestris* is treated here as a synonymy of *V. muralis*. However, preliminary molecular analyses show that *V. muralis* and *V. rupestris* are probably different taxa because the specimens used in the analyses (but not type materials) fell into different clades (Gueidan *et al*. 2009). The taxonomic position of these taxa is still not clear.

Verrucaria confluens A. Massal. was excluded from the synonyms of *V. muralis* by Breuss (2007a). This taxon has the perithecia fused in groups of 2–5, an inconspicuous thallus with semi-immersed to superficial perithecia, an involucrellum present only around the upper half of the excipulum or reaching to two-thirds of distance to the excipulum base, more or less hemispherical and appressed to the excipulum or slightly spreading, with ellipsoid ascospores growing up to 18–25× 8–12 µm and partly branched periphysoids up to 30–40 µm long. Most of the characters agree with *V. muralis* except for the slightly shorter periphysoids in *V. muralis*. In Poland, morphs with perithecia growing in groups of 2-3 or singly were observed in *V. muralis*. All specimens with fused perithecia were distinguished as *V. muralis* during revision. The presence of fused perithecia seems to be dependent on the type and structure of the substrate, rather than a taxonomic character. However, the name *V. confluens* is not included here in the synonymy of *V. muralis* because the type material was not examined.

EXSICCATAE SEEN. Hepp, Flechten Eur. 224 (as *Verrucaria rupestris*) (GFW).

SPECIMENS EXAMINED. BB-75 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE POZNAŃSKIE LAKELAND: Lubosina, 27 April 1934, *F. Krawiec* (POZ); CA-86 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Miechucino near Kartuzy, 24 July 1935, *F. Krawiec* (POZ); CB-27 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND, BORY TUCHOLSKIE FOREST: Chwarzno near Stara Kiszewa, 24 July 1997, *M. Ceynowa-Giełdon* (TRN); CB-38 – POJEZIERZE WSCHODNIO-POMORSKIE LAKELAND, POJEZIERZE STAROGARDZKIE LAKELAND: Zblewo near Starogard Gdański, 9 Aug. 1998, *M. Ceynowa-Giełdon* (TRN); CB-79 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE KUJAWSKIE LAKELAND: Złotowo near Piotrków Kujawski, 22 Sept. 1995, *M. Ceynowa-Giełdon* (TRN); CC-08 – DOLINA DOLNEJ WISŁY VALLEY, DOLINA FORDOŃSKA VALLEY: Topolno, 26 Sept. 1996, *M. Ceynowa-Giełdon* (TRN); CC-08 – KOTLINA GRUDZIĄCKA BASIN: Grudziądz Owczarki, 15 Oct. 1998, *M. Ceynowa-Giełdon* (TRN); Nowa Wieś, 15 Oct. 1998, *M. Ceynowa-Giełdon* (TRN); CC-23 – PRADOLINA TORUŃSKO-EBERSWALDZKA SPILLWAY, DOLINA ŚRODKOWEJ NOTECI VALLEY: Paterek near Nakło, 11 Oct. 1995, *M. Ceynowa-Giełdon* (TRN); CC-42 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE GNIEŹNIEŃSKIE LAKELAND: Wapno, 28 June 1994, *M. Ceynowa-Giełdon* (TRN);

CC-52 – Pradolina Toruńsko-Eberswaldzka spillway, Kotlina Toruńska basin: Nieszawa, 24 July 1995, *M. Ceynowa-Giełdon* (TRN); CC-56 – Pojezierze Wielkopolskie lakeland, Pojezierze Gnieźnieńskie lakeland: between Piechcin and Bielawy, 8 Aug. 1995, *M. Ceynowa-Giełdon* (TRN); CC-66 – Równina Inowrocławska plain: Wierzejewice near Pakość, 3 Aug. 1995, *M. Ceynowa-Giełdon* (TRN); CC-67 – Pojezierze Gnieźnieńskie lakeland: Kołuda Mała near Inowrocław, 1 Aug. 1991, *M. Ceynowa-Giełdon* (TRN); CC-98 – Mielnik, 20 June 1996, *M. Ceynowa-Giełdon* (TRN); DA- 70 − Pobrzeże Gdańskie coastland, Pobrzeże Kaszubskie coastland: Gdańsk Orłowo, Aug. 1930, *F. Krawiec* (POZ); DB-14 – Pojezierze Wielkopolskie lakeland, Pojezierze Kujawskie lakeland: Lubstowo, 22 Aug. 1998, *M. Ceynowa-Giełdon* (TRN); DB-35 – Pojezierze Wschodniopomorskie lakeland, Pojezierze Iławskie lakeland: Stare Miasto near Dzierzgoń, 23 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DB-80 – Dolina Dolnej Wisły valley, Kotlina Grudziądzka basin: Górna Grupa near Grudziądz, 16 Sept. 1996, *M. Ceynowa-Giełdon* (TRN); DB-96 – Pojezierze Chełmińsko-Dobrzyńskie lakeland, Pojezierze Brodnickie lakeland: Mierzęcice near Nowe Miasto Lubawskie, 22 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DC-06 – Dolina Drwęcy valley: Głęboczek near Brodnica, 22 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DC-50 – Pojezierze Wielkopolskie lakeland, Równina Inowrocławska plain: Podgaj near Aleksandrów Kujawski, 22 Sept. 1995, 18 and 21 July 1996, *M. Ceynowa-Giełdon* (TRN); DC-51 – Pradolina Toruńsko-Eberswaldzka spillway, Kotlina Toruńska basin: Ciechocinek, 6 Sept. 1996, *M. Ceynowa-Giełdon* (TRN); DC-52 – Przypust near Nieszawa, 24 July 1995, *M. Ceynowa-Giełdon* (TRN); DC-63 – Pojezierze Chełmińsko-Dobrzyńskie lakeland, Pojezierze Dobrzyńskie: Rutki near Jezioro Ostrowite lake, 20 Sept. 2000, *M. Ceynowa-Giełdon* (TRN); DC-74 – Pradolina Toruńsko-Eberswaldzka spillway, Kotlina Płocka basin: Modzerowo, 19 July 1995, *M. Ceynowa-Giełdon* (TRN); DC-85 – Skoki Duże near Włocławek, 11 Sept. 1995, *M. Ceynowa-Giełdon* (TRN); DC-90 – Pojezierze Wielkopolskie lakeland, Pojezierze Kujawskie lakeland: Rybiny, 12 Sept. 1996, *M. Ceynowa-Giełdon* (TRN); DD-00 – between Mostki and Brzezie, 1 Aug. 1999, *M. Ceynowa-Giełdon* (TRN); Smolniki near Sompolno, 22 Aug. 1998, *M. Ceynowa-Giełdon* (TRN); DE-41 – Wyżyna Woźnicko-Wieluńska upland, Wyżyna Wieluńska upland: Lisowice by Warta river, 30 June 1963, *J. Nowak* (KRAM);

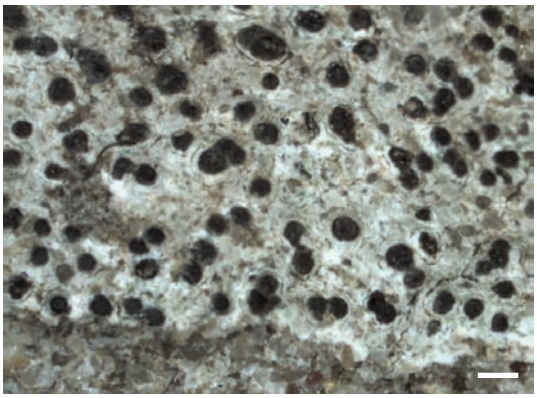

Fig. 34. *Verrucaria muralis* Ach. (Hepp, Flechten Eur. 224, GFW). Scale bar = 0.5 mm.

DF-93 – Western Beskidy Mts, Beskid Średni Mts: Pcim, 26 Feb. 1926. *J. Motyka* (LBL); DF-99 – Pcim, 26 Feb. 1925, *J. Motyka* (LBL); DG-16 – Beskid Żywiecki Mts: Pasmo Wielkiej Raczy range, Roztoka in stream Rycerka, in stream, 640 m, 27 Sept. 1986, *J. Nowak* (KRAM); DG-29 – Gorce Mts: Sieniawa on slope Rabska Góra hill, 600 m, 7 July 1966, *K. Glanc* (KRAM); DG-58 – Tatra Mts, Western Tatra Mts: Dolina Strążyska, 11 July 1926, *J. Motyka* (LBL); DG-59 – Dolina Strążyska valley, 11 Aug. 1926, *J.. Motyka* (LBL); Lodowa Grota near Ciemniak Mt., 24 Aug. 1927, *J. Motyka* (LBL); EB-76 – Pojezierze Mazurskie lakeland, Pojezierze Mrągowskie lakeland: Lemany near Szczytno, 1 May 1989, *J. Nowak* (KRAM); EG-10 – Western Beskidy Mts, Gorce Mts: Poręba Wielka, Park Dworski Wodzickich, 550 m, 5 Oct. 1993, *P. Czarnota* (GPN); EG-11 – valley of Kamienica stream, dam on Spalenice stream, 740 m, 22 Aug. 1996, *P. Czarnota* (GPN); Uroczysko Pasieka, on sandstone, 900 m, 2 July 1996, *P. Czarnota* (GPN); EG-17 – Middle Beskidy Mts, Beskid Niski Mts: Kąclowa village, 16 and 18 July 1926, *J. Motyka* (LBL); Kąclowa village, below Stronia, 250 m, 10 Sept. 1965, *F. Święs* (LBL); EG-17 − Kąclowa, 18, 19 and 21 July 1926, and 1954, and Aug. 1963, *J. Motyka* (LBL); EG-21 – Western Beskidy Mts, Gorce Mts: below Kiczora hill, on Nowa meadow, 1220 m, 6 Nov. 1997, *P. Czarnota* (GPN); EG-23 – Kotlina Sądecka Basin: Maszkowice near Łącko, 18 Aug. 1954, *S. Kuziel* (LBL); EG-23 – Maszkowice near Łącko, 18 Aug. 1954, *S. Kuziel* (LBL); EG-33 – Obniżenie Orawsko-Podhalańskie depression, Pieniny Mts: Sromowce Wyżne, on sandstone by Dunajec river, 17 July 1996, *J. Kiszka* (KRAM); FE- 23 − Wyżyna Lubelska upland, Małopolski Przełom

Wisły water gap: Kazimierz Dolny, 5 July 1931, *F. Krawiec* (POZ); FE-51 – Wyżyna Kielecko-Sandomierska upland, Pogórze Iłżeckie foothills: Krzemionki, 1923, *J. Motyka* (LBL); FF-99 – Pogórze Środkowobeskidzkie foothills, Pogórze Przemyskie foothills: Kruhel Mały by Przemyśl, on calcareous rocks by road, 2 April 1985, *J. Kiszka & J. Piórecki* (KRAP); FG-06 – Dobra by San river, 7 Aug. 1988, *J. Kiszka* (KRAP); FG-17 – Eastern Beskidy Mts, Góry Sanocko-Turczyńskie Mts: Góry Słonne Mt., Tyrawa Wołowska, 8 Aug. 1988, *J. Kiszka* (KRAM); FG-20 − Middle Beskidy Mts, Beskid Niski Mts: Czarne near Nieznajowa, 540 m, 4 Oct. 1979, *J. Nowak* (KRAM); FG-26 – Eastern Beskidy Mts, Góry Sanocko-Turczyńskie Mts: Góry Słonne Mt., Postołów by San river, 28 May 1990, *J. Kiszka* (KRAM); FG-27 – Góry Słonne Mt., Łukawica by San river, 29 July 1988, *J. Kiszka & J. Piórecki* (KRAM); FG-28 – Góry Słonne Mt., Stefkowa, 25 May 1989, *J. Kiszka* (KRAM); FG-28 – Western Bieszczady Mts: Myczkowce Żuków massif, 10 Aug. 1990, *R. Kościelniak* (KRAP).

Verrucaria myriocarpa Hepp Fig. 35

Flechten Eur.: No. 430. 1857. Type: An Kalkfelsen der Lägern. *K. Z. H.* (Hepp, Flechten Eur. 430, GFW! – isotype).

Verrucaria murina auct. *non* Leight., Brit. Sp. Ang. Lich.: 44. 1851. Plate 19, fig. 3.

Verrucaria congregata Hepp *in* Arnold, Flora **41**: 358. 1858.

Prothallus absent. *Thallus* endolithic or partially superficial and visible as small dark points or dots, thin, yellowish to mouse-coloured. *Upper cortex* differentiated into a lithocortex, densely prosoplectenchymatous, up to 20–30 µm thick. *Algal* layer discontinuous, 80–120 µm thick, algal cells in clusters reaching up to 40–60 µm in diam., rounded, scattered, algal cells 10–15 µm. *Medulla* prosoplectenchymatous, thin, without black basal layer. *Perithecia* superficial to half immersed, forming prominent projections, 120–200 µm in diam., not covered by thallus, occasionally collapsed when dry, forming rather shallow pits in rock. *Involucrellum* appressed to excipulum and spreading to base. *Excipulum* colourless, only dark in upper part, globose, 150–200 µm wide.

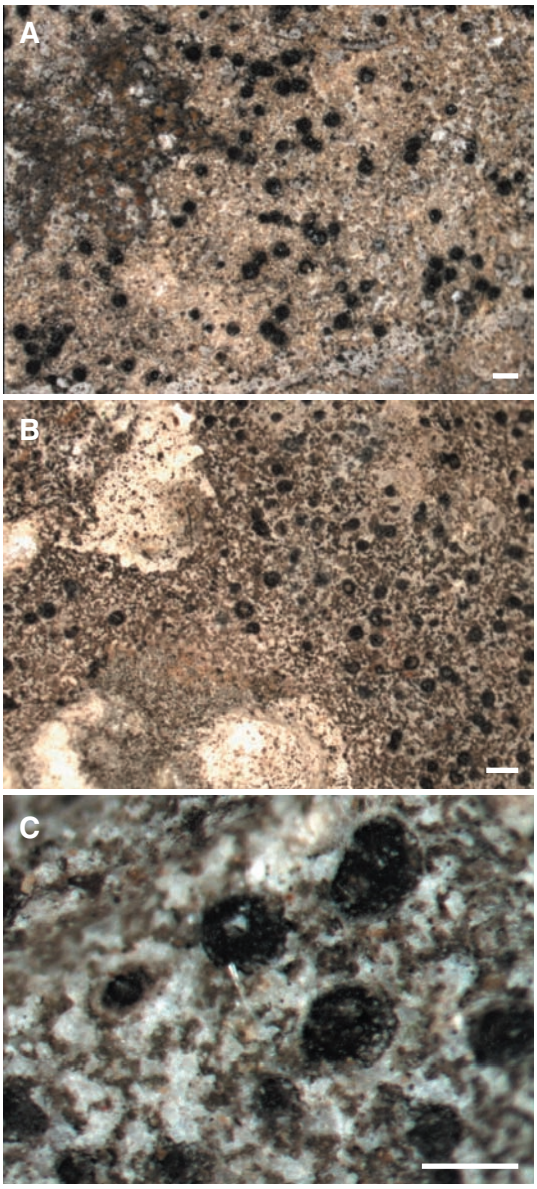

Fig. 35. *Verrucaria myriocarpa* Hepp. A & B – thallus (*Nowak*, KRAM; B – Hepp, Flechten Eur. 430, GFW, isotype); C – perithecia (Hepp, Flechten Eur. 430, GFW, isotype). Scale bars: A & B = 0.5 mm; C = 250 µm.

Periphyses 20–25 µm long. *Asci* 45–50 µm long, 15–20 µm wide. *Ascospores* simple, colourless, oblong ellipsoid (15–)18–22(–24) × (6–)8–9 (–10) µm. *Conidiomata* not observed.

Note. Well characterized by an immersed or

partially superficial thallus visible on the surface of rocks as darker spots (in fact the spots are groups of algal cells in thallus) and more or less superficial small perithecia not covered by the thallus forming rather prominent projections, and perithecia leaving shallow pits in rock. *Verrucaria dolosa* is similar in the patchy to thin superficial thallus but differs in the thallus colour (green to olive-brown, uniformly coloured), and smaller ascospores (15–17.5 × 6.5–8.5 µm). *Verrucaria muralis* is similar in appearance but it has much bigger perithecia forming shallowly convex to conical-hemispherical projections (300–500 µm wide) and has a superficial, partly well developed thallus.

HABITAT. On sandstone and calcareous rocks.

DISTRIBUTION IN POLAND. It occurs on calcareous outcrops in Poland, for example in the Wyżyna Krakowsko-Częstochowska upland, the Pieniny Mts and the Western Tatra Mts. Recorded (as *Verrucaria murina*) one hundred years ago in Silesia by Eitner (1901, 1911) and neglected until 1990 when it was noted by Alstrup and Olech (1990) in the Tatra Mts. At that time specimens were named by Polish researchers as *V. congregata* (e.g. Nowak 1961) but are now treated as *V. myriocarpa.*

WORLD DISTRIBUTION. In Europe known as *V. murina* (Feuerer 2011).

REMARKS. Specimens recognized in Poland as *V. congregata* correspond well with the isotype of *V. myriocarpa* in GFW.

According to Leighton (1871) the name *V. myriocarpa* is a synonym of *V. murina*. However the taxonomic position of *V. murina* Leight. is not clear. At present in Europe this taxon is recognized as *V. murina* auct. (Orange *et al.* 2009). For this reason I propose to use the name *Verrucaria myriocarpa* for this taxon.

SPECIMENS EXAMINED. FE-23 – WYŻYNA LUBELSKA UPLAND, MAŁOPOLSKI PRZEŁOM WISŁY WATER GAP: hill by Kazimierz Dolny, 19 May 1985, *H. Wójciak* (LBL); FG-31 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Ciechania near Krempna, 590 m, 10 Oct. 1979, *J. Nowak* (KRAM).

Verrucaria nigrescens Pers. Fig. 36

Ann. Bot. (Usteri) **14**: 36. 1795. TYPE: hb. ? – *Lithoicea nigrescens* (Pers.) A. Massal., Memor. Lichenogr.: 142. 1853.

Lithoicea nigrescens var. *acrotella* A. Massal., Sched. Crit. V. 106. 1856. TYPE: [Italy] Ad saxa dolomitica in oppido Badia, Provinciae Veronensis, *A. Massalongo* (Massalongo, Lich. Ital. Exs. 172A; M-0156533!, M-0156534! – ISOTYPES). Synonymized here. – *Verrucaria nigroumbrina* f. *acrotella* (A. Massal.) Servít, Ann. Mus. Civ. Stor. Nat. Genova **64**: 52. 1950.

Verrucaria opiziana Servít, Sbor. Nar. Mus. **5B**(9; 3): 39. 1949. TYPE: Auf umherliegenden Kalksteinen einer Oedung an der Sudseite des kleinen Cortigast ober Weismain in Oberfranken, 7 Sept. 1888, *F. Arnold* (Arnold, Lich. Exs. 1399, KRAM! – SYNTYPE). Synonymized here.

Prothallus black, visible also between areoles. *Thallus* superficial, thin to moderately thick, 100–500 µm high, cracked-areolate, chocolate-brown to black. Areoles 0.2–0.8 mm wide, polygonal to roundish-angular, usually smooth, flat to subconvex, occasionally with sorediate margins, epruinose, sides of areoles dark brown to blackish. *Upper cortex* paraplectenchymatous, 10–20 µm thick, the uppermost part brown. *Algal* layer 30–120 µm thick, algal cells 5–10 µm in diam., arranged in ± vertical columns. *Medulla* with a black basal layer half or two-thirds of thallus thickness. *Perithecia* half to three-quarters immersed in thallus, one per areole, apex flat to hemispherical. *Involucrellum* black 200–400 µm in diam., dimidiate or extending downwards. *Excipulum* dark brown, globose, 150–200 µm wide. *Periphysoids* 25–40 µm long. *Asci* 70–90 µm long, 20–30 µm wide. *Ascospores* simple, colourless, ellipsoid, (17–)20–28(–30) × 8–15 µm. *Conidiomata* not observed.

NOTE. Characterized by the chocolate-brown to black, cracked-areolate thallus with a well-developed black basal layer often half or two-thirds of thallus thickness, and areoles more or less similar in size and shape. *Verrucaria tectorum* also has a black basal layer but it differs in the presence of a thinner basal layer which never occupies more than half of thallus thickness; the areoles vary in size and thickness on the same thallus. *Verrucaria*

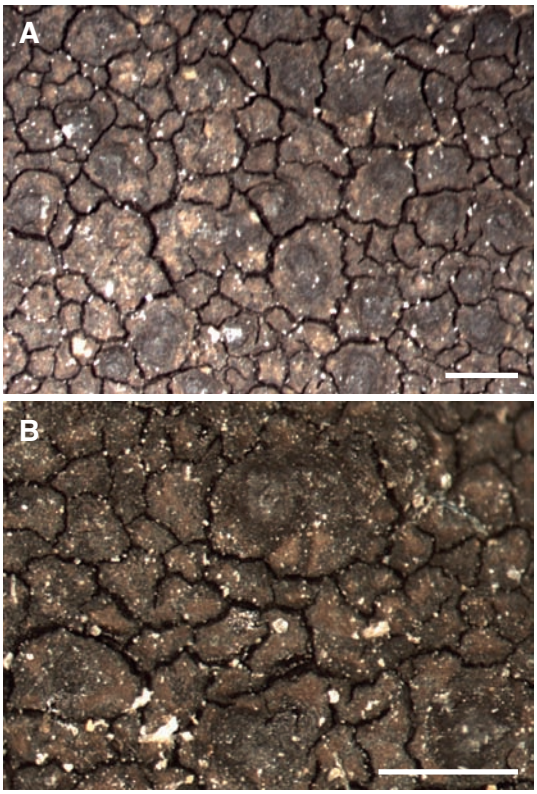

Fig. 36. *Verrucaria nigrescens* Pers. A & B – thallus (A – *Kiszka*, KRAM; B – Massalongo, Lich. Ital. Exs. 172A, M, as *Lithoicea nigrescens* var. *acrotella* A. Massal., isotype). Scale bars = 0.5 mm.

umbrinula also has a black basal layer but this is thinner, and the species occurs on siliceous rock. *Verrucaria cataleptoides* has a brown basal layer but it is well distinguished by a areolate-cracked thallus with well-visible white medulla in cracks.

HABITAT. On limestone, exposed to the sun, in moderately eutrophic environments.

DISTRIBUTION IN POLAND. Recorded at many sites throughout Poland (see Fałtynowicz 2003).

WORLD DISTRIBUTION. Known throughout Europe and on other continents (Feuerer 2011).

REMARKS. The name *Lithoicea nigrescens* var. *acrotella* is proposed here as a synonym of *Verrucaria nigrescens*. The variety *acrotella* was distinguished based on the black colour of the thallus (Massalongo 1855b; see also Zschacke 1933). However, the thallus colour is dependant on illumination and it varies on the same specimen: sun-exposed parts are darker than shaded ones.

Verrucaria opiziana is proposed here as a synonym of *V. nigrescsen*. The species *V. opiziana* was described by Servít (1949) on the Arnold exsiccatae collections distinguished previously by Arnold as *Lithoicea nigrescens.* The examined material (Arnold, Lich. Exs. 1399; KRAM) in fact is a juvenile form of *V. nigrescens*. The dark network of prothallus hyphae is easily well-visible and only a young patch of thallus has developed.

EXSICCATAE SEEN. Hepp, Flechten Eur. 434 (GFW); Anzi, Lich. Exs. Minus Rari Ital. Super. 365B (W), 366 (as *V. nigrescens* var. *acrotella*) (M); Arnold, Lich. Exs. 1189A, 1189B (as *Lithoicea nigrescens* f. *rupicola*) (KRAM).

SPECIMENS EXAMINED. BC-78 – PRADOLINA NOTECKA VALLEY, KOTLINA GORZOWSKA BASIN: Oborniki, 7 May 1935, *F. Krawiec* (POZ); CB-16– POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Kościerzyna Leśna Jastrzębce, Aug. 1935, *F. Krawiec* (POZ); DE-51 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Góra Św. Genowefy near Warta, 23 June 1960, *J. Nowak* (KRAM) as *V. nigroumbrina*; DG-59 – TATRA MTS, WESTERN TATRA MTS: Łysanki Mt., Aug. 1924 and 28 July 1925, *J. Motyka* (LBL); EE-83 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Góra Zelejowa nature reserve near Chęciny, 29 July 1951, *Sucharski* (LBL); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa, 20 July 1924 and 10 July 1926, and 1954, *J. Motyka* (LBL); EG-23 – WESTERN BESKIDY MTS, KOTLINA SĄDECKA BASIN: Maszkowice near Łącko, 18 Aug. 1954, *S. Kuziel* (LBL); EG-27 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Grybów, 22 July 1926, *J. Motyka* (LBL); EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Wąwóz Gorczyński gorge, 3 Sept. 1998, *J. Kiszka* (KRAP); EG-50 – TATRA MTS, WESTERN TATRA MTS: Dolina Bystrej, Polana Kalatówki, 26 Aug. 1926, *J. Motyka* (LBL); FE-23 – WYŻYNA LUBELSKA UPLAND, MAŁOPOLSKI PRZEŁOM WISŁY WATER GAP: Kazimierz Dolny, 6 July 1931, *F. Krawiec* (POZ); Kazimierz Dolny, 5 July 1931, *F. Krawiec* (POZ); FG-14 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Sieniawa, by Wisłok river on sandstone, 20 Aug. 1974, *J. Nowak* (KRAM); FG-16 – EASTERN BESKIDY MTS, GÓRY SANOCKO-

TURCZYŃSKIE MTS: Góry Słonne Mts, rocks by San river between Dębna and Mrzygłód, 18 Aug. 1989, *J. Kiszka & J. Piórecki* (KRAM); FG-23 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: valley of Bołucianka stream near Rymanów, 430 m, 15 Sept. 1974, *J. Nowak* (KRAM).

Verrucaria nigroumbrina (A. Massal.) Servít
Fig. 37

Ann. Mus. Civ. Stor. Nat. Genova **64**: 52. 1950. – BASIONYM: *Lithoicea nigrescens* var. *umbrina* A. Massal., Sched. Crit. V. 106. 1855. TYPE: [Italy] cretacea neocomiana in oppido Trefnagno, Provinciae Veronensis, *Massalongo* (Massalongo, Lich. Ital. Exs. 172 C, M-0156537!, M-0156538! – ISOTYPES), [*non Verrucaria umbrina* Wahlenb., Fl. Lapp.: 464. 1812].

Verrucaria nigrofusca Servít, Sbor. Nar. mus. 5B(9; Bot. 3): 38. 1949. TYPE: Bohemia orient.: Vápený Podol, calc., 1908 *V. Kuťák* (PRM-764879! – SYNTYPE). Synonymized here.

?*Verrucaria fuscoatroides* Servít, Sbor. Nar. Mus. 5B(9; Bot. 3): 25. 1949. TYPE: Germany, Blankenburg, calc., 1892, *C. Müller* as *Lithoicea fuscoatra* (PRM – HOLOTYPE).

Prothallus inconspicuous, brownish, or absent. *Thallus* superficial, moderately thick (100–)200–300(–350) µm thick, dirty yellowish to mid-brown or reddish brown, black to unaided eye, smooth, continuous or discontinuous, not regularly areolate, some cracks present around the perithecia in thicker parts of thallus. Fertile areoles thicker than sterile, 200–350 µm thick. *Upper cortex* paraplectenchymatous, of 1–3 layers of cells, colourless, the uppermost layer reddish brown, 20–30 µm thick. *Algal* layer 30–50 µm thick, algal cells more or less uniformly scattered, 8–10 µm diam. *Medulla* whitish, sometimes brownish near perithecia, paraplectenchymatous, without black basal layer. *Perithecia* half to three-quarters immersed, forming low to moderate projections 150–250(–300) µm in diam., sometimes covered by thin thalline layer. *Involucrellum* reaching to the base of excipulum, up to 80–100 µm thick at the base. *Excipulum* subglobose, colourless to brown, 180–200 µm wide. *Periphysoids* simple 20 µm long. *Asci* 60–70 µm long, 20–30 µm wide. *Ascospores* simple, colourless oblong ellipsoid 16–25(–27) × 8–10(–13) µm. *Conidiomata* not observed.

NOTE. This species is characterized by a thin dirty yellowish to mid-brown thallus (black to unaided eye) without a black basal layer and with cracks by perithecia. *Verrucaria maculiformis* is similar in appearance but differs in a thinner thallus (100–150 µm thick) and more prominent perithecia which are nearly sessile. *Verrucaria tristis* is also black to unaided eye but differs in the slightly more prominent perithecia (300–450 µm wide) and distinctly smaller ascospores (8–10 × 6–8.5 µm) which are globose to broadly ellipsoid. *Verrucaria nigrescens* and *V. tectorum* differs in the presence of a black basal layer. *Verrucaria macrostoma* has a thicker pale brown and regularly areolate

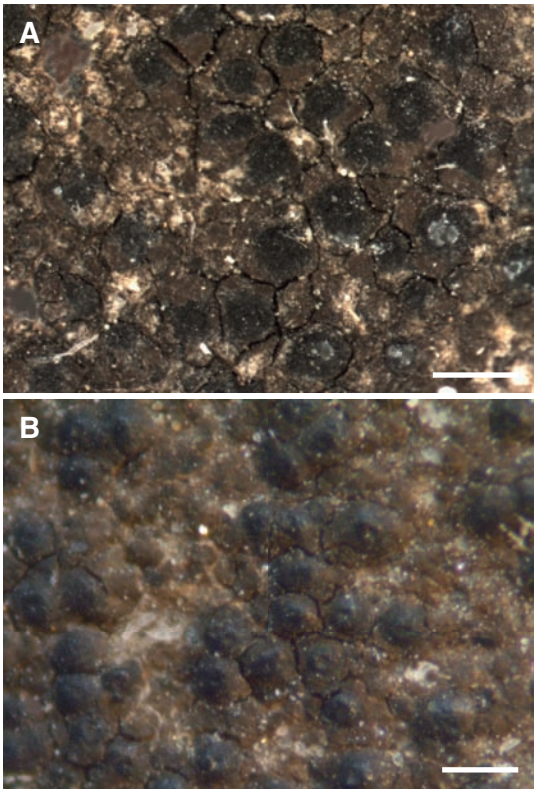

Fig. 37. *Verrucaria nigroumbrina* (A. Massal.) Servít. A & B – thallus (A – Massalongo, Lich. Ital. Exs. 172C, M, as *Lithoicea nigrescens* var. *umbrina* A. Massal., isotype; B – *Kuťák*, PRM, as *Verrucaria nigrofusca* Servít, syntype). Scale bars = 0.5 mm.

thallus with areoles growing up to 0.4–1.5 mm in diam. and larger ascospores [(20–)25–32) × 10–15) μm].

HABITAT. On calcareous substrate in open habitats.

DISTRIBUTION IN POLAND. Poorly known, reported from a few localities in the Carpathians.

WORLD DISTRIBUTION. A poorly known species; in Europe this taxon has been recognized as *V. nigroumbrina* in Poland (Fałtynowicz 2003) and the Czech Republic (Vězda & Liška 1999). In Southern Europe it was known as *Lithoicea nigrescens* var. *umbrina* (Massalongo 1855b). This species is also known in Europe and North America under its synonym names such as *V. nigrofusca* and probably as *V. fuscoatroides* (Breuss 2007a).

REMARKS. The name *Verrucaria nigrofusca* is proposed here as a synonym of *V. nigroumbrina*. The type specimens of both taxa are similar, with a moderately thick dirty yellowish to mid-brown thallus (black to unaided eye) without a black basal layer and with cracks by perithecia, the similar size of ascospores (*V. nigrofusca* 18–24 × 9–12 μm), and similar excipulum and perithecia.

The name *Verucaria fuscoatroides* is proposed here as a likely synonym of *V. nigroumbrina*. Both species are very similar in appearance but *V. fuscoatroides* differs in the thinner thallus and slightly wider ascospores [16–24(–28) × 10–12(–14) μm; according to Servít 1949]. According to Breuss (2007a) the spores are larger, reaching up to 22–30(–35) × 10–13(–15) μm. Unfortunately the type material of *V. fuscoatroides* was not available during the study. Only material in PRM named by Servít as *V. fuscoatroides* was examined; this collection was also recognized as *V. fuscoatroides* by Breuss (2007a). He noted some similarities between *V. fuscoatroides* and *V. nigrofusca* but treated them as separate species. However, in the writer's opinion *V. fuscoatroides* and *V. nigrofusca* are the same taxon and both are synonyms of *V. nigroumbrina.*

EXSICCATAE SEEN. Hepp, Flechten Eur. 941 (as *Verrucaria nigrescens* var. *umbrina*) (GFW).

SPECIMENS EXAMINED. DE-52 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Zalesiaki near Działoszyn, 1 June 1963, *J. Nowak* (KRAM); DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Ojców National Park, Ojców, Brama Krakowska, 2 May 1958, *J. Nowak* (KRAM).

Verrucaria obfuscans (Nyl.) Nyl. Fig. 38

Flora **64**: 540. 1881. – *Verrucaria virens* var. *obfuscans* Nyl., Bull. Soc. Bot. France **13**: 370. 1866. TYPE: France, Paris, jardin du Luxembourg, *Nylander* (probably kept in PC). – *Amphoridium obfuscans* (Nyl.) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 38. 1954.

Amphoridium impurum J. Nowak, Fragm. Florist. Geobot. **20**(3): 391. 1974. TYPE: Poland, Wyżyna Krakowsko-Częstochowska, okręg północny. Przymiłowice koło Olsztyna. Na nasłonecznionych skałach wapiennych koło 400 m od szosy do Janowa. 16.05.1958. *J. Nowak* (KRAM! – HOLOTYPE, KRAM! – ISOTYPE). Synonymized here.

Verrucaria obfuscans var. *deminuta* Servít, Stud. Bot. Čes. **7**(2–4): 54. 1946. TYPE: Ústí n. Orl., aren.-calc. 1937, *Kuťák* (PRM! – SYNTYPE). – *Verrucaria deminuta* (Servít) Servít, Sborn. Nár. Muz. Praze, Řada B, Přír. Vědy 9(3): 22. 1949. – *Amphoridium deminutum* (Servít) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 38. 1954.

Prothallus absent or indistinct, black. *Thallus* superficial, well-developed, 300–1200 μm thick, cracked. Areoles separated by deep cracks, angular in outline, 0.5–1.2(–2.0) mm in diam., plane or slightly concave, yellowish brown, greenish brown, pale brown or brown, occasionally pruinose, sides concolorous with upper surface or slightly darker. Upper surface subdivided by inconspicuous thin lines. Margin thin, initially not broken into discrete areas, but very early divided by cracks. *Upper cortex* a pseudocortex, paraplectenchymatous, 10 μm high, composed of one layered, small cells, with dilute brown pigment, covered by dead cells. *Algal* layer 80–100(–140) μm high, dissected by brown pigmented areas of medulla, algae up to 8–10 μm in diam., cells arranged in weak columns. *Medulla* in upper part paraplectenchymatous, colourless, in lower part prosoplectenchymatous and

often densely pigmented, hyphae 4–5 µm thick. *Perithecia* forming projections 100–200 µm in diam., mainly half to one-quarter or rarely three-quarters immersed, (1–)8–18 per areole, most often one per photosynthetic unit. *Involucrellum* absent. *Excipulum* pale brown to brown throughout, globose or slightly ellipsoid, 180–250 µm. *Periphysoids* unbranched 20–25 µm long. *Asci* 50–75 µm long (15–)20–25 µm wide. *Ascospores* colourless, simple or sometimes also two-celled, narrowly oblong-ellipsoid, 16–22 × 7–8 µm. *Conidiomata* not observed in examined material.

NOTE. This species is characterized by pale to dark brown cracked-areolate thallus, half to one-quarter immersed perithecia, lack of involucrellum, and medium size ascospores. From *V. nigrescens* and *V. tectorum* it is easily distinguished by the absence of an involucrellum. *Verrucaria ochrostoma* also lacks an involucrellum and has the excipulum pigmented throughout but differs in the pale grey to grey-brown thallus with completely immersed perithecia. *Verrucaria policensis* lacks involucrellum but differs in the dirty white thallus, an excipulum colourless except by the ostiole, wider ascospores [17–20(–24) × 9–10(–11) µm] and thallus irregularly cracked, never regular cracked-areolate.

HABITAT. On limestone. Thalli often parasitised by *Verrucaria polysticta* and *Placopyrenium fuscellum*.

DISTRIBUTION IN POLAND. Reported from scattered localities, it occurs in Central Poland in the Wyżyna Wieluńska upland (Nowak 1961, 1967) and the Góry Świętokrzyskie Mts (Toborowicz 1983; reported as *Verrucaria lecideoides*), Pogórze Iłżeckie upland (KTC). It was reported also from many localities in the Carpathians: in the Gorce Mts (Bielczyk 2003), Beskid Niski (Krzewicka 2009b) and the Góry Słonne Mts (Kiszka & Piórtecki 1992).

WORLD DISTRIBUTION. Known from Central Europe (Zschacke 1934) and the British Isles (Orange *et al.* 2009).

REMARKS. *Amphoridium impurum* is proposed here as a synonym of *V. obfuscans* because it seems

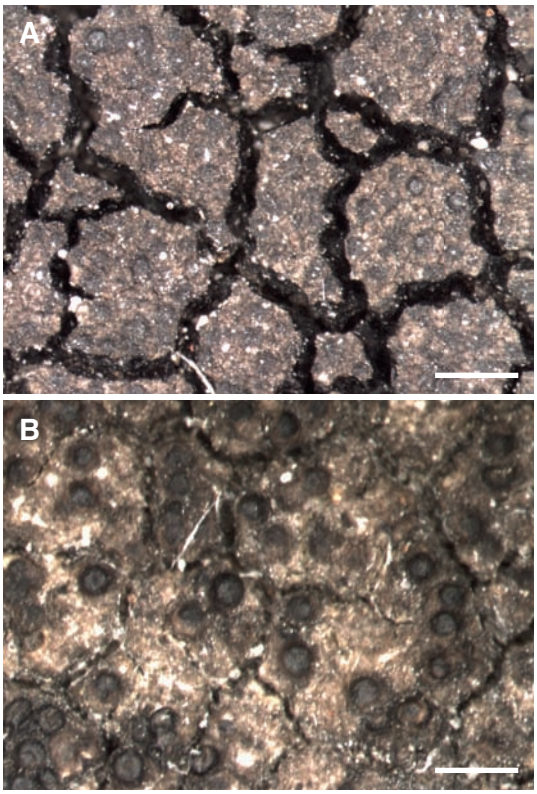

Fig. 38. *Verrucaria obfuscans* (Nyl.) Nyl. A & B – thallus (A – *Nowak*, KRAM; B – *Nowak*, KRAM, as *Amphoridium impurum* J. Nowak, holotype). Scale bars = 0.5 mm.

to be a juvenile form of the latter species. The thallus is similar in appearance in both taxa but *A. impurum* has a thinner thallus, up to 200–500 µm thick, a paler medulla, fewer perithecia per areole (1–8) and slightly smaller ascospores (12–18 × 5–7 µm). These characters can also be seen in juvenile morphs of *V. obfuscans.*

EXSICCATAE SEEN. Rabenhorst, Lich. Eur. 824 (B); Nowak, Lich. Polon. Merid. Exs. 248 (KRAM).

SPECIMENS EXAMINED. DF-68 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, RÓW KRZESZOWICKI DEPRESSION: Dolina Kobylańska valley near Rudawa, 350 m, on sunny vertical limestone, 17 April 1956, *J. Nowak* (KRAM, LBL); DG-59 – TATRA MTS, WESTERN TATRA MTS: Łysanki Mt., 10 Aug. 1925, *J. Motyka* (LBL); EE-72 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Góra Kozi Grzbiet near Chęciny, 17 Aug. 1976, *K. Toborowicz*

(KTC); EE-77 – Pogórze Iłżeckie foreland: Trójca village, July 1978, *K. Toborowicz* & *W. Cedro* (KTC); EE-82 – Góry Świętokrzyskie Mts: Góra Bocheńska near Chęciny, 9 Nov. 1974, *K. Toborowicz* (KTC); FG-22 – Middle Beskidy Mts, Beskid niski Mts: on the bank of Jasiołka river near Dukla village, 340 m, 10 Sept. 1974, *J. Nowak* (KRAM).

Verrucaria ochrostoma Borrer Fig. 39

in Schrader, Lich. Helv. Spicil. **7**: 347. 1836. – *Lithoicea ochrostoma* (Borrer) Stein, Kryptogamen-Flora von Schlesien: 324. 1879. – *Verrucaria cataleptoides* var. *ochrostoma* (Borrer *ex* Leight.) Servít, Stud. Bot. Čech. **7**(2–4): 65. 1946.

Prothallus absent or indistinct. *Thallus* superficial, well-developed, 300–700(–1000) μm thick, regularly areolate, pale grey to grey-brown. Areoles 0.3–0.45 mm in diam., sides the same colour as upper surface. *Upper cortex* a pseudocortex, paraplectenchymatous, with dilute brown pigment, a distinct epinecral layer present. *Medulla* paraplectenchymatous, without black basal layer. *Perithecia* completely immersed, 1 per areole, possibly the base immersed in the substratum, only plane brown apex visible. *Involucrellum* absent. *Excipulum* pigmented throughout. *Ascospores* colourless, simple or sometimes also two-celled, narrowly oblong-ellipsoid, 16–26 × 10–13 μm. *Conidiomata* not observed.

Note. This species is characterized by a superficial cracked-areolate thallus and immersed perithecia without an involucrellum and with concave plane brown apex visible as a brown spot. The epinecral layer can give a somewhat cartilaginous appearance to the thallus. *Verrucaria ochrostoma* is easily distinguished from most *Verrucaria* species by lack of an involucrellum. *Verrucaria hochstetteri* and *V. viridicans* differs in the endolithic thalli, additionally *V. viridicans* has perithecia fused in groups of 2–3. *Verrucaria hochstetteri* has lager perithecia often surrounded by a collar of thallus. *Verrucaria obfuscans* has a regularly-areolate thallus but differs in a singlr perithecium per areole, mainly one-quarter to half immersed, and narrower ascospores (16–22 × 7–8 μm). *Verrucaria policensis* differs in the ashy grey to yellowish grey

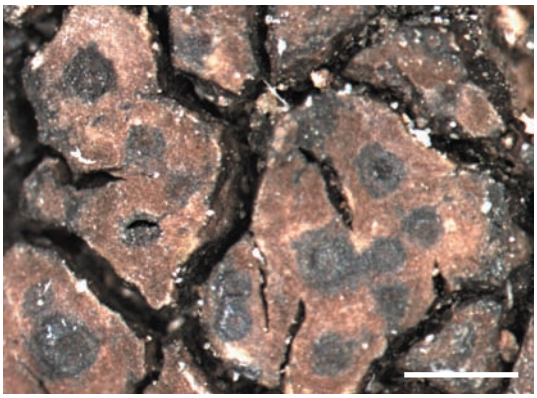

Fig. 39. *Verrucaria ochrostoma* Borrer (*Glanc*, KRAM). Scale bar = 0.5 mm.

endolithic to superficial thallus and excipulum colourless except by the ostiole, and slightly smaller ascospores [17–20(–24) × 9–10(–11) μm].

Habitat. On limestone in terrestrial habitats.

Distribution in Poland. Very rare, noted from only two localities in medium height mountains in the Carpathians, namely the Gorce Mts and the Beskid Niski Mts. The historical record (Stein 1879) could not be confirmed, as herbarium material was not found.

World distribution. Rare, in Europe reported from England, Italy, Switzerland (Servít 1946; Orange *et al.* 2009).

Specimens examined. EG-22 – Western Beskidy Mts, Gorce Mts: S slope of the Twarogów hill, 500–600 m, 6 Sept. 1960, *K. Glanc* (KRAM); FG-23 – Middle Beskidy Mts, Beskid Niski Mts: Wisłoczek near Rymanów Zdrój, 540 m, 21 Aug. 1974, *J. Nowak* (KRAM).

Verrucaria pachyderma (Arnold) Arnold Fig. 40

Verh. Zool.-Bot. Ges. Wien **30**: 146. 1880. – *Verrucaria chlorotica* var. *pachyderma* Arnold, Verh. Zool.-Bot. Ges. Wien **22**: 286. 1872. Type: [Austria] Rosskogel bei Innsbruck in Tirol, 24 Aug. 1875, *Arnold* (Arnold, Lich. Exs. Lich. Jur. 638, W! – isotype).

Prothallus black, poorly-visible. *Thallus* superficial, thin to thick, 50–200 μm thick, dark grey-green to blackish, sometimes with brownish tinge,

subgelatinous, uncracked or with cracks developing in herbarium, smooth, glossy. *Upper cortex* weakly defined, with dull green to dull brown pigment. *Algal* layer paraplectenchymatous, 50–80 µm thick. *Medulla* paraplectenchymatous, without distinct black basal layer but sometimes with brownish punctae. *Perithecia* entirely immersed in the thallus, forming low projections, apex visible as a black dot or black ring, 100–150 µm in diam. *Involucrellum* thin and appressed to apex of excipulum or conical and narrowly or widely spreading sometimes reaching to the base of the thallus. *Excipulum* colourless, 160–350 µm wide. *Periphysoids* up to 20 µm long. *Asci* 45–50 µm long, 10–15 µm wide. *Ascospores* ellipsoid to oblong-ellipsoid or narrowly (15–)17–22 × 6–8 µm, without halo. *Conidiomata* not observed.

NOTE. *Verrucaria pachyderma* is easily identified among amphibious species by a dark greenish, nearly black uncracked thallus with a smooth and glossy upper surface and medium-sized ascospores. It differs from *Hydropunctaria rheitrophila* and *H. scabra* in the larger ascospores and lack of black columns in the medulla. It is distinguished from *V. praetermissa* by lacking a continuous, distinctly visible black basal layer that usually occupies more than half of the thallus thickness. Morphs of *V. praetermissa* without a black basal layer are distinguished by the white-green or pinkish green, non-gelatinous cracked thallus. *Verrucaria madida* differs by the presence of a dull green or in part brown pigment which is turning brownish in HCl and smaller ascosopores [9–13.5(–15) × 5.5–7.5 µm].

HABITAT. Amphibious species occurring in very clean and cool mountain streams, on permanently submerged siliceous rocks. In Europe it is also known from lower altitudes in Austria (Keller 2000) and Great Britain (Orange *et al*. 2009).

DISTRIBUTION IN POLAND. *Verrucaria pachyderma* was recorded in the High Tatra Mts: in the streams of the Dolina Pańszczyca valley and the Pod Mnichem valley.

WORLD DISTRIBUTION. In Europe it is known from Scandinavia, Great Britain and from Central and Southern Europe (Nimis & Martellos 2003; Keller 2000; Thüs 2002; Lisická 2005; Orange *et al*. 2009).

REMARKS. Thüs and Schultz (2008) probably incorrectly included the name *V. pissina* into the synonyms of *V. pachyderma* after Zschacke (1934). *Verrucaria pissina* is characterized by small ascospores 11–17 × 5–7 µm according to the protologue whereas *V. pachyderma* has distinctly bigger spores 17–23 × 6–8 µm. Based on the size of ascospores *V. pissina* seems to be closer to *Hydropunctaria rheitrophila* or *H. scabra* than to *V. pachyderma*. Unfortunately, the type material of *V. pissina* was not available for study and it cannot be determined here.

In Poland Eitner (1911) reported specimens with a blackish, glossy and cracked thallus with projecting perithecia and ascospores up to 13–17 µm long and 5–7 µm wide under the name *V. pissina*. This combination of the characters suggests that the specimens collected by Eitner belong to *Hydropunctaria scabra* not to *V. pachyderma* as reported in a recent checklist (Fałtynowicz 2003).

SPECIMENS EXAMINED. EG-50 – TATRA MTS, HIGH TATRA MTS: Dolina Pańszczyca in stream, on granite rockin stream, 1310 m, 10 Aug. 1971, *J. Nowak* (KRAM); Dolina Pańszczyca, 1520 m, 13 Aug. 1971, *J. Nowak* (KRAM); EG-60 – Morskie Oko valley, Pod Mnichem in water, 1590 m, 6 June 1971, *J. Nowak* (KRAM).

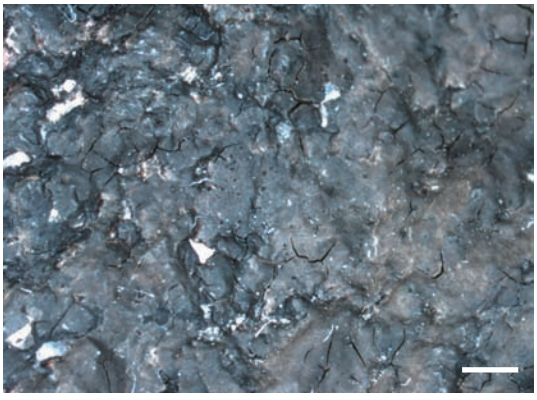

Fig. 40. *Verrucaria pachyderma* (Arnold) Arnold (Arnold, Lich. Exs. Lich. Jur. 638, W, as *Verrucaria chlorotica* var. *pachyderma* Arnold, isotype). Scale bar = 1 mm.

Verrucaria pinguicula A. Massal. Fig. 41

Lotos **6**: 80. 1856. TYPE: Ad saxa in Franconia superiori prope Muggendorf, *F. Arnold* (probably kept in W).

Prothallus yellowish in single thalli; contiguous conspecific thalli separated by dark lines. *Thallus* superficial, smooth, thick, often raised above surrounding rock, 200–300 µm thick, with distinct outline, continuous to extensively cracked, yellowish to light brown. *Upper cortex* a eucortex, without or with dilute brown pigment. *Algal* layer clearly delimited, algal cells 10–15 µm in diam., uniformly scattered. *Medulla* paraplectenchymatous, without black basal layer, hyphae K/I–. *Perithecia* half-immersed, forming low to moderate projections 180–220 µm wide (rarely fused perithecia up to 400 µm wide), black, not covered by thallus in upper part, apex flattened or occasionally concave, ostiole inconspicuous, or visible as a slightly paler dot or shallow pit. *Involucrellum* well-developed, thickest beside upper half of excipulum, but often more or less clasping excipulum below and reaching to its base. *Excipulum* colourless to slightly pale brown, globose, 190–280 µm wide. *Periphysoids* unbranched 15–20 µm long. *Asci* 45–55 µm long, 15 µm wide. *Ascospores* simple, oblong to ellipsoid, 15–18 × 6–8 µm. *Conidiomata* not observed.

NOTE. This species is characterized by the superficial pale brown cracked thallus usually raised above surrounding rock, a distinctly delimited thallus and by half-immersed perithecia. *Verrucaria polonica* differs in the presence of macrospheroids and a white thallus. *Verrucaria caerulea* is similar in the presence of a superficial, closely and finely cracked thallus with a distinctly visible margin but rosette-like in outline, and differs also in smaller perithecia three-quarters to completely immersed in the thallus and an often grey-blue thallus (however morphs growing in shaded places have pale brown thalli). The thallus of *V. caerulea* has a distinct zone at margin without perithecia whereas in *V. pinguicula* perithecia are scattered throughout the upper surface.

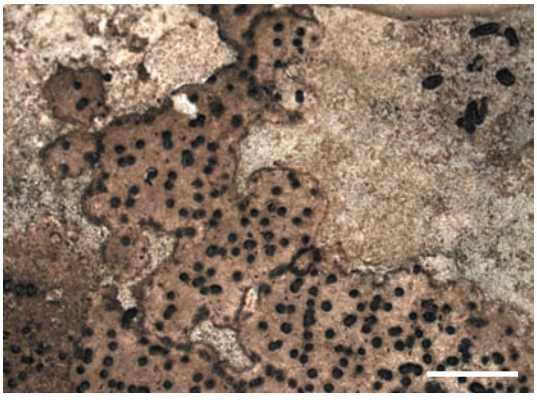

Fig. 41. *Verrucaria pinguicula* A. Massal. (Hepp, Flechten Eur. 688, GFW). Scale bar = 0.5 mm.

HABITAT. It occurs on limestone and dolomites mainly in sunny places.

DISTRIBUTION IN POLAND. It is reported from the Carpathians from the Pieniny Mts and the Tatra Mts and from central Poland from the Wyżyna Krakowsko-Wieluńska upland.

To date, *V. pinguicula* has been reported from Poland twice: from Elbląg in northern Poland as *V. integra* Nyl. by Olerht (1870) and from the Carpathians by Moruzi (1933; see also Fałtynowicz 2003). However, this material was not available during this study and its occurrence in northern Poland was not confirmed.

WORLD DISTRIBUTION. Reported from Europe, Macaronesia, Asia (Orange *et al*. 2009).

REMARKS. Type material was not examined during this study. Hepp's exsiccatae collection no 688 and Krypt. Exs. no. 1761 were treated as reference materials following Zschacke (1933).

EXSICCATAE SEEN. Hepp, Flechten Eur. 688 (GFW); Krypt. Exs. 1761 (KRAM).

SPECIMENS EXAMINED. DF-68 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, RÓW KRZESZOWICKI DEPRESSION: Dolina Kobylańska valley near Rudawa, 350 m, on sunny vertical limestone, 17 April 1956, *J. Nowak* (KRAM); EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Pieniny National Park, Wąwóz Gorczyński gorge, 2 Sept. 1998, *J. Kiszka* (KRAM); DG-59 – TATRA MTS, WESTERN TATRA MTS: Łysanki Mt. by Dolina Małej Łąki, 30 July 1925, *J. Motyka* (LBL).

Verrucaria policensis Servít Fig. 42

Stud. Bot. Čech. **7**(2–4): 55. 1946. TYPE: Bohemia, Police, Hvězda, in lapidibus aren. (calc.) 1918, *Kuťák* (PRM 756814!, 789443! – SYNTYPES). – *Amphoridium deminutum* f. *policense* (Serví) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 38. 1954.

Prothallus indistinct, whitish. *Thallus* endolithic to superficial, thin, widely spreading, dirty ash grey to yellowish grey, cracked into discrete areoles, but never regularly areolate, matt. *Upper cortex* absent, fungal hyphae forming a thin, irregularly developed net surrounding algae, colourless or yellowish, upper surface uneven, scabrid. *Algal* layer 60 µm thick, algal cells 8–15 µm in diam. *Medulla* 200 µm thick, colourless. *Perithecia* entirely immersed in the thallus, except for the ostiolar region, visible as projecting dark spots, 150–200 µm. *Involucrellum* absent or weakly developed beside upper excipulum. *Excipulum* colourless except the brown ostiolar region, globose, 120–160 µm. *Periphyses* 10–15 µm. *Asci* 40–50 µm long, 18–20 µm wide. *Ascospores* simple, ellipsoid to oblong, 17–20(–24) × 9–10(–11) µm. *Conidiomata* not observed.

NOTE. This species is characterized by endolithic to superficial, irregularly cracked, dirty white thallus which is never regular-areolate, perithecia without an involucrellum and colourless excipulum except for the brown ostiolar region. It is easily distinguished from most *Verrucaria* species by lack of an involucrellum. From other taxa lacking an without involucrellum (such as *V. hochstetteri*, *V. obfuscans*, *V. ochrostoma* and *V. viridicans*) it is easily distinguished by the colourless excipulum. *Verrucaria viridicans* differs in the perithecia fused in groups of 2–3, *V. obfuscans* by the presence of half to one-quarter immersed perithecia, (1–)8–18 per areole and by the brown thallus; *V. ochrostoma* differs in the regularly-areolate, pale grey to grey-brown thallus. *Verrucaria hochstetteri* differs in the perithecia immersed in the thallus in well-defined pits in rocks and surrounded by a collar of thallus.

HABITAT. On calcareous rocks.

DISTRIBUTION IN POLAND. Occurs on the Wyżyna Krakowsko-Częstochowska upland.

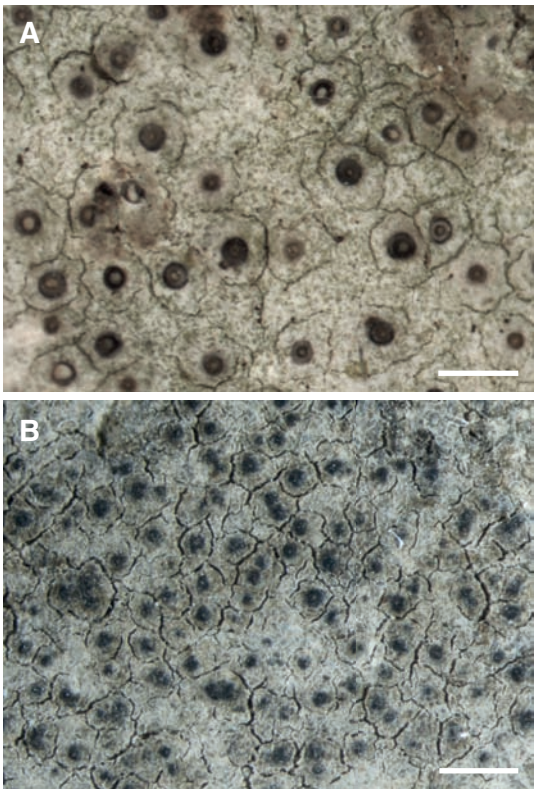

Fig. 42. *Verrucaria policensis* Servít. A & B – thallus (A – *Kiszka*, KRAP; B – *Kuťák*, PRM, syntype). Scale bars: A = 0.5 mm; B = 1 mm.

WORLD DISTRIBUTION. Poorly known in Europe, recognized only in Central part from Czech Republic and Poland (Nowak 1961; Vězda & Liška 1999).

REMARKS. Poorly known species in Poland. The specimens of this taxon were often incorrectly named as *V. deminuta.* On the other hand some specimens previously reported as *V. policensis* from the Wyżyna Krakowsko-Częstochowska upland (Nowak 1961) belong to *Verrucula polycarparia*.

SPECIMENS EXAMINED. DE-73 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Kamyk near Kłobuck, 270 m, 2 June 1964, *J. Nowak* (KRAM); DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Ojców National Park, Wąwóz Ciemne Skały, 9 Aug. 2002, *J. Kiszka* (KRAP); Dolina Sąspowska

valley, 18 Aug. 2004, *J. Kiszka* (KRAP); DF-58 – Wąwóz Korytania, Węże Skały rock, 12 May 2004, *J. Kiszka* (KRAP).

Verrucaria polonica J. Nowak Fig. 43

Fragm. Florist. Geobot. **5**(1): 155. 1959. TYPE: [Poland] Wyżyna Krakowsko-Częstochowska, Jura Południowa, Wierzchowie koło Ojcowa, 2.05.1956. *J. Nowak* (KRAM! – HOLOTYPE, KRAM! – ISOTYPE).

Prothallus whitish in single thalli, or forming thin, brown-black to black lines separating contiguous conspecific thalli. *Thallus* superficial, white to greyish white, thinly superficial and cracked only near the perithecia to cracked into discrete areoles. *Upper cortex* a pseudocortex, 10–25 µm thick, with or without dilute brown pigment, even, rather smooth, matt. *Algal* layer prosoplectenchymatous clearly delimited, 70–190 µm thick, hyphae K/I+ violet-blue, algal cells 5–12 µm in diam., aggregated in clusters. *Medulla* poorly formed, prosoplectenchymatous, hyphae K/I+ violet-blue, with macrospheroids in the lower part, cells cylindrical to oblong, 8–18 µm in diam. *Perithecia* half to rarely three-quarters immersed, sometimes 2–3 growing together, forming black projections 250–300 µm wide, with plane apex and ostiole visible as a shallow black pit 50–100 µm wide. *Involucrellum* black 40–80 µm thick, flanking upper half of excipulum. *Excipulum* globose, colourless 160–230 µm wide. *Periphysoids* unbranched 15–20 µm long. *Asci* 42–55 µm long, 12–20 µm wide. *Ascospores* simple, ellipsoid to oblong, 12–18(–21) × (4–)5–7 µm. *Conidiomata* not observed.

NOTE. *Verrucaria polonica* is well distinguished by a unique combination of characters including a white superficial thallus, often cracked into areoles, half-immersed perithecia, macrospheroids and I+ thallus hyphae. *Parabagliettoa cyanea* differs in the absence of macrospheroids. *Verrucaria pinguicula* also has a superficial, cracked-areolate thallus but differs in the pale brown thallus with a distinct border, raised above surrounding rock, by lacking macrospheroids and the I– thallus. *Verrucaria viridicans* also has fused perithecia but lack an involucrellum and macrospheroids.

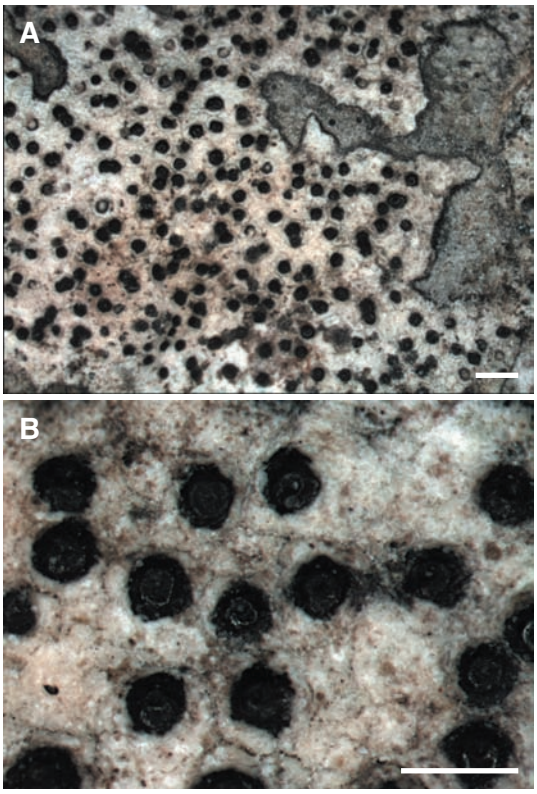

Fig. 43. *Verrucaria polonica* J. Nowak. A & B – thallus (*Nowak*, KRAM, holotype). Scale bars: A = 1 mm; B = 0.5 mm.

HABITAT. Saxicolous species growing on vertical surfaces of calcareous rocks in shady places, often north-facing.

DISTRIBUTION IN POLAND. Noted in the Carpathians and Central Poland. This species has been reported only from the Wyżyna Krakowsko-Częstochowska upland (Nowak 1959) and the Góry Świętokrzyskie Mts (Toborowicz 1983). During the revision it was also confirmed from the Carpathians, where it was collected in the Pieniny Mts. It is probably more frequent but has been poorly understood.

WORLD DISTRIBUTION. In Europe this species is known only from Poland.

REMARKS. This species seems to be closely related to the species of *Parabagliettoa*; however, it has not been transferred to this genus because

macrospheroids so far unknown there (Gueidan *et al*. 2009).

SPECIMENS EXAMINED. DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Dolina Prądnika valley near Ojców, 3 May 1958, *J. Nowak* (KRAM); DF-57 – GARB TENCZYŃSKI HUMMOCK: Dubie near Rudawa, 16 July 1958, *J. Nowak* (KRAM); DF-58 – WYŻYNA OLKUSKA UPLAND: Wierzchowie near Ojców, 2 May, 1956 and 25 July 1958, *J. Nowak* (KRAM); Dolina Bolechowicka, 25 May, 1958, *J. Nowak* (KRAM); DF-59 – Dolina Kluczwody near Biały Kościół, 19 May 1959, *J. Nowak* (KRAM); DF-68 – RÓW KRZESZOWICKI DEPRESSION: Dolina Brzoskwinki near Brzoskwinia, 15 April 1959, *J. Nowak* (KRAM); EE-83 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE UPLAND: Chęcińsko-Kielecki Park Krajobrazowy landscape, Góra Zalejowa, 14 Aug. 1978, *K. Toborowicz* (KTC); EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Wąwóz Sobczański gorge, 11 Sept. 1957, *K. Glanc* (KRAM) as *V. cyanea*; and 12 Sept. 1959, *J. Nowak* (KRAM).

Verrucaria polysticta Borrer Fig. 44

Engl. Bot. Suppl. **2**: Plate 2741. 1834. TYPE: [England] Sussex, *W. Borrer* (BM! – SYNTYPE).

Verrucaria fuscella f. *subpruinosa* Servít, Beih. Bot. Centralb. **55**: 253. 1936. TYPE: Styria. Kraubath, Gulsen, in rup. Serpentin. 24.6.1931. *J. Suza* (PRM 645359! – SYNTYPE) – *Dermatocarpon subpruinosum* (Servít) Servít, Stud. Bot. Čech. **7**(2–4): 62. 1946. – *Verrucaria subpruinosa* (Servít) auct.

Verrucaria fuscella var. *nigricans* Nyl., Flora **64**: 189. 1881. – *Verrucaria nigricans* (Nyl.) Zschacke, Rabenh. Kryptog.-Fl. **9**: 274. 1934.

Verrucaria subfuscella Nyl., Lich. Scand.: 271. 1861. – *Dermatocarpon subfuscellum* (Nyl.) Servít, Beih. Bot. Centralb. **55**: 270. 1936.

Prothallus present, blackish, non-fimbriate, primary areoles arising on prothallus. *Thallus* superficial, well developed, 280–700(–1000) µm thick, cracked, areoles separated by deep dark cracks, mature areoles 0.3–1.1 mm in diam., multiangular in outline, plane or slightly concave, upper surface of areoles grey or light brown to brown, pruinose or not, usually marked by dark lines. *Upper cortex* a pseudocortex, ill-defined, cell walls darkly pigmented, yellowish brown to blackish brown. *Algal layer* dissected by brown pigmented parts of medulla, algae up to 7–10 µm in diam., arranged in well-defined columns. *Medulla* paraplectenchymatous, densely pigmented, often occupying half or more of thallus thickness (50–)100–200 µm thick. *Perithecia* immersed, 1–6(–9) per areole, arising between the photosynthetic units, rarely within one of the units; ostiole appearing at thallus surface as brownish to black, slightly concave disc 100–260 µm wide. *Involucrellum* absent. *Excipulum* dark brown, usually flanked by dark medulla, 150–290 µm wide. *Periphysoids* 10–15 µm long. *Asci* 38–45 µm long, 13–18 µm wide. *Ascospores* colourless, simple, oblong-ellipsoid or ellipsoid, (11–)12–14 × 5.5–7.0 µm, without halo. *Conidiomata* not observed.

NOTE. This species is distinguished from other *Verrucaria* species by the thick thallus with dark-sided areoles. The perithecia are immersed between tightly appressed photosynthetic units within each areole; an involucrellum is absent, but the dark sides of the units may suggest that one is present. *Placopyrenium canellum* differs in the larger ascospores (20–23 × 6–7 µm) with a halo; young thalli of this species grow on *Aspicilia calcarea*. *Placopyrenium fuscellum* differs in the angular, elongated areoles with a thick, well-defined margin (in mature, non-parasitic thalli) and absence of prothallus; the upper surface of the areole is usually sparsely marked by dark lines and the perithecia are immersed in photosynthetic units.

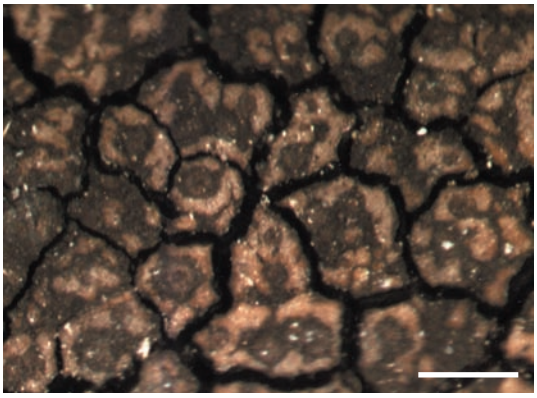

Fig. 44. *Verrucaria polysticta* Borrer (*Glanc*, KRAM). Scale bar = 0.5 mm.

HABITAT. This species grows on calcareous rocks in sunny places. Young individuals parasitic on thalli of *Verrucaria nigrescens* group, mature individuals become independent.

DISTRIBUTION IN POLAND. *Verrucaria polysticta* occurs in areas with large natural limestone outcrops, i.e. in the Wyżyna Krakowsko-Częstochowska upland and in limestone mountain massifs, such as the Pieniny Mts and the Western Tatra Mts. It was also found at scattered localities on calcareous sandstones in the Polish Carpathians, such as in the Bieszczady Mts and the Beskidy Zachodnie Mts. Outside the Carpathians it was recorded in Central Poland in the Góry Świętokrzyskie Mts. The occurrence of this species in Poland was recently discussed by Krzewicka (2009a).

WORLD DISTRIBUTION. Known in Europe, Asia, North and Central America (Orange *et al*. 2009).

REMARKS. The name *Verrucaria polysticta* was incorrectly included into the synonyms of *V. caerulea* on the recent Polish checklist of lichens (Fałtynowicz 2003; see also remarks under *V. caerulea*). The synonymy follows Orange (2004a) and Krzewicka (2009a).

SPECIMENS EXAMINED. DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA: Ojców National Park, Dolina Zachwytu valley near Wola Kalinowska, 29 June 2005, *J. Kiszka* (KRAP); DF-58 – by Wąwóz Złodziejski Dół gorge, on rocks, 6 May 2004, *J. Kiszka* (KRAP); DG-58 – TATRA MTS, WESTERN TATRA MTS: Bobrowiec on calcareous rock, 1400 m, Aug. 1982, *Z. Toborowicz* (KTC); DG-59 – Dolina Białego, 10 July 1926, *J. Motyka* (LBL); EE-87 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Łagów on calcareous rock, 24 April 1982, *K. Toborowicz* & *I. Wrocławska* (KTC); EG-21 – WESTERN BESKIDY MTS, GORCE MTS: Ku Samorodom below Średniak meadow in valley of Jaszcze Duże, 1080 m, 3 Sept. 1997, *P. Czarnota* (GPN); EG-22 – GORCE MTS: S slope of the Twarogów hill, 740 m, 5 July 1967, *K. Glanc* (KRAM); EG-31 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, KOTLINA ORAWSKO-NOWOTARSKA: Skalice Nowotarskie, Kramnica, 15 Aug. 1998, *J. Kiszka* (KRAP); Obłazowa near Krempachy, in sunny place, 29 Sept. 1997, *J. Kiszka* (KRAP); EG-32 – PIENINY MTS: Zielone Skałki rocks by Dunajec river near Niedzica Zamek, 27 July 1995, *J. Kiszka* (KRAM); Góra Pulsztyn Mt., 605 m, Aug. 1981, *J. Menert* & *K. Toborowicz* (KTC); Góra Zamkowa, 560 m, 5 Sept. 1982, *J. Menert* & *K. Toborowicz* (KTC); EG-33 – Sromowce Niżne by Grabczycha hill, 24 Sept. 1980, *K. Toborowicz* (KTC); Wąwóz Sobczański, on calcareous rocks 680 m, 1 Sept. 1981, *J. Pyrek* & *K. Toborowicz* (KTC); Wąwóz Sobczański, on calcareous rocks 720 m, 1 Sept. 1981, *J. Menert* & *K. Toborowicz* (KTC); Trzy Korony Mt., 1 Sept. 1927, *J. Motyka* (LBL); Góra Czerwone Skalki Mt. (Macelowa Góra Mt.) on vertical calcareous rock, 742 m, 26 June 1982, *J. Pyrek* & *K. Toborowicz* (KTC); Grabczychy rocks near Sromowce Niżne, 529 m, 22 June 19820, *K. Toborowicz* (KTC); EG-34 – Małe Pieniny Mts, nature reserve Skalskie, 840 m, 15 Sept. 1981, *K. Toborowicz* (KTC); Biała Woda nature reserve near Jaworki, 2 June 1999, *J. Kiszka* (KRAP); EG-36 – WESTERN BESKIDY MTS, BESKID SĄDECKI MTS: Pasmo Jaworzyny range, Żebracze nature reserve, 810 m, 5 July 2001, *P. Czarnota* (GPN); FG-14 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Sieniawa, by Wisłok river on sandstone, 315 m, 20 Aug. 1974, *J. Nowak* (KRAM).

Verrucaria praetermissa (Trevisan) Anzi

Fig. 45

Comm. Soc. Critt. Ital. **2**(1): 24. 1864. – *Leiophloea praetermissa* Trevisan, Conspect. Verruc.: 10. 1860. TYPE: Koerber (Typenherbar). s. nom. *Verrucaria laevata* (Mosig) Körber (L! – LECTOTYPE, designated by Swinscow 1968).

Verrucaria guestphalica Servít, Československé Lišenjníky Čeledi Verrucariaceae: 146. 1954. TYPE: Arnold, Lich. Exs. 867 (M – HOLOTYPE).

Verrucaria annulifera Eitner, Jahresber. Schles. Ges. Vaterl. Cultur **88**: 57. 1911. TYPE: Schlesien, Sattlerschlucht am Bober, 15.06.1911 *Eitner* nr. 4144 (W! – HOLOTYPE).

Verrucaria laevata Körber, Syst. Lich. German: 349. 1855. [*non Verrucaria laevata* Ach., Lich. Univ.: 284. 1810].

Verrucaria tapetica var. *fluvialis* Eitner, Jahresber. Schles. Ges. Vaterl. Cultur **88**: 57. 1911. TYPE: [Poland] Im Bober der Sattlerschlucht bei Hirschberg [Jelenia Góra] (BR).

Verrucaria elaeina var. *determinata* Körb., Syst. Lich. Germaniae: 345. 1855. TYPE: [Germany] Auf Kalkschiefer in Bächen (Hepp, Flechten Eur. 94, GFW! – SYNTYPE). Synonymized here. – *Verrucaria zahl-*

bruckneri Zschacke, Rabenh. Krypt.-Fl. **9**(1/1): 207. 1933. BASIONYM: *Verrucaria turicensis* Zschacke, Hedwigia **67**: 57. 1927. [*non Verrucaria turicensis* (Winter) Stzbg., Jahresber. St. Gall.. Naturw. Ges. (1880–81): 500. 1882].

Prothallus pinkish or whitish in free thalli or visible as thin black lines separating adjacent thalli. *Thallus* superficial, (40–)100–240 µm thick, non-gelatinous, white-green, pinkish green, pale greenish or greenish brown, surface smooth, matt, uncracked or with numerous cracks when well-developed. *Upper cortex* weakly differentiated, thin 5–10 µm, the uppermost layer of cells sometimes with dark pigment. *Algal* cells 5–12 µm in diam., scattered, arranged in very weak columns. *Medulla* paraplectenchymatous, irregularly arranged or in weakly defined vertical columns, with black basal layer usually thicker than half of the thallus thickness, or discontinuous in immature areas, rarely absent. *Perithecia* entirely immersed in the thallus, forming very low projections, visible as pinkish or brownish points 60–130 µm in diam. when immature and later visible as black discs or rings 60–200 µm in diam. *Involucrellum* well-developed, conical, extending laterally below, 260–900 µm wide, black, connected with the black basal layer, fused with excipulum. *Excipulum* usually colourless, 150–240 µm wide, ostiolar region with dark brown or dark green pigment. *Periphysoids* up to 25–30 µm long. *Asci* 60–85 µm long, 15–25 µm wide. *Ascospores* oblong, narrowly ellipsoid, rounded at both ends, 18–23 × 7–13 µm, with thin halo. *Conidiomata* not observed.

NOTE. *Verrucaria praetermissa* is easily identified among amphibious species by having a greenish (white-green, pink-green, grey-green or brown-green), matt thallus with a well-developed black basal layer and lacking black punctae and black columns in the medulla. It has an even thallus with usually more or less completely immersed perithecia visible only as black dots and not forming mounds, as in *V. denudata*, *V. elaeomelena*, and *V. funckii*, and it has narrowly ellipsoid ascospores. *Verrucaria elaeina* differs from morphs without black basal layer (not observed in material examined) by a less widely spreading involucrellum with a weaker coloration in basal parts and more prominent perithecia, often one-quarter to three-quarters immersed. *Verrucaria funckii* can have a greenish thallus with a black basal layer but differs by the subgelatinous thalli with a glossy surface with the perithecia forming mounds in the thallus. *Hydropunctaria scabra* also has a black basal layer but differs in the presence of carbonised columns in the medulla, roughened upper surface of involucrellum, smaller ellipsoid to oblong-ellipsoid ascospores (14–17 × 7.5–9 µm) and by having perithecia forming mound-like projections. Other amphibious species of *Verrucaria* in Poland lack a black basal layer. *Hydropunctaria rheitrophila* differs in the absence of a continuous black basal layer, the presence of carbonised dots and columns in the medulla and the smaller, rounded ascospores.

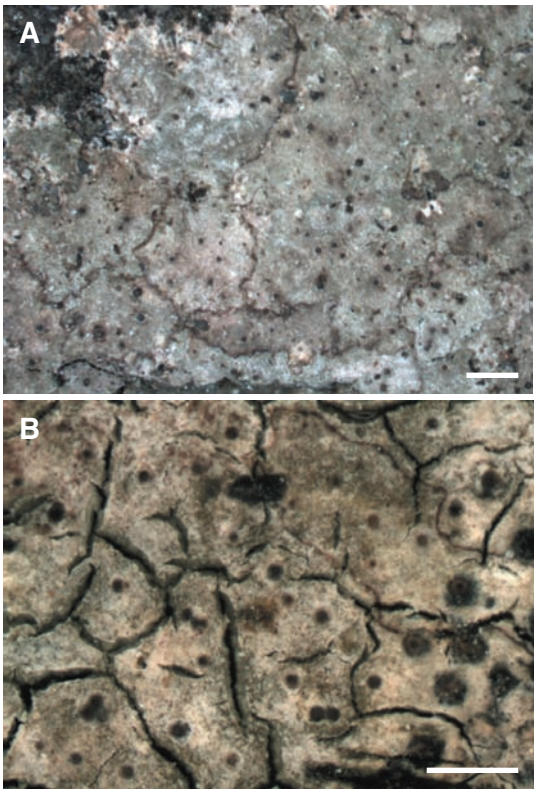

Fig. 45. *Verrucaria praetermissa* (Trevisan) Anzi. A & B – thallus (A – Nowak, Lich. Polon. Merid. Exs. 247, KRAM; B – *Nowak*, KRAM). Scale bars: A = 1 mm; B = 0.5 mm.

HABITAT. Amphibious species occurring on a variety of siliceous and calcareous rocks, on the shores of rivers and mountain lakes subject to periodic submersion, and on seepage rocks. In mountain streams most frequent in the main current of watercourses on larger rocks above the water level in the splash zone, often in shady places.

DISTRIBUTION IN POLAND. This species in Poland has been recorded at many localities: the Pobrzeże Gdańskie coastland, the Pobrzeże Szczecińskie coastland, the Pojezierze Wschodniopomorskie lakeland, the Pojezierze Mazurskie lakeland, the Nizina Północnopodlaska lowland, the Wzniesienia Południowomazowieckie hills, the Pogórze Środkowobeskidzkie foothills, the Obniżenie Orawsko-Podhalańskie depression, the Western Beskidy Mts, the Middle Beskidy Mts, the Eastern Beskidy Mts, and the Tatra Mts. It is one of the commonest freshwater species in Poland. It occurs in many Polish Carpathian rivers (Motyka 1926; Kiszka & Piórecki 1991, 1992; Czarnota 2000, 2002b; Kiszka 2000; Bielczyk 2003; Kościelniak & Kiszka 2003; Kościelniak 2004; Krzewicka 2006, 2009b). Outside the Carpathian Mts it has been reported from the Sudeten Mts (Eitner 1911) and lower altitudes in Central, N and NE Poland (Krawiec 1938a, as *V. laevata*; Fałtynowicz 1992; Zalewska 2000; Czyżewska *et al*. 2001, 2002; Krzewicka & Hachułka 2008).

WORLD DISTRIBUTION. Widespread in Europe (Thüs 2002; Orange *et al*. 2009; Thüs & Schultz 2008). Reported also from North America, Asia Australia (Feuerer 2011).

REMARKS. Thüs and Schultz (2008) included *Verrucaria zahlbruckneri* into the synonyms of *V. submersella*. However, the type material of *V. zahlbruckneri* (Hepp, Flechten Eur. 94; GFW) is characterized by the presence of a greenish dull thallus with a black basal layer and absence of black punctae and black columns in the medulla. It also has completely immersed perithecia visible only as black punctae and narrowly ellipsoid ascospores. These characters correspond very well with the description of *V. praetermissa*. For this reason I propose to return to the early synonymization proposed by Clauzade and Roux (1985), who placed it into the synonymy of *V. praetermissa*.

Körber (1855) described a new variety *V. elaeina* var. *determinata* based on a specimen of Hepp's (Flechten Eur. No. 94). The variety has a greenish cracked thallus with immersed parithecia, a distinct black basal layer and ascospores up to 18–22 × 7–12 µm. It is regarded here as a synonym of *V. praetermissa*.

In Poland many specimens of *Verrucaria praetermissa* were mistakenly labelled as *V. laevata* Ach. following Körber (1855) and later Nowak and Tobolewski (1975). However, at present *V. laevata* Ach. is a synonym of *V. aethiobola* (Thüs 2002). For this reason the specimens named *V. laevata* in Polish herbaria cannot be automatically transferred to *V. aethiobola* as the synonym name indicates.

EXSICCATAE SEEN. Nowak, Lich. Polon. Merid. Exs. 247 (as *Verrucaria laevata*) (KRAM); Körber, Lich. Sel. Germ. 81 (as *Verrucaria laevata*) (M).

SPECIMENS EXAMINED. CA-89 – POBRZEŻE GDAŃSKIE COASTLAND, POBRZEŻE KASZUBSKIE COASTLAND: Gdańsk Oliwa, Dolina Ewy valley, July 2000, *M. Kukwa* (UGDA); Trójmiejski Landscape Park, Źródliska w Dolinie Ewy nature reserve, in stream, 31 May 2003, *M. Kukwa 1821* (UGDA); CA-48 – POBRZEŻE SZCZECIŃSKIE COASTLAND, WYSOCZYZNA ŻARNOWIECKA PLATEAU: stream by Wielka Piaśnica, 16 July 1935, *F. Krawiec* (POZ); CA-68 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Potok Zagórzański stream, 18 July 1935, *F. Krawiec* (POZ); CA-89 – Trójmiejski Landscape Park, Dolina Ewy valley, in stream, 4 April 2004, *M. Kukwa 3002* (UGDA); CA-99 – Rekitnica river, 1 km to Kolbudy village, 5 May 1975, *W. Fałtynowicz* (UGDA); CB-09 – Kłodawa river valley, vicinity of Kleszczewo village, by forester's lodge Trąbki Wielkie, June 2004, *M. Kukwa 3350* (UGDA); CB-16 – Kościerzyna, stream in Jarząbce forest, Aug. 1935, *F. Krawiec* (POZ); CB-68 – POJEZIERZE POŁUDNIOWOPOMORSKIE, BORY TUCHOLSKIE FOREST: 1 km E of Stara Rzeka village, on stones in water, 13 June 2004, *M. Kukwa 3294* (UGDA); valley of Wda river, between Błędno and Stara Rzeka villages, 6 July 2004, *M. Kukwa 3384* (UGDA); DB-42 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE IŁAWSKIE LAKELAND: Kwidzyń forest devision, Lisewo forest district, forest section No. 190, valley of Postolińska Struga, on rocks in river, 21 April 2003, *M. Kukwa 1791* (UGDA); DD-68 – WZNIESIENIA

Południowomazowieckie heights, Wzniesienia Łódzkie hills: Wzniesienia Łódzkie Landscape Park, on stones in Grzmiąca stream, 10 June 2006, *M. Hachułka* (LOD); on stones in Kammienna stream, 23 June 2006, *M. Hachułka* (LOD); DF-96– Western Beskidy Mts, Beskid Mały Mts: in stream below Jaroszowicka Góra hill, 340–350 m, 18 April 1961, *J. Nowak* (KRAM); in valley of Glinki stream, below Królewizna hill (Królowa Wyżnia), 550 m, 28 Aug. 1961, *J. Nowak* (KRAM); DF-99 – Western Beskidy Mts, Beskid Średni Mts: Ziębowo near Stróża, 400 m, 22 Aug. 1996, *J. Nowak* (KRAM); DG-05 – Pasmo Pewelskiego range, Ubocz near Pewel Wielka, in stream, 650 m, 17 Sept. 1965, *J. Nowak* (KRAM); DG-05– Beskid Mały Mts: valley of stream on W slope of Madohora, 700 m, 11 April 1961, *J. Nowak* (KRAM); DG-06 – Beskid Żywiecki Mts: Pasmo Jałowieckie range, in Czerna stream, 500 m, 5 Sept. 1965, *J. Nowak* (KRAM); Adamy by Lachowice, 690 m, 25 July 1965, *J. Nowak* (KRAM); Wątrobów Potok stream, 680 m, 25 July 1965, *J. Nowak* (KRAM); Stryszawa-Matusy, in Stryszawka stream, 520 m, 16 Aug. 1965, *J. Nowak* (KRAM); DG-07 – Pasmo Jałowieckie range, in Grzechynka stream, 470 m and 575 m, 3 Sept. 1965, *J. Nowak* (KRAM); DG-09 – Beskid Średni Mts: Kaczanka stream below Kotoń near Pcim, 480 m, 15 April 1966, *J. Nowak* (KRAM); EA- 99 – Pobrzeże Wschodniobałtyckie coastland, Nizina Sępopolska lakeland: Wilczyny near Srokowo, on granite rock in stream, 4 May 1989, *J. Nowak* (KRAM); EB-37 – Pojezierze Mazurskie lakeland, Pojezierze Mrągowskie lakeland: by NW part of Lake Kiersztanowskie, valley of a small temporal brook, deciduous forest, 4 July 2006, *M. Kukwa 5256* (UGDA); EB-62 – Pojezierze Mazurskie lakeland, Pojezierze Olsztyńskie lakeland: Nowe Rumaki forest Łyna river near Ustrych damp, Aug. 2009, *D. Kubiak* (KRAM); EF-99 – Pogórze Środkowobeskidzkie foothills, Pogórzer Ciężkowickie foothills: Liwocz Mt. above Wróblowa, 400 m, 30 June 1972, *R. Kozik* (KRAP); EG-00 – Western Beskidy Mts, Beskid Średni Mts: Mizerów by Pcim, 340 m, 22 July 1996, *J. Nowak* (KRAM); EG-30 – Obniżenie Orawsko-Podhalańskie depression, Kotlina Orawsko-Nowotarska basin: Ostrowsko near Nowy Targ, on stone in stream, 7 June 1997, *D. Baraniak* (KRAP); EG-32 – Western Beskidy Mts, Gorce Mts: valley of Kluszkowianka stream, in stream, 922 m, 10 Aug. 1967, *K. Glanc* (KRAM); EG-33 – Beskid Sądecki Mts: Zakijowski stream near Krościenko, 620 m, on submerged sandstone boulders, 12 Sept. 1976, *J. Nowak* (KRAM; LBL); EG–50 – Tatra Mts, High Tatra Mts: Hala Gąsienicowa, stream by Czarny Staw Gąsienicowy, 16 Sept. 1949, *J. Motyka* (LBL); FA-86 – Pojezierze Mazurskie lakeland, Kraina Węgorapy Land: Park Krajobrazowy Puszczy Rominckiej, Bludzia river by Bludzie Małe village, 19 Aug. 2010, *D. Kubiak* (OLTC); FG-47 – Eastern Beskidy Mts, Western Bieszczady Mts: between Polanki and Monaster villages, in stream, left of tributary of Solinka river, E slope of Korbania hill, 17 May 2008, *B. Krzewicka* (KRAM); GB-92 – Nizina Północnopodlaska lowland, Wysoczyzna Białostocka plateau: Puszcza Knyszyńska forest, Budzisk Nature Reserve, by the stream, 10 June 1999, *K. Czyżewska* (LOD); Budzisk Nature Reserve, forest area No. 109, on siliceous stone in forest stream bed, 11 June 1999, *J. Motiejūnaite* (BILAS); GC-55 – Nizina Północnopodlaska lowland, Równina Bielska plain: Białowieża National Park, forest area No 314, Orłówka, on submerged block of concrete in forest sream bed, 14 June 1999, *J. Motiejūnaite* (BILAS); GG-50 – Eastern Beskidy Mts, Western Bieszczady Mts: Bieszczadzki National Park, in Syhła stream, 19 July 2001, *J. Kiszka* (KRAP); GG-60 – Bieszczadzki National Park, valley of the Zwór stream, 2 Oct. 2000, *J. Kiszka* (KRAP); GG-61 – Bieszczadzki National Park, in Halicz stream, 1042 m, 27 Aug. 1999, *J. Kiszka* (KRAP).

Verrucaria procopii Servít Fig. 46

Stud. Bot. Čech. **7**(2–4): 76. 1946. Type: Bohemia centr: Praga, st. Prokop, Klukovice 240 m, 1920, *M. Servít* (PRM 765228!, 857017!– syntypes).

Prothallus discontinuous, black. *Thallus* superficial, 400–700 µm thick, verrucose-areolate, areoles 0.2–0.4(–0.7) × (0.2–)0.4–0.6(–1) mm in diam., slightly narrowed at base, upper surface dark brown to blackish, scabrous. Vegetative propagules (isidia) often present, on young areoles at margin, or on mature areoles, sometimes on whole upper surface; subglobose, dark brown 50–80 µm wide, darker than upper cortex. *Upper cortex* 5–30 µm thick, darkly pigmented. *Algal* layer 50–100 µm thick, algal cells 5–10 µm in diam. *Medulla* in upper part whitish, paraplectenchymatous, in basal reddish brown prosoplectenchymatous, without black basal layer. *Perithecia* rare, half-immersed, upper part covered by a thin thallus layer, ostiole visible as a paler dot. *Involucrellum* black, often reaching down to the brown part of the medulla. *Excipulum* 300–320 µm wide, subglobose, colour-

less, brown only near ostiole. *Periphysoids* up to 30–35 µm long. *Asci* 80–90 µm long, 18–20 µm wide. *Ascospores* colourless, simple, ellipsoid, 19–26 × 9–12 µm. *Conidiomata* not detected in the material examined; according to Servít (1946) pycnidia present, conidia 8–9 × 0.5 µm.

NOTE. This species is characterized by a verrucose-areolate thallus often with vegetative propagules. Isidia are present at the margin of areoles and are darker than the upper cortex, black to unaided eye. The upper surface is often covered with granular colonies of free-living cyanobacteria (*Gleocapsa*) which look like black isidia to the unaided eye. The free cyanobacterial colonies often also occur on thalli of other lichens, and sometimes these individuals are misidentified as isidiate specimens of *V. procopii*. *Verrucaria macrostoma* is similar in the presence of vegetative propagules but differs in the paler thallus with a white medulla and branched-anastomosing periphysoids. The areoles in *V. macrostoma* are angular to irregular in outline and up to 0.4–1.5 mm in diam. *Verrucaria nigrescens* sometimes also forms vegetative propagules but differs in a well-developed black basal layer. Members of the *Verrucaria nigrescens* group often create vegetative propagules. This seems to be dependent on the health condition of thalli and environmental conditions rather than being an individual taxonomic character. The individuals of grazing by snails often in areas damaged form soredia in *V. nigrescens* group. The presence or absence of vegetative propagules is not a good taxonomic character in this group.

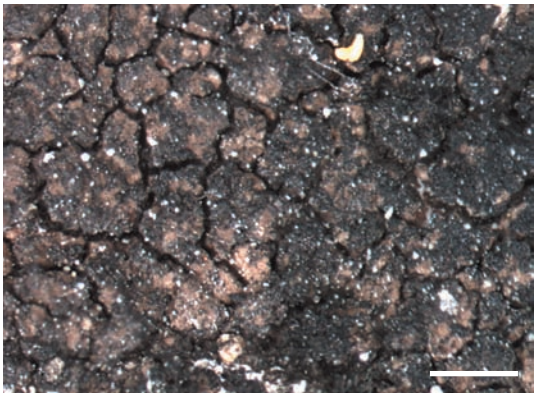

Fig. 46. *Verrucaria procopii* Servít (*Kiszka*, KRAP). Scale bar = 0.5 mm.

HABITAT. On calcareous rocks.

DISTRIBUTION IN POLAND. The species occurs mainly at lower altitudes where it is known from scattered localities in lowlands and uplands. Also known from mountains but at lower altitudes. There have been numerous records from Poland (see Fałtynowicz 2003) but some are incorrect as sterile specimens of other lichens, bearing colonies of cyanobacteria, were mistaken for isidiate specimens of *V. procopii*.

WORLD DISTRIBUTION. Known in Central and southern Europe (Feuerer 2011).

REMARKS. In the protologue Servít (1946; p. 77) mistakenly reported the year 1925 as the collection date of *V. procopii*. All materials deposited in the PRM herbarium and collected by Servít from this locality were collected in 1920. The material collected in 1920 also has hand-written notes '*cotype*' (PRM-857017) and '*sp. org.*' (PRM-765228) on the envelopes probably made by Servít. For this reason both specimens are treated as the type material of *Verrucaria procopii* and the date 1925 in the protologue is treated as a spelling error.

SPECIMENS EXAMINED. DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Ojców National Park, Skała Malasowa, 11 Aug. 2004, *J. Kiszka* (KRAP); EE-83 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Góra Zelejowa nature reserve near Chęciny, 29 July 1951, *Sucharski* (LBL); and 29 July 1951, *J. Rydzak* (LBL); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa near Grybów,7 and 26 July 1926, *J. Motyka* (LBL); FG-14 – Sieniawa by Wisłok river, 340 m, 4 Sept. 1977, *J. Nowak* (KRAM); FG-34 – near Wisłok Wielki, between Kiczera and Tokarnia peaks, 570 m, 19 June 1974, *J. Nowak* (KRAM).

Verrucaria sphaerospora Anzi Fig. 47

Cat. Lich. Sondr.: 110. 1860. TYPE: Anzi, Lich. Rar. Langob. Exs. 240. (TO!, W! – SYNTYPES). – *Dermatocarpon anzianum* Servít, Beih. Bot. Centralbl. **55**(3): 265. 1936. [*non Dermatocarpon sphaerosporum* Lynge *in* Lynge & Scholander, Skrifter om Svalbard og Ishavet **41**: 17. 1932].

Prothallus absent. *Thallus* superficial, areolate to subsquamulose, 0.5–1 mm high, upper surface grey to brownish grey, wrinkled to finely cracked, dull, pruinose or not. Areoles subangular, to crenate at margin, 0.5–2 mm in diam., subdivided into smaller units by fine pale brown cracks, but never by black lines, the upper surface of areoles sometimes granular-verrucose (composed of goniocysts). Sides of areoles in lower part ± dark brown, but in upper part concolourous with the upper surface. *Upper cortex* composed of 1–2 layers of round to angular brown cells. *Algal* layer 100–150 µm thick, algal cells 8–13 µm in diam. *Medulla* in upper part hyaline, paraplectenchymatous, in lower part brown and prosoplectenchymatous with thick hyphae. *Perithecia* one to several per areole, often between smaller units, completely to rarely half-immersed. *Involucrellum* black, 35–50 µm thick, completely encircling the excipulum. *Excipulum* globose, brown to dark brown, 200–300 µm wide. *Periphysoids* 20–30 µm long, simple or sparsely branched. *Asci* oblong-clavate, 60–75 µm long, 13–20 µm wide. *Ascospores* simple, colourless, globose to subglobose, 9–12 × 7.5–10 µm. *Conidiomata* not observed.

NOTE. This species is easily distinguished by the small globose to subglobose ascospores (uniqe in terrestrial *Verrucaria*), a well-developed superficial areolate to subsquamulose thallus, and completely immersed perithecia. In contrast to the genera *Placopyrenium* and *Verrucula*, *V. sphaerospora* has an involucrellum which completely encloses the excipulum and has smaller ascospores.

HABITAT. On limestone, sandstone and siliceous rocks.

DISTRIBUTION IN POLAND. *Verrucaria sphaerospora* was recorded in a small mountain massif, the Gorce Mts, in the Carpathians where it was recorded in the 1960s by K. Glanc and J. Nowak (Nowak & Tobolewski 1975) and confirmed in the same region by Czarnota 30 years later (2002a).

WORLD DISTRIBUTION. Known in Central Europe, from Austria, the Czech Republic, Germany, Italy, Poland, Slovakia and Switzerland (Nimis 1993; Vězda & Liška 1999; Scholz 2000; Hafellner & Türk 2001; Fałtynowicz 2003; Clerc 2004; Lisická 2005).

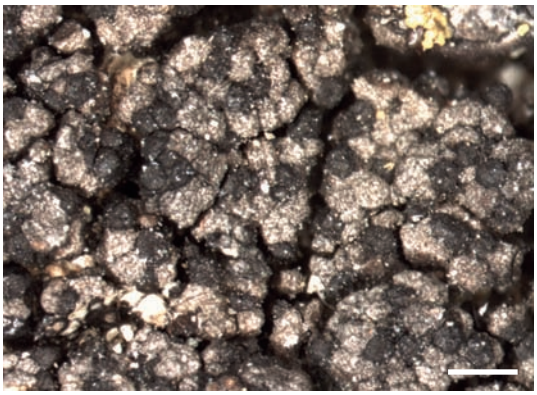

Fig. 47. *Verrucaria sphaerospora* Anzi (Suza, Lich. Bohemoslov. Exs. 274, KRAM). Scale bar = 0.5 mm.

REMARKS. The type material of *V. sphaerospora* (Anzi, Lich. Rar. Langob. Exs. 240) contains three samples collected from different substrates: calcareous rock (240A), serpentine (240B) and granite (240C). The exsiccata contains mixed material, for instance Anzi 240A in W belongs to *Verruculopsis minutum*. For this reason a lectotype should be designated; however, the type material examined here (TO, W) was small and damaged and not suitable as a lectotype. Suza's collection (Suza, Lich. Bohemoslov. Exs. 274) contains a well-developed typical material and can be treated as reference material for this species.

In Poland *V. sphaerospora* was also known under the name *Dermatocarpon anzianum* (Nowak & Tobolewski 1975). The latter name was proposed for this lichen as a *nomen novum* by Servít (1936) because at that time when he transferred this taxon to the genus *Dermatocarpon* the name *D. sphaerosporum* (Lynge & Scholander 1932) already existed.

EXSICCATAE SEEN. Suza, Lich. Bohemoslov. Exs. 274 (as *Dermatocarpon anzianum*) (KRAM).

SPECIMENS EXAMINED. EG-10 – WESTERN BESKIDY MTS, GORCE MTS: by Porębianka stream near Poręba Górna Halamy, 600 m, 26 June 1999, *P. Czarnota* (GPN); EG-22 – S slope of the Tworogów hill, 650 m, 10 Aug. 1965, *K. Glanc* (KRAM); S slope of the Twarogów hill, 750 m, 8 July 1966, *K. Glanc* (KRAM);

Boginka rock, by the valley of Lublański stream, 680 m, 15 Aug. 1967, *K. Glanc* (KRAM); EG-31 – Dębno by the Dunajec river valley, 520 m, 27 July 1967, *J. Nowak* (KRAM); Dębno by the Dunajec river valley, 520 m, 27 July 1968, *K. Glanc* (KRAM).

Verrucaria sublobulata Servít Fig. 48

Stud. Bot. Čech. **11**(1–2): 36. 1950. TYPE: [Czech Republic] Bohemia: Krkonoše, Janské lázně, silic. 1913. *Kuťák* (PRM).

Verrucaria sublobulata var. *robustior* Servít, Věstn. Král. Čes. Společ. Nauk, Praha **4**: 7. 1951. TYPE: [Czech Republic] Bohemia: Rudohoří, Celná, schist., 690 m, 1950 *Servít* (PRM-758641! – HOLOTYPE). Synonymized here.

Prothallus absent or very narrow and inconspicuous, dark. *Thallus* superficial, thick up to 200 µm, non-gelatinous, pale green, green to greenish grey sometimes with dark green tinge, uncracked or deeply cracked, margin typically thinning abruptly, giving well-defined appearance to the thallus, margins occasionally almost lobate. *Upper cortex* weakly defined, colourless. *Algal* layer paraplectenchymatous, not arranged in columns, algal cells in scattered groups, 10–12 µm in diam. *Medulla* proso- to paraplectenchymatous, rarely in part with brown pigment, black basal layer absent. *Perithecia* immersed to semi-immersed, forming low projections 80–120 µm in diam. *Involucrellum* thin, apical in young perithecia, when mature extending downwards, sometimes as far as the thallus base. *Excipulum* colourless, globose, 100–180 µm. *Periphysoids* up to 10 µm long. *Asci* 40–60 µm long, 14–20 µm wide. *Ascospores* 16–20 × 7–10 µm, without halo. *Conidiomata* not observed in the material examined, according to Orange *et al*. (2009) rarely present, pycnidia colourless, 4.5–6 × 1.2 µm.

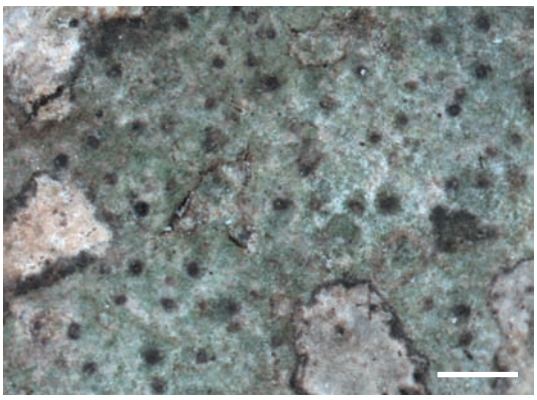

Fig. 48. *Verrucaria sublobulata* Servít (*Krzewicka*, KRAM). Scale bar = 0.5 mm.

NOTE. This amphibious species is easily distinguished from the other freshwater species of *Verrucaria* by the very small perithecia forming low projections (80–120 µm in diam.), or often completely immersed, the lack of black basal layer, and medium sizde ascospores. Morphs with a dark green tinge to the upper surface seem to be mechanical hybrids with *Bacidina inundata*. *Verrucaria submersella* is similar in appearance but differs in the distinctly cracked, pale (usually whitish-grey) thallus with semi-immersed perithecia, a very sharply delimited involucrellum, larger perithecia and larger ascospores (20–32 µm long). *Verrucaria denudata* has a bright green (when wet and fresh) to mid brown (when dry) subgelatinous thallus, the perithecia form mounds covered by a thalline layer (240–560 µm in diam.), and the ascospores are slightly larger [20–25(–26) × 10–12(–15) µm].

HABITAT. Amphibious species occurring on shady siliceous rocks by streams and rivers in the splash zone.

DISTRIBUTION IN POLAND. Reported from scattered sites mainly in the Carpathian Mts and from Central and N Poland; it is probably more frequent in the mountains but it was overlooked in the field.

WORLD DISTRIBUTION. Due to frequent misidentification and the changing concept of this species, the distribution is currently unknown.

REMARKS. The typical form of *V. sublobulata* and the variety *robustior* were recently included into the synonyms of *V. hydrela* (Thüs 2002). However, further revisions have shown that *V. sublobulata* is a well-distinguished taxon (Thüs & Schultz 2008; Orange *et al*. 2009).

Variety *robustior* is a very similar to the typical form and it is placed here in synonymy with *V. sublobulata*. The variety was distinguished by a bright green and thin thallus (up to 200 µm thick)

and perithecia covered with an involucrellum only in the upper part of the excipulum (Servít 1951). However, this material is only a young morph of *V. sublobulata*.

SPECIMENS EXAMINED. BC-22 – POJEZIERZE POŁUDNIOWOPOMORSKIE LAKELAND, RÓWNINA DRAWSKA PLAIN: Drawiński National Park, Stara Węgornia range in valley of the Płociczna river, 8 May 2010, *M. Kukwa* (UGDA, KRAM); DD-68 – WZNIESIENIA POŁUDNIOWOMAZOWIECKIE HEIGHTS, WZNIESIENIA ŁÓDZKIE HILLS: Wzniesienia Łódzkie Landscape Park, on stones in Kammienna stream, 11 July 2006, *M. Hachułka* (LOD); DF-96 – WESTERN BESKIDY MTS, BESKID MAŁY MTS: in stream between Leśniówka and Braniówka in Świnna Poręba village, 400 m, 24 April 1961, *J. Nowak* (KRAM); valley of stream below Leskowiec hill, 27 Aug. 1962, *J. Nowak* (KRAM); in valley of Glinki stream, below Królewizna hill (Królowa Wyżnia), 550 m, 28 Aug. 1961, *J. Nowak* (KRAM); DG-05 – Zakocierz, 650 m, 10 Aug. 1960, *J. Nowak* (KRAM); DG-06 – WESTERN BESKIDY MTS, BESKID ŻYWIECKI MTS: Pasmo Jałowieckie range, Stryszawa-Matusy, in Stryszawka stream, 520 m, 16 Aug. 1965, *J. Nowak* (KRAM); DG-15 – Pilsko range, valley below Przełęcz Przysłopy pass, 700 m, in stream, 17 Sept. 1964, *J. Nowak* (KRAM); DG-33 – Zimna Woda, NE slope of Praszywki, 600 m, 12 Aug. 1964, *J. Nowak* (KRAM); DG-58 – TATRA MTS, WESTERN TATRA MTS: Dolina Chochołowska valley, in Chochołowski stream, 1130 m, 16 July 2004, *B. Krzewicka* (KRAM); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa village, 1954, *J. Motyka* (LBL); FG-20 – Żydowskie village near Krempna village, strem on S slope of Cyrla Mt., 540 m, 21 Sept. 1979, *J. Nowak* (KRAM); FG-23 – Królik Włoski near Królik Polskivillage, 510 m, 11 Oct. 1974, *J. Nowak* (KRAM); FG-44 – Wisłok Wielki Górny village, stream Jamiska on W slope of Pasika Mt., 675 m, 22 June 1974, *J. Nowak* (KRAM); FG-69 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Bieszczadzki National Park, below Szeroki Wierch, upper part of stream Zakopaniec, 906 m, 15 July 2005, *J. Kiszka* (KRAP); in sream by road from Ustrzyki Górne to Wołosate, 780 m, 10 July 2004, *J. Kiszka* (KRAP).

Verrucaria submauroides auct. Fig. 49

non Zschacke, Rabenh. Krypt. Fl. **9**(1/1): 243. 1934.

Prothallus absent. *Thallus* thin, 60–100 µm thick, olive-green, grey-green to mid-brown, uneven, scabrous, bullate, subgelatinous, continuous

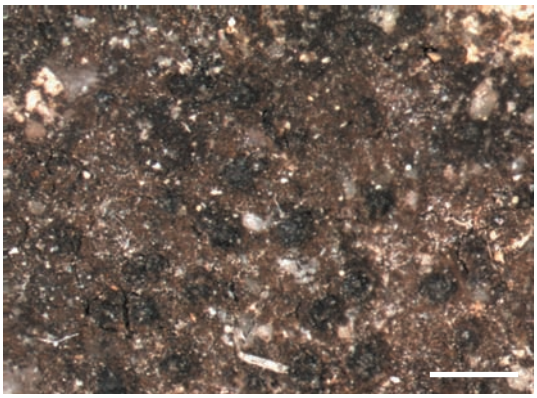

Fig. 49. *Verrucaria submauroides* auct. (*Nowak*, KRAM). Scale bar = 0.5 mm.

with a few cracks or without cracks. *Upper cortex* ill-defined with dull green or in part brown pigment. *Algal* layer paraplectenchymatous, algal cells 10–12 µm in diam. *Medulla* paraplectenchymatous, black basal layer absent. *Perithecia* forming moderate to distinct projections 240–300 µm in diam., half or three-quarters immersed. *Involucrellum* conical, reaching to the base of thallus, laterally spreading into the thallus. *Excipulum* globose, colourless except at apex, 100–200 µm wide. *Periphysoids* up to 20 µm long. *Asci* 70–75 µm long, 23–28 µm wide. *Ascospores* simple, narrowly ellipsoid, (15–)18–23 × 7–9 µm, not halonate. *Conidiomata* not observed.

NOTE. This amphibious species is distinguished from the other freshwater species of *Verrucaria* by a thin and never areolate dark thallus, a conical involucrellum covered by a thin layer of thallus and medium sized ascospores. *Verrucaria andesiatica* differs by having larger ascospores [(22–)24–27 (–30) × 10–14 µm] and a thallus which is rimose to areolate around the perithecia.

HABITAT. Amphibious species occurring on rocks and stones in springs and streams, in shady sites.

DISTRIBUTION IN POLAND. It occurs at scattered localities in the Carpathian Mts (in many mountain ranges: the Beskid Żywiecki Mts, the Beskid Wyspowy Mts, the Gorce Mts and the Bieszczady Mts).

WORLD DISTRIBUTION. Due to the changing concept of this species, the distribution is currently unknown.

REMARKS. This taxon is reported here as *V. submauroides* auct. because the specimens examined differ from the type material of *Verrucaria submauroides* Zschacke (1934), which has smaller ascospores (14–17 × 6–7 µm) and smaller asci (36–42 µm long, 16 µm wide). It is likely that a published name already exists for the taxon described here, but further revision of the genus is necessary.

SPECIMENS EXAMINED. DG-24 – BESKID ŻYWIECKI MTS: Pilsko range, Spotnia Mała, Hala Wieprzska, 1060 m, 25 Sept. 1964, *J. Nowak* (KRAM); DG-29 – GORCE MTS: Sieniawa, in Raba stream on pebbles, 590 m, 7 July 1966, *K. Glanc* (KRAM); EG-01 – BESKID WYSPOWY MTS: Gruszowiec in the valley of Do Uboczy stream near Miśkowce, 760 m, 11 Aug. 1966, *J. Nowak* (KRAM); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa village, 26 July 1926, *J. Motyka* (LBL as *V. andesiatica*); EG-22 – WESTERN BESKIDY MTS, GORCE MTS: in stream Gorcowy by Ochotnica Dolna, 670 m, 12 July 1966, *K. Glanc* (KRAM); FG-69 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: S slope of Stuposiańska Magura near Bereżki, 600 m, 23 Sept. 1958, *K. Glanc* (KRAM).

Verrucaria submersella Servít Fig. 50

Československé Lišenjníky Čeledi Verrucariaceae: 142. 1954. BASIONYM: *Verrucaria submersa* Schaer., Spicil. **7**: 334. 1836. [*non Verrucaria submersa* Borrer *in* Hooker & Sowerby, Suppl. Engl. Bot. **2**: Tab. 2768. 1834]. TYPE: Ad saxa calcaria in agro Neocomensi, unde misit cl. *Chaillet* sub nomine *Verrucaria mucosa* Wahlenb. (hb. ?).

Verrucaria elaeina var. *effusa* Körb., Syst. Lich. Germaniae: 345. 1855. TYPE: [Switzerland] bei Zürich (Hepp, Flechten Eur.: 93, GFW! – SYNTYPE). Synonymized here.

Verrucaria submersa var. *litorea* Hepp, Flechten Eur. No. 438. 1857. TYPE: [Switzerland] An hölzernen Dämmen, am Ufer der Sihl bei Zürich (Hepp, Flechten Eur. 438, GFW! – ISOTYPE). – *Verrucaria litorea* (Hepp) Zschacke, Hedwigia **67**: 84. 1927.

Verrucaria rivalis Zschacke, Hedwigia **67**: 56. 1927. TYPE: Norditiroler Kalkalpen: An Kalksteinen im Seitenbachen unterhalb der Waldrast, 1525 m, Aug. 1871, *F. Arnold* (M! – HOLOTYPE).

Prothallus indistinct. *Thallus* non-gelatinous, superficial to semi-endolithic, thin, 50–150 µm thick, dirty white to yellowish green when wet, cracked into flecks, at margin not adhering to substrate but slightly elevated when dry. *Upper cortex* ill-defined, 5–25 µm thick, upper surface scabrous. *Algal* layer prosoplectenchymatous, algal cells 4–10 µm in diam, arranged in groups. *Medulla* proso- to paraplectenchymatous, black basal layer absent. *Perithecia* half or three-quarters immersed in the thallus, forming moderate projections raised above the thallus, (150–)250–350 µm in diam., naked in the upper part, forming shallow pits in the substrate. *Involucrellum* present, in the upper half of the excipulum, rarely reaching to the thallus base, appressed to the excipulum or slightly laterally spreading into the thallus, apical part naked. *Excipulum* colourless to pale brown, 200–300 µm wide. *Periphysoids* up to 20 µm long. *Asci* 65–85 µm long, 23–30 µm wide. *Ascospores* ellipsoid, (20–)24–32 × 9–14 µm, without halo. *Conidiomata* not observed.

NOTE. This amphibious species is characterized by a thin superficial to semi-endolithic dirty white to yellowish green cracked thallus without a black basal layer, and by large ascospores. *Verrucaria cernaensis* differs in a thicker thallus, smaller ascospores [18–22(–25) × 8–14 µm], a black excipulum and habitat on siliceous rocks. *Verrucaria praetermissa* and *V. funckii* differ by the presence of a black basal layer. *Verrucaria aquatilis* and *V. madida* differ by the distinctly smaller ascospores (less than 16 µm long) and a darker thallus (blackish). *Verrucaria sublobulata* has a similar colour of thallus but differs in distinctly smaller perithecia nearly completely immersed in the thallus, forming low projections 80–120 µm in diam. *Verrucaria denudata* and *V. margacea* differ in the smooth, continuous thallus only sporadically with some cracks around perithecia. *Verrucaria latebrosa* has a thicker and usually darker thallus (greyish brown or brownish in Poland), though elsewhere whitish grey forms (= *V. anziana*) have been observed (H. Thüs *in litt.*), which is more regularly cracked, with the

never forming shallow pits in the substrate, and with halonate ascospores.

HABITAT. Amphibious species occurring in the splash zone on limestone and dolomite mainly in shady places. Also recorded on siliceous rocks and pebbles in streams with hard, well-buffered water (see Thüs & Schultz 2008).

DISTRIBUTION IN POLAND. It occurs at scattered localities in southern Poland in the Carpathian Mts and in the central part in the Wyżyna Krakowsko-Wieluńska upland. A poorly-known species in Poland, previously reported from Silesia by Körber (1855) under the name *V. elaeina* var. *effusa*, from the Tatra Mts by Motyka (1924b) as *V. submersa* and recently as *V. submersella* from the Beskid Niski Mts (Krzewicka 2009b).

WORLD DISTRIBUTION. It is known in Central Europe (Thüs & Schultz 2008).

REMARKS. *Verrucaria elaeina* var. *effusa* is synonymized here with *V. submersella*. Zhalbruckner (1922) considered *Verrucaria elaeina* var. *effusa* to be a likely synonym of *V. submersa*. Zschacke (1933) later reported Hepp's exsiccatae no. 93 (M) as reference material of *V. submersa*. Likewise specimens of Hepp's exsiccatae no. 93 in GFW examined in this study are the typical form of *V. submersella*. For this reason var. *effusa* is included in the synonymy of *V. submersella*.

Verrucaria litorea was distinguished at species level by Zschacke (1927) based on the atypical substratum of submerged wood. Thüs (2002) and Thüs & Schultz (2008) synonymised this taxon with *V. latebrosa*. The type material (GFW) examined here confirms this; both taxa are have a white to yellowish green, cracked, semi-endolithic thallus a lacking black basal layer, and large ascospores.

Thüs and Schultz (2008) listed *Verrucaria rivalis* as an 'uncertain taxon' within *V. submersella*. The specimens of *V. rivalis* have larger ascospores than those observed in *V. submersella*. Morphs of *V. submersella* with large ascospores were also often found in the material from Poland (longer than 25 µm). These morphs have a typical appearance, with a dirty white to yellowish green thick thallus cracked into flecks. *Verrucaria rivalis* agrees with *V. margacea* in the very thin thallus which rarely has a few cracks, but a semi-endolithic thallus is never present in *V. margacea* although it occurs in *V. submersella* and in *V. rivalis*. For this reason following Thüs and Schultz (2008) it is listed as an uncertain taxon within *V. submersella*.

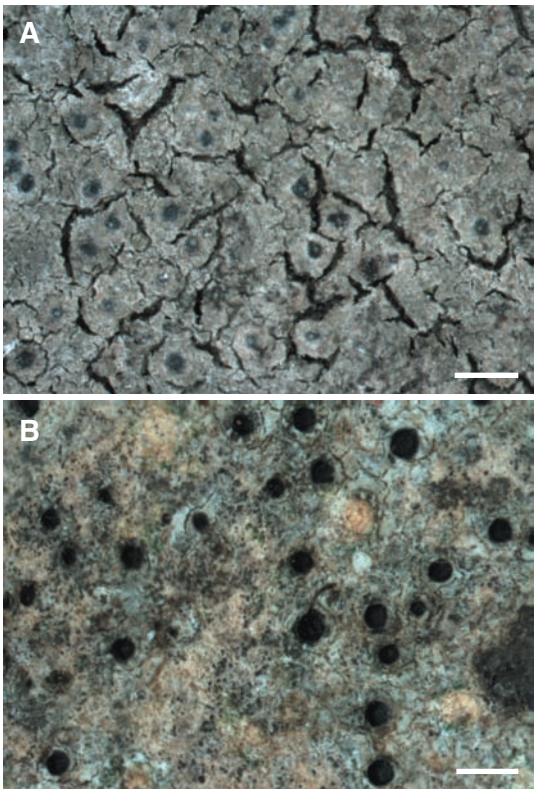

Fig. 50. *Verrucaria submersella* Servít. A & B – thallus (*Nowak*, KRAM; B – Hepp, Flechten Eur. 93, GFW, as *Verrucaria elaeina* var. *effusa* Körb., syntype). Scale bars = 0.5 mm.

SPECIMENS EXAMINED. DE-51 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Lisowice near Działoszyn, on calcareous rock in stream, 30 May 1963, *J. Nowak* (KRAM); DG-06 – WESTERN BESKIDY MTS, BESKID ŻYWIECKI MTS: Jałowiec range, Matusy by Stryszawa, in stream, 520 m, 16 Aug. 1965, *J. Nowak* (KRAM); EG-00 – BESKID ŚREDNI MTS: Pcim Mała Suszanka stream, 390 m, 24 Aug. 1996, *J. Nowak* (KRAM); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa village, 21 July 1926 and 1954, *J. Motyka* (LBL); FG-45 –

Osławica village, on bank of Osławica river, 520 m, 21 June 1974, *J. Nowak* (KRAM); FG-58 – Eastern Beskidy Mts, Western Bieszczady Mts: Bieszczadzki National Park, N slope of Połonina Wetlińska, below Średni Wierch, in stream, 26 Aug. 1995, *J. Kiszka* (KRAP); FG-68 – Bieszczadzki National Park, stream in Wielki Lutowy valley, 24 July 2000, *J. Kiszka* (KRAP); FG-69 – Bieszczadzki National Park, Brzegi Górne, in stream, 13 July 2003, *J. Kiszka* (KRAP).

Verrucaria tectorum (A. Massal.) Körb. Fig. 51

Parerg. Lich.: 368. 1863. – *Lithoicea tectorum* A. Massal., Symmict. Lich.: 91. 1855. Type: [Italy] Ad tegulas lateritias in prov. Veronensi (Tregnago), *Massalongo* (Anzi, Lich. Rar. Veneti 156, TO!, W! – topotypes). – *Verrucaria nigrescens* f. *tectorum* (A. Massal.) Coppins & Aptroot, Lichenologist **40**(5): 372. 2008.

Prothallus dark. *Thallus* superficial, well-developed, 280–700(–1000) µm thick, cracked into areoles of different size, separated by more or less deep cracks, mature areoles 0.3–1.1 mm in diam., neighbouring areoles of different thickness, polygonal to rounded in outline, uneven or slightly rugose, upper surface of areoles brown to dark brown. Vegetative propagules (soredia) sometimes present, dark brown to black, marginal, round, 50–160 µm in diam., darker than upper cortex. *Upper cortex* 2–3-layered, paraplectenchymatous, 20 µm thick, the uppermost part dark brown. *Algal* layer paraplectenchymatous, 70–100(–200) µm thick, algal cells 5–10 µm in diam., discontinuous, divided into smaller photosynthetic units by columns of darkly pigmented medulla. *Medulla* upper part paraplectenchymatous, colourless, lower part dark brown prosoplectenchymatous, sometimes the pigmented part of medulla reaches the upper surface. Black layer present, algal layer divided into two parts, upper and lower. New thalli often overgrowing older areoles (so that an older and younger black layer may be visible in section). *Perithecia* rare, entirely immersed in the thallus. *Involucrellum* well-developed, dark brown, reaching to the base of excipulum, often fusing with a black basal layer. *Excipulum* brown, subglobose 170–190 µm wide. *Periphysoids* 35 µm long. *Ascospores* simple, ellipsoid, 18–24 × 10–12 µm, according to Massalongo (1855a). *Conidiomata* not observed in the material examined; according to Christiansen and Roux (1987) pycnidia 60–75 µm in diam. immersed in the thallus, conidia bacilliform, 1–1.5 × 0.5 µm.

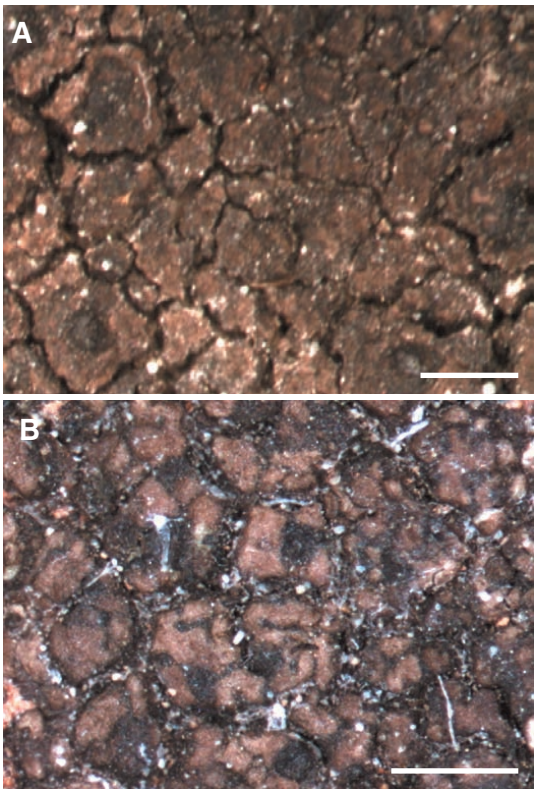

Fig. 51. *Verrucaria tectorum* (A. Massal.) Körb. A & B – thallus (A – *Kiszka*, KRAM; B – Anzi, Lich. Rar. Veneti 156, W, as *Lithoicea tectorum* A. Massal., topotype). Scale bars = 0.5 mm.

Note. This species is characterized by neighbouring areoles of different thickness and a black basal layer; there may appear to be a second black layer within the thallus, due to new thalli overgrowing older ones. *Verrucaria polysticta* also has photosynthetic units but differs in its parasitic habit. *Verrucaria cataleptoides* also has an areolate thallus but the fertile areoles are thicker, but differs by lacking a black basal layer and having a pale brown thallus. *Verrucaria macrostoma* differs in the thicker and paler thallus, absence of a black basal layer, slightly larger ascospores, and branched-anastomosing periphysoids. *Verrucaria nigrescens* is similar to *V. tectorum* but differs in

the well-developed black basal layer in the thallus, often occupying half or two-thirds of the thallus thickness.

HABITAT. On bricks and calcareous rocks, probably a ruderal species. *Placopyrenium fuscellum* has been observed growing on the thallus.

DISTRIBUTION IN POLAND. *Verrucaria tectorum* was confirmed from scattered localities throughout Poland. It was also reported from Kraków (Kiszka & Kościelniak 1996) and from the Białowieża forest (Sparrius 2003). No specimens were found to support these records.

WORLD DISTRIBUTION. Reported in Europe from many countries (Feuerer 2011); however, this material should be revised.

REMARKS. Coppins and Aptroot (2008) reported this taxon at form level in *Verrucaria nigrescens* species. They treated this taxon as a blastidiate morph of *V. nigrescens* based on the same colour and a similar thickness of the thallus. Nordin *et al*. (2010) distinguished this taxon at species level. However, it is very likely that this taxon is a morph of *V. nigrescens* growing in suboptimal environmental conditions (substrate poor in calcium carbonate). For this reason it occurs mainly as a non-sexual producing vegetative propagules. Molecular studies should clarify the relationship between the taxa.

SPECIMENS EXAMINED. CC-42 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE GNIEŹNIEŃSKIE LAKELAND: between Wapno and Podolin, 12 April 1930, *F. Krawiec* (POZ); CD-42 – POJEZIERZE POZNAŃSKIE LAKELAND: Ludwikowo near Poznań, 11 April 1935, *F. Krawiec* (POZ); DC-50 – RÓWNINA INOWROCŁAWSKA PLAIN: Podgaj near Aleksandrów Kujawski, 18 July 1996, *M. Ceynowa-Giełdon* (TRN); EG-50 – TATRA MTS, WESTERN TATRA MTS: Dolina Bystrej, Polana Kalatówki, 26 Aug. 1927, *J. Motyka* (LBL); GF-32 – ROZTOCZE, EASTERN ROZTOCZE: Dziewięcierz, Jałowiec nature reserve, 25 July 1991, *J. Kiszka* (KRAM).

Verrucaria tristis (A. Massal.) Kremp. Fig. 52

Flora **40**: 376. 1857. – *Lithoicea tristis* A. Massal., Atti I.R. Istit. Veneto, Reihe 3, **2**: 378. 1857. TYPE: [Germany] Ad saxa in Franconia et Algovia, *D. Rehm* (hb. ?).

Prothallus present, dark brown. *Thallus* superficial, continuous or inapparent, marginally very thin, often without distinct outline, at centre thicker and cracked to minutely areolate, areoles 0.3–0.5 mm in diam., dirty brown (black to unaided eye). *Upper cortex* a eucortex, 40–50 µm, outer layer with cell walls dark pigmented yellowish brown to brown, inner layer colourless. *Algal* layer continuous, uniformly scattered, 50–100 µm thick, algae cell 5–10 µm in diam. *Medulla* ill-defined, without black basal layer. *Perithecia* forming shallowly convex to conical-hemispherical projections (200–)300–450 µm wide. *Involucrellum* thick, present around upper half of excipulum. *Excipulum* pale brown to brown, globose, 200–350 µm wide. *Periphyses* 20 µm long, periphysoids 15–20 µm long. *Asci* 40–60 µm long, 18–20 µm wide. *Ascospores* simple, colourless, globose to broadly ellipsoid 8–10(–14) × 6–8.5 µm, with a thick wall up to 1 µm. *Conidiomata* rare, conidia straight or curved, 5–10 × 0.5 µm.

NOTE. This species is characterized by a dark brown superficial thallus without a distinct outline which is black to the unaided eye, often with a few cracks at centre but not regularly areolate, without a black basal layer, and by the prominent half-immersed perithecia and small ascospores. *Verrucaria nigrescens* and *V. polysticta* differ by having a black basal layer and larger oblong-ellipsoid to ellipsoid ascospores. *Verrucaria acrotella* auct. is similar in the presence of a dark brown superficial thallus without a distinct outline and the absence of an areolate thallus but differs by having a thallus composed of small granules, and by the longer, ellipsoid ascospores [12–17(–22) × 7.5–9(–10) µm]. *Verrucaria macrostoma* has a pale brown to brown regularly areolate thallus and bigger ascospores (20–)25–32) × 10–15) µm.

HABITAT. On calcareous rocks including calcareous sandstone.

DISTRIBUTION IN POLAND. Reported from the Western Tatra Mts in the Carpathians, probably more frequent but overlooked in the field as *V. nigrescens* or a dead lichen. *Verrucaria tristis* was first reported by Motyka (1924b, 1927)

from the Tatra Mts. However, these specimens were incorrectly determined and they belong to *V*. *tectorum*. Other herbarium materials reported as *V*. *tristis* from the Pieniny Mts (Tobolewski 1955a, 1958; Kiszka 1997a) were not available in the herbaria and were not confirmed. At present the specimens of *V*. *tristis* were found only in the Tatra Mts in an indeterminate collection of J. Motyka (LBL) and in collection of J. Nowak (KRAM).

World distribution. Known from southern and central European mountains (Scholz 2000; Llimona & Hladun 2001; Hafellner & Türk 2001; Nimis & Martellos 2003; Clerck 2004; Lisická 2005).

Remarks. The Arnold's exsiccatae collection no. 364 B following Zschacke (1933) is treated as a referable material of *V*. *tristis* (Massalongo 1857).

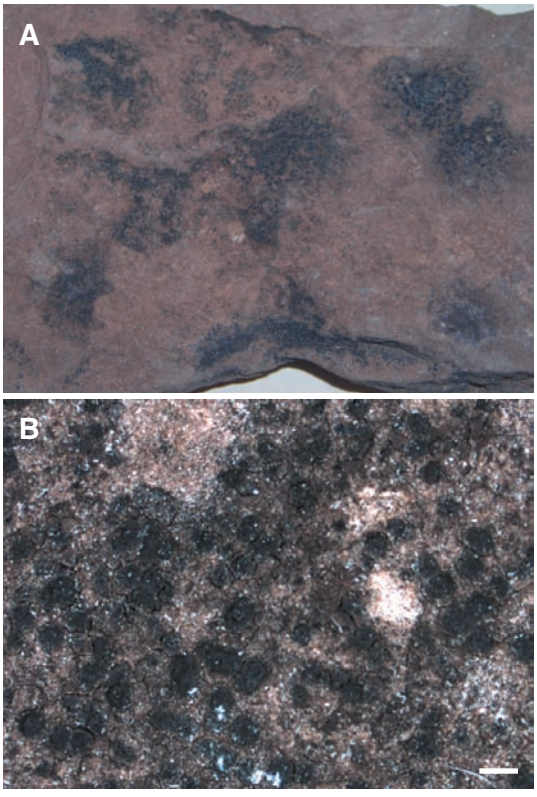

Fig. 52. *Verrucaria tristis* (A. Massal.) Kremp. A – habit; B – thallus (A & B – Arnold, Lich. Exs. Lich. Jur. 364B, W). Scale bar = 0.5 mm.

Exsiccatae seen. Arnold, Lich. Exs. Lich. Jur. 364B (as *Lithoicea tristis*) (W).

Specimens examined. EG-50 – Tatra Mts, Western Tatra Mts: Dolina Bystrej, Polana Kalatówki, 23 Aug. 1927, *J. Motyka* (LBL); Kalacka Turnia, 1350 m, 21 May 1959, *J. Nowak* (KRAM); EG-59 – Giewont, S-slope above Dolina Kondratowa valley, 1700 m, 24 May 1959, *J. Nowak* (KRAM); Czerwony Żleb above Hala Tomanowa below, on calcareous rocks, 1600 m, 13 June 1963, *J. Nowak* (KRAM); Hala Kondratowa below Giewont, on calcareous rocks, 1500 m, 24 May 1959, *J. Nowak* (KRAM); Hala Tomanowa, on dolomite rocks, 1500 m, 13 June 1963, *J. Nowak* (KRAM); Wąwóz Kraków, 1600 m, 10 June 1963, *J. Nowak* (KRAM).

Verrucaria umbrinula Nyl. Fig. 53

Flora **53**: 37. 1870. Type: Ad saxa in Lapponia, *Norrlin* (probably kept in H).

Prothallus sometimes visible, black. *Thallus* superficial, moderately thick, 70–200 µm high, dark brown to black, minutely cracked-areolate, to areolate. Areoles 0.05–0.25 mm wide, slightly convex, upper surface scabrous. *Upper cortex* paraplectenchymatous, 10–20 µm thick, the uppermost part brown. *Algal* layer 30–120 µm thick, algal cells 5–10 µm in diam., arranged in ill-visible vertical columns. *Medulla* white with a black basal layer continuous or often discontinuous. *Perithecia* half to three-quarters immersed in thallus, forming hemispherical prominent projections 200–250 µm in diam., one per areole rarely 2 or 3, fertile areoles distinct convex. *Involucrellum* black, 35–50 µm thick, completely encircling the excipulum. *Excipulum* dark brown, globose, 180–200 µm wide. *Periphysoids* 20 µm long. *Asci* 40–45 µm long, 12–15 µm wide. *Ascospores* simple, colourless, ellipsoid, 16–18(–20) × 6–8 µm. *Conidiomata* not observed.

Note. Characterised by the dark brown to black, minutely cracked-areolate thallus with a continuous or discontinuous black basal layer present. *Verrucaria nigrescens* and *V*. *tectorum* also have a black basal layer but they differ in their habitat on calcareous substrata.

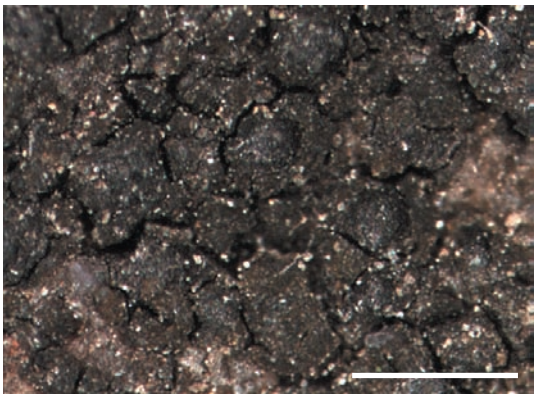

Fig. 53. *Verrucaria umbrinula* Nyl. (*Ceynowa-Giełdon*, TRN). Scale bar = 0.5 mm.

HABITAT. On siliceous and non-calcareous rocks, found also on mylonite rock, in places exposed to the sun.

DISTRIBUTION IN POLAND. Reported from a few scattered sites in Poland; mainly in lowlands of central and northern Poland, less frequent in the south where it was recorded in the mountains.

WORLD DISTRIBUTION. Known in Europe from many localities, such as from Fennoscandia, Denmark, Estonia, Germany, Austria, France and Romania (Feuerer 2011).

REMARKS. The description of this species follows Zschacke (1933) and Servít (1954).

SPECIMENS EXAMINED. BC-78 – PRADOLINA TORUŃSKO-EBERSWALDZKA SPILLWAY, KOTLINA GORZOWSKA BASIN: Oborniki, 7 May 1935, *F. Krawiec* (POZ); CC-08 – DOLINA DOLNEJ WISŁY VALLEY, DOLINA FORDOŃSKA VALLEY: Starogród near Chełmno, 19 July 1996, *M. Ceynowa-Giełdon* (TRN); CD-42 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE POZNAŃSKIE LAKELAND: Ludwikowo near Poznań, 11 April 1935, *F. Krawiec* (POZ); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa village, 21 July 1926, *J. Motyka* (LBL); EG-60 – TATRA MTS, HIGH TATRA MTS: Hińczowa Przełęcz pass, on mylonite rock, 2323 m, 1 Aug. 2003, *A. Flakus 1143* (KRAM); FB-19 – POJEZIERZE LITEWSKIE LAKELAND, POJEZIERZE WSCHODNIOSUWALSKIE LAKELAND: Wigry National Park, Stary Folwark, on granite rock, 14 Sept. 1984, *J. Nowak* (KRAM).

Verrucaria viridicans Servít Fig. 54

Stud. Bot. Čech. **9**(2–4): 109. 1948. TYPE: Hungaria, Veszprém, Bakonybél, Hogyskö, 300 m, 1925, *Gvelnik* (PRM! – HOLOTYPE).

Prothallus absent. *Thallus* semi-endolithic to endolithic, 100–200(–300) µm thick, continuous, never areolate, sometimes a few cracks by perithecia, upper surface scabrous, dull, dirty greenish white to brownish. *Upper cortex* absent. *Algal* layer discontinuous or continuous, 40–60 µm high, algal cells 6–8 µm in diam. *Perithecia* entirely immersed in the thallus in well-defined pits in rocks, often fused in groups of 2–3. *Involucrellum* absent. *Excipulum* dark brown, globose 170–250 µm wide. *Periphysoids* up to 25 µm long. *Asci* 55–65 µm long, 17–20 µm wide. *Ascospores* colourless, simple, ellipsoid, 16–21 × 7–10 µm. *Conidiomata* not detected in examined material.

NOTE. This species is characterized by more or less endolithic thallus, entirely immersed perithecia fused in groups of 2–3. The perithecia have dark brown globose excipulum without involucrellum. The other species with perithecia growing in groupsof 2–3, *V. polonica*, differs in the presence of an involucrellum, the half to rarely three-quarters immersed perithecia, K/I+ thallus hyphae, and presence of macrospheroids.

HABITAT. On limestone.

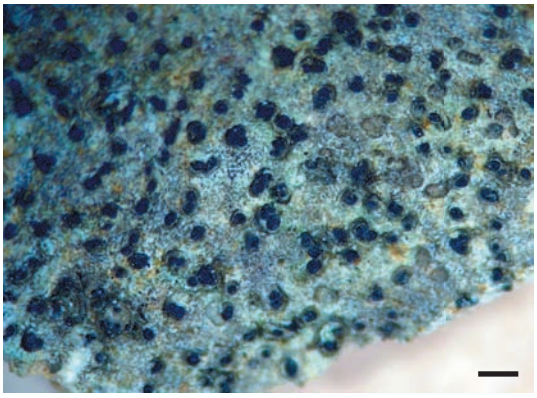

Fig. 54. *Verrucaria viridicans* Servít (*Gvelnik*, PRM, holotype). Scale bar = 0.5 mm.

DISTRIBUTION IN POLAND. Occurs on the Wyżyna Krakowsko-Wyżyna Wieluńska upland.

WORLD DISTRIBUTION. Poorly known species, recognized only in Central Europe, including Hungary (Servít 1948), Poland (Nowak 1961, 1967).

REMARKS. It is very likely that an older name for this species exists. The taxonomy of the *Verrucaria* lacking an involucrellum (= *Amphoridium* gr.) is not yet clarified and needs further studies.

SPECIMENS EXAMINED. DF-27 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA CZĘSTOCHOWSKA UPLAND: Ryczów near Ogrodzieniec, 16 April 1958, *J. Nowak* (KRAM); DF-58 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Ojców National Park, Wąwóz Korytnia, 12 May 2004, *J. Kiszka* (KRAP).

Verrucaria viridula (Schrad.) Ach. Fig. 55

Meth. Lich. Suppl.: 16. 1803. – *Endocarpon viridulum* Schrad., Spicil. Flor. German.: 192. 1794. TYPE: Ad saxa arenaria in Germania (H-ACH 819 – LECTOTYPE, designated by Christiansen & Roux 1987).

Verrucaria papillosa Ach., Lich. Univ.: 286. 1810. TYPE: Habitat in saxis calcariis durioribus Helvetiae. *Schleicher* (H-ACH – HOLOTYPE).

Amphoridium viridulum (Ach.) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 41. 1954.

Verrucaria polygonia Körb. Parerga: 377. 1863. – *Amphoridium polygonium* (Körb.) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 42. 1954.

Verrucaria silvatica Zschacke, Rabenh. Krypt.-Fl. **9**(1/1): 139. 1933.

Prothallus whitish. *Thallus* more or less immersed, whitish, pale grey or greenish grey, or reaching the surface as as brownish flecks, or superficial, pale brown, divided by cracks. *Perithecia* half- to almost completely immersed in thallus, appearing as convex to conical-hemispherical projections 150–500 μm wide, the base immersed in the substrate. *Involucrellum* variably developed, almost absent to more or less well-developed and spreading from apex of excipulum, to more or less appressed to upper half of exciple or slightly spreading, pigment like excipulum. *Excipulum* dark brown throughout, K+ darker brown, 350–400(–600) μm wide, apex somewhat produced into a short beak (ostiolar canal distinctly elongated). *Asci* 65–110 μm long, 25–40 μm wide. *Ascospores* simple, ellipsoid to broadly ellipsoid, 28—34(–40) × 15–20(–23), halo sometimes apparent, to 0.5 μm thick. *Conidiomata* pycnidia appearing as dark dots to 60 μm wide or more, conidia straight to slightly curved, 7–10 × *ca* 1 μm.

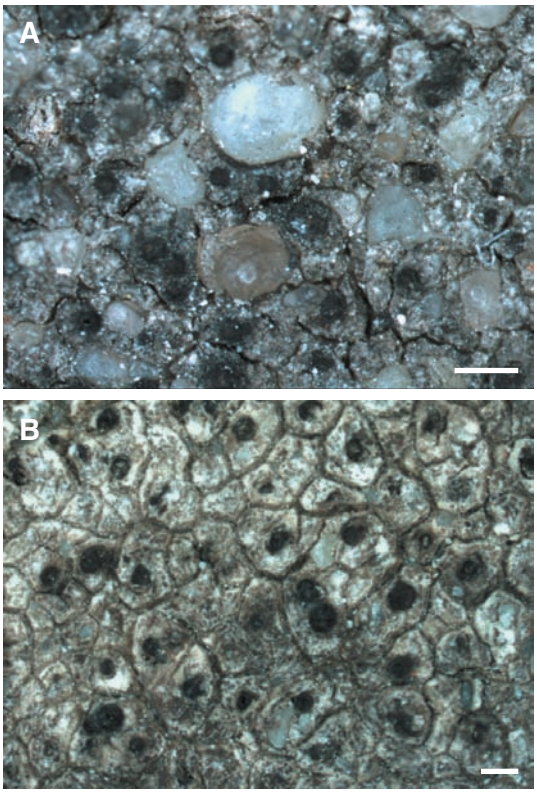

Fig. 55. *Verrucaria viridula* (Schrad.) Ach. A & B – thallus (A – *Cieśliński*, KTC; B – Hepp, Flechten Eur. 91, GFW). Scale bars = 0.5 mm.

NOTE. This species is characterized by the large perithecia with elongated ostiolar canal, pigmented excipulum and large ascospores. *Verrucaria hochstetteri* also has large ascospores [(25–)30–32(–40) × 15–20(–23) μm] but differs in the always endolithic thallus, the absence of involucrellum and perithecia often surrounded by collar of thallus. *Verrucaria macrostoma* [(20–)25–32 × 10–15 μm] and *V. nigrescens* [(17–)20–28(–30) × 8–15 μm] have somewhat shorter and narrower ascospores,

and a brown areolate-cracked thallus. *Verrucaria cincta* has distinctly narrower ascospores [(20–) 22–28(–32) × 7–9 µm] and a white endolithic thallus with superficial perithecia often slightly pruinose at the base.

HABITAT. On calcareous rock, including limestone, mortar, brick and sandstone with calcium carbonate.

DISTRIBUTION IN POLAND. Throughout the country.

WORLD DISTRIBUTION. Known throughout Europe, and on other continents (Feuerer 2011).

REMARKS. The synonyms are listed following Christiansen and Roux (1987) and Orange (2004c).

EXICCATAE SEEN. Hepp, Flechten Eur. 91 (GFW); Rabenhorst, Lich. Europ. Exs. 875 (TO); Rabenhorst, Lich. Europ. Exs. 572 (as *Verrucaria papillosa*) (KRAM).

SPECIMENS EXAMINED. CA-87 – POJEZIERZE WSCHODNIOPOMORSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Kartuzy, 4 Aug. 1934, *F. Krawiec* (POZ); DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Dolina Prądnika valley near Ojców, 4 Aug. 2004, *J. Kiszka* (KRAP); EG-17 – MIDDLE BESKIDY MTS, BESKID NISKI MTS: Kąclowa village, 21 July 1926, *J. Motyka* (LBL); EG-32 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Biała Woda nature reserv, on calcareous rock, 605 m, 3 June 1999, *J. Kiszka* (KRAP); FC-86 – NIZINA PÓŁNOCNOPODLASKA NIZINA, WYSOCZYZNA DROHICKA PLATEAU: Granne, on wall, 8 May 1987, *S. Cieśliński* & *Z. Tobolewski* (KTC).

Verrucaria xyloxena Norman Fig. 56

Botaniska Notiser 1867: 87. 1867. TYPE: [Norway] in insula Tromsö ad ligna particulis terries conspurcata, *J. M. Norman* (H! – TOPOTYPE). – *Thelidium xyloxenum* (Norman) Norman, Botaniska Notiser 1872: 38. 1872.

Verrucaria melaenella Vain., Acta Soc. Fauna Flora Fenn. **49**: 44. 1921. TYPE: Finland, Ostrobotnia borealis, Simo, Tiurasenkrunni, kalkkisoralla, 14 June 1920, *V. Räsänen* (TUR-Vanio 30216! – HOLOTYPE, TUR-Vanio 30215! – ISOTYPE).

Verrucaria velutinoides Hellb., Nerik. Laffl.: 132. 1871. TYPE: [Sweden], Nerike, Glanshammar vid Skala [kalkjord ödelagda blyglansgrufva], *P. J. Hellbom* (S! – HOLOTYPE). – *Thelidium velutinoide* (Hellb.) Servít, Stud. Bot. Čech. **11**(3): 138. 1950. – *Involucrothele velutinoides* (Hellb.) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 185. 1954.

Verrucaria acrotella f. *terrestris* Arnold, Verh. Zool. Bot. Ges. Wien **37**: 109. 1887. TYPE: [Italy] Auf Erde bei Paneveggio, 1884, *Lojka* (Zwackh, Lich. Exs. 924, M – ISOTYPE). – *Verrucaria terrestris* (Arnold) Vain., Acta Soc. Fauna Flora Fenn. **49**: 66. 1921., *nom. illeg*., [*non Verrucaria terrestris* (Th. Fr.) Tuck., Genera Lichen.: 270. 1872].

Prothallus sometimes visible, brown. *Thallus* on soil, rarely on soil-impregnated wood, brown to blackish brown or almost black, thin, indistinct to granular-areolate, composed of goniocyst-like units 15–35 µm in diam. *Upper cortex* absent or weakly differentiated, the uppermost layer of cells often with brownish to olive-black pigments. *Algal* layer arranged in goniocysts, algae cells isodiametric to broadly rectangular, 5–12 × 4–9 µm in diam., hyphal walls thickened, sometimes up to 1 µm thick, brown pigmented on exposed side of goniocysts. *Medulla* composed of loose hyphae, arachnoidal prosoplectenchymatous, hyphae up to 2.5 µm thick. *Perithecia* numerous, one-third to three quarters immersed, black, ± spherical to broadly ovoid, 170 µm wide, with paler easily-visible ostiole. *Involucrellum* absent. *Excipulum* dark brown to black, pigmented throughout, 25–40 µm thick at sides and base, 150–220 µm wide. *Periphysoids* branched (25–)30–36 µm long. *Asci* 50–60(–75) µm long, 16–21 µm wide. *Ascospores* simple, rarely 1-septate, 15–21 × 5–7 µm. *Conidiomata* not detected.

NOTE. Only two terricolous species of *Verrucaria* (*V. xyloxena* and *V. bryoctona*) are known in Poland. *Verrucaria xyloxena* differs from *V. bryoctona* in a brown to blackish brown thallus, a dark brown to black excipulum throughout (pale at base in *V. bryoctona*), and smaller ascospores. Other terricolous species occurring in Europe are easily distinguished by different spore sizes. *Verrucaria navarrense* Breuss & Etayo has smaller ascospores (12–15 × 6–7 µm) (Breuss & Etayo 1995) and a pale brown minutely cracked-areolate thallus,

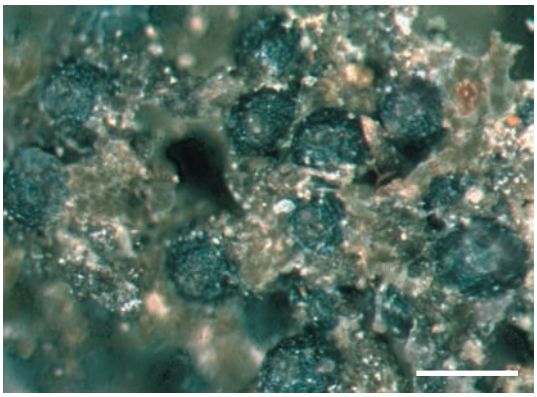

Fig. 56. *Verrucaria xyloxena* Norman (*Ceynowa-Giełdon*, KRAM). Scale bar = 0.5 mm.

V. geophila Zahlbr. has larger ascospores (20–36 × 12–16 µm) and a greenish grey thallus (Nimis & Martellos 2004), and *V. sibirica* Zahlbr. differs in small ascospores (13–14 × 6–7 µm), smaller asci (34–36 µm long) and a blackish brown thallus (Orange 1991).

HABITAT. Usually on basic soil, rarely on soil-impregnated wood.

DISTRIBUTION IN POLAND. Reported from many scattered localities in Poland; mainly in lowlands of Central and northern Poland, less frequent in the south where it was recorded in the mountains at a few scattered localities. It is probably more frequent but overlooked. Confirmed records from the Białowieża old-growth forest (Cieśliński & Tobolewski 1988, as *Thrombium epigaeum*; Cieśliński 2003; Czyżewska *et al*. 2001), the Kujawy region (Ceynowa-Giełdon 1996, 1998, 2001), the Góry Świętokrzyskie Mts (Toborowicz 1983), the Tarnobrzeg area (Kiszka 1997b) and the Bieszczady Mts (Kiszka & Kościelniak 2002, as *V. bryoctona*; Kościelniak 2004).

WORLD DISTRIBUTION. Reported from Great Britain, Sweden, Italy, Russia (Orange 1991, Nimis & Martellos 2004).

REMARKS. The synonyms follow Orange (1991).

EXSICCATAE SEEN. Vězda, Lich. Sel. Exs.1151 (as *Verrucaria melaenella*) (KRAM).

SPECIMENS EXAMINED. AE-89 – WESTERN SUDETES, KARKONOSZE MTS: Karkonosze National Park, Równia Pod Śnieżką, 1430 m, *P. Czarnota* (GPN); CA-99 – POJEZIERZE WIELKOPOLSKIE LAKELAND, POJEZIERZE KASZUBSKIE LAKELAND: Kolbudy near Gdańsk, 11 July 2000, *M. Ceynowa-Giełdon* (TRN); CB-05 – near Kościerzyna, 25 Aug. 1997, *M. Ceynowa-Giełdon* (TRN); CB-15 – Rybaki 25 Aug. 1997, *M. Ceynowa-Giełdon* (TRN); CB-17 – Barkoczyn near Kościerzyna, 23 Aug. 1999, *M. Ceynowa-Giełdon* (TRN); CB-27 – POJEZIERZE WSCHODNIO-POMORSKIE LAKELAND, POJEZIERZE STAROGARDZKIE LAKELAND: Chwarzenko near Stara Kiszewa, 24 July 1997, *M. Ceynowa-Giełdon* (TRN); CB-52 – POJEZIERZE POŁUDNIOWOPOMORSKIE LKELAND, RÓWNINA CHARZYKOWSKA PLAIN: Polnica near Chojnice, 18 Oct. 1999, *M. Ceynowa-Giełdon* (TRN); CC-24 – PRADOLINA TORUŃSKO-EBERSWALDZKA SPILLWAY, KOTLINA TORUŃSKA BASIN: between Gorzeń and Łochowicw, 29 Sept. 1999, *M. Ceynowa-Giełdon* (TRN); CC-27 – Bydgoszcz-Fordon, 6 Aug. 1998, *M. Ceynowa-Giełdon* (TRN); DB-00 – POBRZEŻE GDAŃSKIE COASTLAND, VISTULA MARSHLAND: Pszczółki near Tczew, 21 Aug. 1997, *M. Ceynowa-Giełdon* (TRN); DB-35 – POJEZIERZE WSCHODNIO-POMORSKIE LAKELAND, POJEZIERZE IŁAWSKIE LAKELAND: Dzierzgoń, 23 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DC-06 – POJEZIERZE CHEŁMIŃSKO-DOBRZYŃSKIE LAKELAND, POJEZIERZE DOBRZYŃSKIE LAKELAND: Głęboczek near Brodnica, 22 Sept. 1997, *M. Ceynowa-Giełdon* (TRN); DC-30 – PRADOLINA TORUŃSKO-EBERSWALDZKA SPILLWAY, KOTLINA TORUŃSKA BASIN: Toruń, 30 Aug. 1999, *M. Ceynowa-Giełdon* (TRN); Toruń by the bridge Toruń-Bydgoszcz, 23 Sept. 1994, *M. Ceynowa-Giełdon* (TRN); DC-44 – POJEZIERZE CHEŁMIŃSKO-DOBRZYŃSKIE LAKELAND, POJEZIERZE DOBRZYŃSKIE LAKELAND: Chrostkowo near Lipno, 22 Sept. 2000, *M. Ceynowa-Giełdon* (TRN); GB-10 – POJEZIERZE LITEWSKIE LAKELAND, POJEZIERZE WSCHODNIOSUWALSKIE LAKELAND: Wigry National Park, Mikołajewo, 15 Sept. 1984, *K. Toborowicz* (KTC); Maćkowa Ruda, 15 Sept. 1984, *K. Toborowicz* (KTC); GB-10 – POJEZIERZE LITEWSKIE LAKELAND, RÓWNINA AUGUSTOWSKA PLAIN: Wigry National Park, Maćkowa Ruda near Suwałki, 15 Sept. 1984, *K. Toborowicz* (KTC); GG-60 – EASTERN BESKIDY MTS, WESTERN BIESZCZADY MTS: Tarnawa, 7 July 2003, *J. Kiszka* (KRAP).

THE GENUS *VERRUCULA*

Steiner (1896) described the genus *Verrucula* to segregate the species growing as parasites on the species of *Caloplaca* containing anthraquinones.

This genus was not accepted by later scientits who included the parasitic taxa in the genus *Verrucaria* within the *V. helveticorum* group (Erichsen 1943; Zehetleiner 1978; Clauzade & Roux 1985; Navarro-Rosinés & Roux 1987; McCarthy 1988). The species of this group were the subject of a recent detailed study by Navarro-Rosinés *et al*. (2007); the name *Verrucula* was resurrected, and the taxonomy was clarified using morphological, anatomical and molecular data. The group was found to be heterogeneous, comprising two genera, *Verrucula* and *Verruculopsis*. Twenty two species were recognized in the genus *Verrucula*, including ten newly described species: *V. aegyptica* (Müll. Arg.) J. Steiner, *V. ahlesiana* (Zwackh) J. Steiner, *V. arnoldiana* Nav.-Ros. & Cl. Roux, *V. biatorinaria* (Zehetl.) Nav.-Ros. & Cl. Roux, *V. clauzadaria* Nav.-Ros. & Cl. Roux, *V. coccinearia* (Zehetl.) Nav.-Ros. & Cl. Roux, *V. coronataria* Nav.-Ros. & Cl. Roux, *V. elegantaria* (Zehetl.) Nav.-Ros. & Cl. Roux, *V. fulvaria* Nav.-Ros. & Cl. Roux ad.int., *V. granulosaria* (Clauz & Zehetl.) Nav.-Ros. & Cl. Roux, *V. helvetica* (B. de Lesd.) Nav.-Ros. & Cl. Roux, *V. hladuniana* (Nav.-Ros. & Cl. Roux) Nav.-Ros. & Cl. Roux, *V. inconnexaria* Nav.-Ros. & Cl. Roux, *V. lactearia* Nav.-Ros. & Cl. Roux, *V. latericola* (Erichs.) Nav.-Ros. & Cl. Roux, *V. maritimaria* Nav.-Ros. & Cl. Roux, *V. microspora* Nav.-Ros. & Cl. Roux ad. int., *V. navasaria* Nav.-Ros. & Cl. Roux, *V. polycarparia* Nav.-Ros. & Cl. Roux, *V. protearia* (Zehetl.) Nav.-Ros. & Cl. Roux, *V. pusillaria* Nav.-Ros. & Cl. Roux, *V. tarraconensis* Nav.-Ros. & Cl. Roux. Seven taxa were excluded from this genus by the authors: *Verrucula beltraminiana* (A. Massal.) J. Steiner – currently *Verrucaria beltraminiana* (A. Massal.) Trevis., *Verrucula fraudulosa* (Nyl.) J. Steiner – currently *Verruculopsis lecideoides* var. *fraudulosa* (Nyl.) comb. ined. *Verrucula glaucina* f. *griseoatra* (Krempelh.) J. Steiner – currently *Placopyrenium fuscellum* (Turner) Gueidan & Cl. Roux, *Verrucula lecideoides* (A. Massal.) J. Steiner – currently *Verruculopsis lecideoides* (A. Massal.) Gueidan & Cl. Roux, *Verrucula monstrosa* (J. Steiner) J. Steiner – currently *Placocarpus schaereri* (Fr.) Breuss, *Verrucula rheitrophila* (Zschacke) M. Choisy – currently *Hydropunctaria rheitrophila* (Zschacke) Keller, Gueidan & Thüs, *Verrucula subcrustosa* (Nyl.) J. Steiner – currently *Placopyrenium trachyticum* (Hazsl.) Breuss.

Verrucula J. Steiner

Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl. **105**(1): 444. 1896. – TYPE SPECIES: *Verrucula aegiptiaca* (Müll. Arg.) J. Steiner, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl. **105**(1): 444. 1896. (*Verrucaria aegiptiaca* Müll. Arg., Rev. Mycol. **8**: 82. 1880).

Prothallus absent. *Thallus* parasitic on thalli and/or on apothecia of *Caloplaca* with anthraquinones or on *Xanthoria elegans*; first developing inside the host thallus and then becoming more or less independent, areolate to squamulose-areolate, sometimes reduced, white-grey, grey-brown to dark brown. *Upper cortex* a pseudocortex, thin, weakly differentiated, consisting of one, two or three layers of cells, with pale brown walls, often covered by dead cells or rarely with white crystals. *Algal* layer ± paraplectenchymatous, continuous, algal cells 8–16(–23) µm in diam. *Medulla* distinct, prosoplectenchymatous, hyphae irregularly oriented, K/I+ blue or K/I–, with crystals bright in polarized light (pol+). *Perithecia* entirely immersed in the thallus except the dark brown to black, upper part by ostiole. *Involucrellum* absent. *Excipulum* globose, 100–300 µm, paraplectenchymatous, with somewhat elongated cells, colourless except for the brown part around the ostiole, sometimes also with a few green cells. *Hymenium* colourless, I+ red, K/I+ red. *Hamathecium* consisting of periphyses and periphysoids, periphyses inconspicuousin short ostiolar canal, periphysoids easily visible, located in the upper part of the perithecial cavity, 10–25 × 1–3 µm. *Asci Verrucaria*-type, clavate, 8-spored, two-layered, fissitunicate, upper part (tholus) thin and K/I–. *Ascospores* colourless, simple or rarely uniseptate, globose, ellipsoid to nearly oblong. *Conidiomata* present, pycnidia immersed or partially prominent, globose, colourless except for the pale or medium brown part around the ostiole, *Dermatocarpon*-type, conidia bacilliform, simple.

NOTE. *Verrucula* is characterized by the parasitic habit, the areolate to squamulose-areolate thalli with a weakly differentiated upper cortex (pseudocortex), a pale excipulum darker around the ostiole, *Dermatocarpon*-type pycnidia and by the absence of an involucrellum. *Verrucula* seems to be a sister group to the genus *Placocarpus* (Gueidan *et al*. 2009). Both genera include exclusively parasitic species. However, young thalli of *Placocarpus schaereri* (Fr.) Breuss, the species occurring in Poland, often parasitize *Lecanora muralis* (Schreb.) Rabenh. The species of *Veruculopsis* develop on the same hosts as *Verrucula*, such as on the species of *Caloplaca* with anthraquinones. Species of both *Verrucula* and *Verruculopsis* are morphologically quite similar, probably as a result of a convergence to parasitism. Only a few characters distinguish them. *Verrucula* has a colourless excipulum except for the darker part around the ostiole, whereas *Verruculopsis* has the excipulum pale brown at the base and dark brown in the upper part in mature specimens. The medulla of *Verrucula* gives a blue reaction with Lugol's solution or not, whereas it always is negative in *Verruculopsis*. Moreover, the perithecia of *Verrucula* are immersed inside the areoles, ± in the centre while the species of *Verruculopsis* occurring in Poland have perithecia situated between areoles or marginal to them. *Placopyrenium* also contains parasitic species. It differs in the black-sided areoles and the partially brown pigmented medulla, whereas *Verrucula* and *Verruculopsis* always have a white medulla.

HABITAT. Exclusively parasitic on thalli of other lichens containing anthraquinones or rarely on their apothecia (*Caloplaca* and *Xanthoria elegans*). Occurring mainly in Western Europe and the Mediterranean region.

REMARKS. As the original diagnosis of *Verrucula* reported by Steiner (1896) dose not give sufficient detail to definitely identify this genus, Navarro-Rosinés *et al*. (2007) offered a detailed Latin description of it. They provided also a key to all currently know species of *Verrucula* and *Verruculopsis*.

KEY TO THE SPECIES OF *VERRUCULA*

Key to the species with a distinctly areolate or squamulose-areolate thallus with areole without black sides, perithecia located within the areoles, often half to completely immersed without an involucrellum, white medulla present.

1. Parasitic on *Xanthoria elegans*, medulla K/I–, ascospores 12–14 × 6–7 µm . . . . . ***Verrucula elegantaria***
1*. Parasitic on *Caloplaca sp*., medulla K/I+ or K/I– **2**
2. Medulla K/I+ dark blue, parasitic on *Caloplaca cirrochroa*, ascospores 14–18 × 6–8 µm . . . . . ***Verrucula helvetica***
2*. Medulla K/I– **3**
3. Parasitic on *Caloplaca proteus*, ascospores 15–20 × 6–8.5 µm . . . . . ***Verrucula protearia***
3*. Parasitic on *Caloplaca polycarpa*, ascospores 12.5–16 × 5–6(–7.5) µm . . . . . ***Verrucula polycarparia***

Verrucula elegantaria (Zehetl.) Nav.-Ros. & Cl. Roux Fig. 57

in Navarro-Rosinés *et al*., Bull. Soc. Linn. Provence **58**: 156. 2007. – *Verrucaria elegantaria* Zehetl., Nova Hedwigia **29**: 723. 1978. TYPE: Italien, Südtirol, Passo di Rolle, südwestlich gerichtete Felsabbrüche, 23.10.1976. *J. Poelt* & *G. Zehetleitner* (GZU – HOLOTYPE).

Prothallus absent. *Thallus* parasitic on *Xanthoria elegans*, thin 160–200 µm, continuous, consisting of elongated areoles whose shape corresponds more or less with the shape of the host thallus. Areoles grey-brown, upper surface flat to convex, irregularly folded, pruinose, sides of areoles concolorous with the upper surface. *Upper cortex* a pseudocortex, weakly differentiated, consisting of a dark brown layer (6–11 µm thick) covered by a discontinuous layer of colourless dead cells (2–6 µm thick). *Algal* layer 140–180 µm thick, algal cells up to 7–15 µm. *Medulla* K/I–, 60–220 µm, colourless, prosoplectenchymatous, with thick hyphae 3–4 µm. *Perithecia* entirely or three-quarters immersed in the thallus, 180–260(–300) µm diam. *Involucrellum* absent. *Excipulum* paraplectenchymatous, at base 22–30 µm thick, colourless except for the brown part around the ostiole. *Periphysoids* (10–)18–27 × 2–3.5 µm. *Asci* 60–70 µm long, 15–25 µm wide. *Ascospores* simple, ellipsoid, 12–14 × 6–7 µm. *Conidiomata*

not observed in examined material, according to Navarro-Rosinés *et al*. (2007) pycnidia partially immersed, 90–160 µm diam., colourless, only in upper part by ostiole pale brown, (3.5–)4–5.5 × 1–1.5 µm.

NOTE. Growing exclusively on *Xanthoria elegans* and recognized by the elongated outline of the areoles, the I– medulla, and ellipsoid ascospores. Other species of this genus reported from Poland occur on different hosts: *Verrucula helvetica* on *Caloplaca cirrochroa*, *V. polycarparia* on *C. polycarpa*, *V. protearia* on *C. proteus*. They also differ from *V. elegantaria* by the following characters: *V. helvetica* gives a dark blue reaction of the medulla with Lugol's solution; *V. polycarparia* has distinctly narrowly ellipsoid ascospores with the length/width ratio 2.2–3.1 and a thallus consisting of small irregular areole; *V. protearia* also has a thallus consisting of angular to irregular areoles not elongated as in *V. elegantaria*.

HABITAT. Parasitic species growing on thallus and apothecia of *Xanthoria elegans* on limestone in sunny and exposed places in alpine and subalpine belts.

DISTRIBUTION IN POLAND. *Verrucula elegantaria* was not previously reported from Poland. At present it is known from one locality in the Pieniny Mts and one locality in the Tatra Mts. It was previously known in neighbouring Slovakia from the Slovakian Tatra Mts (Pišút *et al*. 1996; Lisická 2005). This species is probably more frequent in Poland but it has been overlooked by Polish lichenologists.

WORLD DISTRIBUTION. In Europe it occurs mainly at higher altitudes in the Mediterranean region but it was also reported from the Alps of Austria and Switzerland (Navarro-Rosinés *et al*. 2007).

REMARKS. Along with the typical form of *V. elegantaria*, Navarro-Rosinés *et al*. (2007) observed specimens with larger spores (11.5–)13.5–17 (–20.5) × (5–)6–7.5(8) µm, with the length/width ratio 2–2.7 from Pakistan, which were referred to as *Verrucula* aff. *elegantaria*.

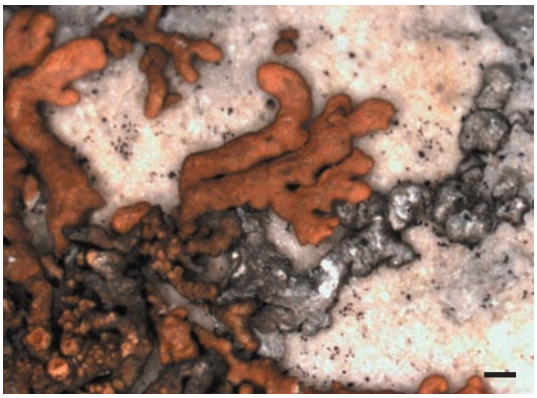

Fig. 57. *Verrucula elegantaria* (Zehetl.) Nav.-Ros. & Cl. Roux (*Nowak*, KRAM). Scale bar = 0.5 mm.

SPECIMENS EXAMINED. DG-60 – TATRA MTS, HIGH TATRA MTS: Ciemnosmereczyńska Przełęczka pass, 2115 m, 7 Aug. 2004, *A. Flakus* (KRAM); EG-32 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Ociemny Wierch, on calcareous rock, S exp., 5 May 1955, *J. Nowak* (KRAM).

Verrucula helvetica (B. de Lesd.) Nav.-Ros. & Cl. Roux Fig. 58

in Navarro-Rosinés *et al*., Bull. Soc. Linn. Provence **58**: 158. 2007. – *Endopyrenium helveticum* B. de Lesd., Bull. Soc. Bot. France **68**: 493. 1921. TYPE: Jura, Grand Savagnier, Chasseron, 1400 m, 1921/11, *Ch. Meylan*, (Herb. Frey n. 8418 – G! – HOLOTYPE). – *Verrucaria helveticorum* Zehetl., Nova Hedwigia **29**: 726. 1978.

Prothallus absent. *Thallus* parasitic on *Caloplaca cirrochroa*, areolate or squamulose-areolate, grey-brown to brown, slightly pruinose. Areoles rounded, angular or irregular, (0.2–) 0.3–0.3 × 0.5–0.8 mm wide, 0.2–0.3 mm thick, upper surface convex and weakly folded, sides of areoles concolorous with the upper surface. *Upper cortex* a pseudocortex, weakly differentiated, consisting of a layer of dark brown cells and discontinuous layer of colourless dead cells above. *Algal* cells up to 15–20(–30) µm. *Medulla* 100–200 µm thick, K/I+ dark blue, with crystals bright light in polarization (pol+ white). *Perithecia* 2–3 per areole entirely immersed in the thallus, 180–250 µm in diam., only the brown

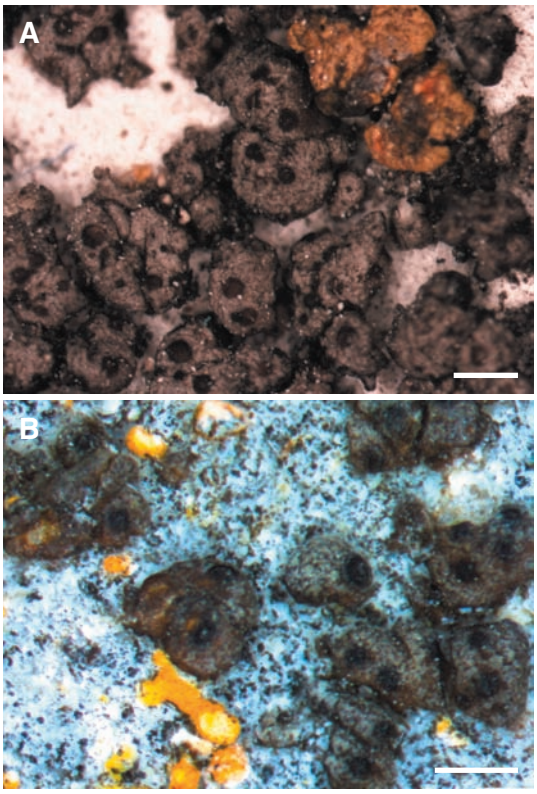

Fig. 58. *Verrucula helvetica* (B. de Lesd.) Nav.-Ros. & Cl. Roux A & B – habit (A – Nowak, Lich. Pol. Merid. Exs. 246, KRAM; B – *Meylan*, G, as *Endopyrenium helveticum* B. de Lesd., holotype]. Scale bars = 0.5 mm.

part surrounding the ostiole visible at surface. *Involucrellum* absent. *Excipulum* colourless, brown onlynear ostiole. *Periphsoids* 16–24 µm. *Asci* (35–)45–50 µm long, 15–20 µm wide. *Ascospores* simple, narrowly ellipsoid, 14–18 × 6–8 µm. *Conidiomata* present, pycnidia oblong to ellipsoid, 105–240 × 45–65 µm, conidia baciliform (3–)4–5 × 1–1.5 µm.

NOTE. Easily distinguished from other species of *Verrucula* occurring in Poland by the host and the I+ (dark blue) medulla. Other I+ species are: *V. coccinearia* on *Caloplaca coccinea*, with smaller, globose ascospores 8.5–12 × 7.5–9 µm; and *V. fulvaria* on *C. proteus* s.l., with somewhat smaller ascospores 12–15 × 5–6.5 µm. Four others species which can give a blue or pale blue I reaction, at least on fresh material, are *V. granulosaria* on *C. granulosa*, and *V. aegyptica*, *V. microspora* and *V. tarraconensis*, all parasitic on *Caloplaca* gr. *velana*.

HABITAT. Parasitic on thalli of *Caloplaca cirrochroa* on calcareous substrate in sunny and exposed places.

DISTRIBUTION IN POLAND. In Poland found at xerothermic localities in the Jura Krakowsko-Częstochowska upland in Ojców, Kobylany and Nieplice villages. It is probably more frequent in this area but was overlooked in the field.

WORLD DISTRIBUTION. The species is known in Central Europe from Austria, France, Germany, Italy and Switzerland (Zehetleiner 1978; Navarro-Rosinés *et al*. 2007).

REMARKS. The species was mistaken in Poland for *Amphoridium deminutum* (Servít) Servít (1954) [= *Verrucaria obfuscans* var. *deminuta* Servít (1946), = *Verrucaria deminuta* (Servít) Servít (1949), *non Verrucaria deminuta* (Arnold) Leight. (Leighton 1879)]. It was first reported from Poland by Nowak (1995) from the Jura Krakowsko-Częstochowska upland under its synonym *Verrucaria helveticorum* Zehetl.

EXSICCATAE SEEN. Nowak, Lich. Pol. Merid. Exs. 246 (as *Verrucaria helveticorum*) (KRAM).

SPECIMENS EXAMINED. DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Ojców, 360 and 370 m, 3 May 1958, *J. Nowak* (KRAM); Ojców, 350 m, 5 April 1957 *J. Nowak* (KRAM, LBL); valley of Prądnik stream by Ojców, 370 m, on calcareous rock, 16 Sept. 1958, *J. Nowak* (KRAM); DF-58 – Dolina Kobylańska valley near Kobylany, 370 m, 6 Aug. 1957, *J. Nowak* (KRAM); 17 May 1957, *J. Nowak* (KRAM) as *Amphoridium deminutum*; Dolina Kluczwody, 19 Feb. 1992, *J. Nowak* (KRAM); DF-68 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, GARB TENCZYŃSKI HUMMOCK: Nielepice near Rudawa, 13 Sept. 1957, *J. Nowak* (KRAM); EG-32 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: E slope of Zamczysko hill, 4 June 1998, *J. Kiszka* (KRAM); EG-33 – Małe Pieniny Mts, Stolarzówka hill, 742 m, on calcareous rock, 24 June 1982, *J. Pyrek & Z. Toborowicz* (KTC); Grabczychy rocks near Sromowce Niżne, 529 m, on calcareous rock, 22 June 1982, *K. Toborowicz* (KTC).

Verrucula polycarparia Nav.-Ros. & Cl. Roux Fig. 59

in Navarro-Rosinés *et al*., Bull. Soc. Linn. Provence **58**: 163. 2007. TYPE: Langvedoko, Lozère, causse Méjean La Malène, roc des Hourtous, 200 m, à l'ouest de la Buvette, tout à fait au sommet du grand escarpement, petite paroi calcarèo-dolomitique, orient. gén. E, orient. loc. E, pente 90, alt. 920 m. *C. Roux* 2003.06.19 (MARRJ).

Prothallus absent. *Thallus* parasitic on *Caloplaca polycarpa*, consisting of scattered or contiguous small areoles, pale grey to whitish or greyish black. Areoles angular or irregular, small (0.2–)0.3–0.6(–0.8) mm in diam., 100–200 µm thick, upper surface flat to convex, not or slightly pruinose, sides of areoles pale brown to blackish. *Upper cortex* a pseudocortex, thin, weakly differentiated, consisting of one or two layers of cells, with pale brown walls, often covered by discontinuous layer of dead cells. *Algal* layer 80–110 µm thick, algal cells 8–16 µm in diam. *Medulla* K/I–, 150–190 µm thick, with numerous crystals from the substrate. *Perithecia* black 0.1–0.2 mm, entirely immersed or slightly prominent. *Involucrellum* absent. *Excipulum* at base colourless and 20–30 µm thick, by the ostiole pale brown. *Periphsoids* 15–20 × 2.5–3 µm. *Asci* 45–50 × 15 µm. *Ascospores* simple, narrowly elongate, 12.5–16 × 5–6(–7.5) µm. *Conidiomata* not observed.

NOTE. Apart from the identity of the host this species is distinguished from other species of *Verrucula* occurring in Poland by distinctly narrowly ellipsoid ascospores with a length/width ratio 2.2–3.1(–4.1).

HABITAT. Parasitic on thalli of *Caloplaca polycarpa*, on limestone at xerothermic localities exposed to the sun, in lowly to moderately eutrophic environments.

DISTRIBUTION IN POLAND. Found on one locality in the southern part of the Jura Krakowsko-Częstochowska upland.

WORLD DISTRIBUTION. This recently described species is at present known from Ireland, Slovakia and Spain (Navarro-Rosinés *et al*. 2007) but it is probably more frequent in Europe, especially in the Mediterranean region and at xerothermic localities in temperate and boreal zones.

REMARKS. In Poland the specimens of *Verrucula polycarparia* were previously incorrectly reported as *Verrucaria policensis* Servít (Nowak 1961) or as its synonym *Amphoridium deminutum* f. *policense* (Servít) Servít (KRAM). However Nowak (1961) noted that some specimens occurring in Poland and reported as *Verrucaria policensis* (and currently recognized as *Verrucula polycarparia*) were different from the type material of *Verrucaria policensis* Servít (PRM!). They have narrower ascospores which well correspond with the ascospores of *Verrucula polycarparia*.

REFERENCE MATERIAL. Slovakia, Maninska Tiesnava NE Považská Bystrica, 400 m, 19 April 1986, *H. Mayrhofer* (GZU) (rev. by P. Navarro-Rosines & Cl. Roux).

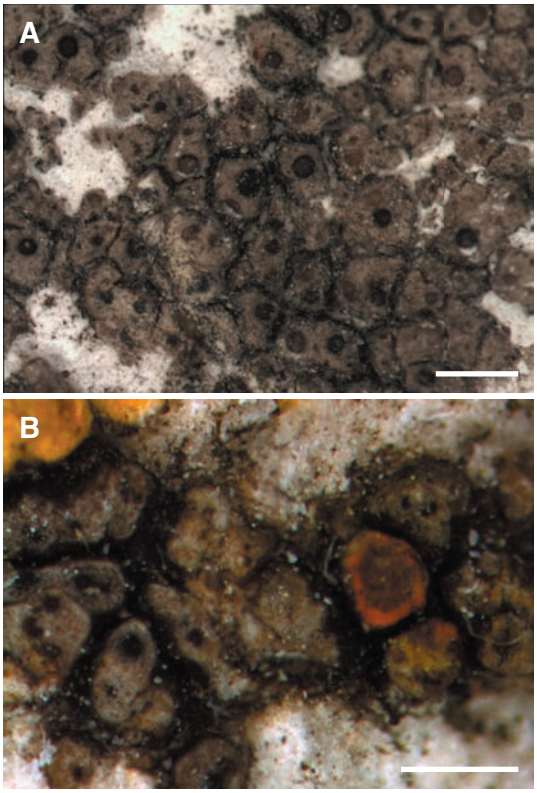

Fig. 59. *Verrucula polycarparia* Nav.-Ros. & Cl. Roux. A & B – habit (A – *Nowak*, KRAM; B – *Mayrhofer*, GZU). Scale bars = 0.5 mm.

SPECIMENS EXAMINED. DF-58 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: Dolina Bolechowicka valley, on vertical surface of calcareous rock, SW-expose, 370 m, 14 Sept. 1957, *J. Nowak* (KRAM) as *Amphoridium deminutum* f. *policense*.

Verrucula protearia (Zehetl.) Nav.-Ros. & Cl. Roux Fig. 60

in Navarro-Rosinés *et al*., Bull. Soc. Linn. Provence **58**: 164. 2007. – *Verrucaria protearia* Zehetl., Nova Hedwigia **29**: 727. 1978. TYPE: Osterreich, Tirol: Stubaier Alpen, [Serles-Gruppe], Gschnitztal, unterhalb St. Magdalena, W exponierte Steilflächen, Dolomit, 1650 m, 9 Aug. 1972, *M. Steiner* (GZU! – HOLOTYPE).

Prothallus absent. *Thallus* parasitic on *Caloplaca proteus*, consisting of scattered or contiguous, crustose to subsquamulose areoles, greyish brown to whitish grey. Areoles rounded, angular or irregular, (0.2–)0.3–0.6(–0.9) mm wide and 160–300(–400) µm thick, smooth to rugose, slightly concave to convex, matt, occasionally rimulose, slightly attenuated at the base, sides concolorous with the upper surface or slightly darker but never black. *Upper cortex* a pseudocortex, consisting of one layer of cells with brown pigment, paraplectenchymatous, partially covered with colourless dead cells. *Algal* layer 50–100 µm thick, frequently surrounding perithecia, cells green, globose, 10–15(–25) µm. *Medulla* K/I–, 100–200 µm thick, some crystals present in lower part, bright under crossed polars (pol+ white). *Perithecia* entirely immersed in the thallus, or with ostiolum convex simple, up to 1–5(–10) per areole. *Involucrellum* absent. *Excipulum* hyaline, except for the part around the ostiole, globose, 150–180 µm wide, 15–18 µm thick. *Periphyses* 15–16(–20) µm long. *Asci* 35–45 µm long, 10–17 µm wide. *Ascospores* simple, 15–20 × 6–8.5 µm. *Conidiomata* not observed.

NOTE. This species is distinguished from *V. helvetica* by the I– medulla, from *V. polycarparia* by ellipsoid ascospores, from *V. elegantaria* by the grey, small irregular areoles which are never elongated as in *V. elegantaria*.

HABITAT. Initially on *Caloplaca proteus* later independent after death of the host.

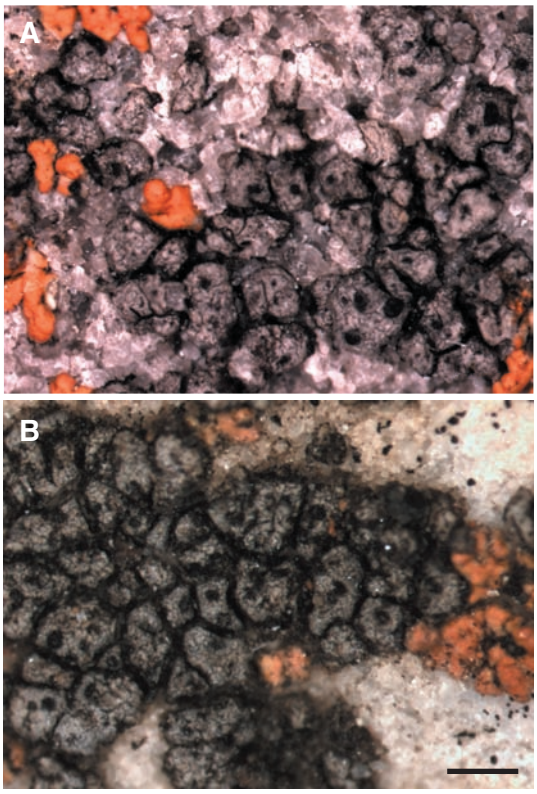

Fig. 60. *Verrucula protearia* (Zehetl.) Nav.-Ros. & Cl. Roux. A & B – habit (*Nowak*, KRAM; B – Poelt, Lich. Alpium 349, KRAM, as *Verrucaria protearia* Zehetl., topotype). Scale bars = 0.5 mm.

DISTRIBUTION IN POLAND. Found in the Carpathian Mts at one locality in the Western Tatra Mts in the Dolina Chochołowska valley, where it is abundant locally, and at one locality in the Pieniny Mts (KRAM).

WORLD DISTRIBUTION. In Europe known from the Alps, e.g. from the Tyrol in Austria, Val Tantermozza in Switzerland, Ammergau Alps in Germany, Rodan-Alpy in France (Zehetleiner 1978; Navarro-Rosinés *et al*. 2007).

REMARKS. This species was found and correctly identified in 1987 by J. Nowak (KRAM) in the Polish Western Tatra Mts, but the record was not published until 2003 when it was listed by Bielczyk (2003). Specimens collected in the Pieniny Mts in 1981 were recorded as *Verrucaria minuta* (KTC).

EXSICCATAE SEEN. Poelt, Lich. Alpium 349 (KRAM! – TOPOTYPE); POELT, Pl. Graec. Lich. 114 (GZU! – TOPOTYPE).

SPECIMENS EXAMINED. DG-58 – TATRA MTS, WESTERN TATRA MTS: Dolina Chochołowska valley, on vertical surface of calcareous rock, S exp., 1000 m, 11 Oct. 1987, *J. Nowak* (KRAM); Mnichy Chochołowskie, 1470 m, 9 Oct. 1987, *J. Nowak* (KRAM); EG-32 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Biała Woda nature reserv, on calcareous rock, 605 m, 14 Aug. 1981, *S. Malesa* & *K. Toborowicz* (KTC) as *Verrucaria minuta*.

THE GENUS *VERRUCULOPSIS*

Verruculopsis is a genus recently circumscribed by Navarro-Rosinés and Roux (Navarro-Rosinés *et al*. 2007). The genus is characterized by initial growth as a parasite of lichens containing anthraquinones. Like *Verrucula*, individuals of *Verruculopsis* develop on *Caloplaca* species as their parasites or can live independently, but growing amongst *Caloplaca*. Based on morphological, anatomical, biological and phylogenetic studies Navarro-Rosinés *et al*. (2007) transferred three species of the *Verrucaria helveticorum* group into this new genus: *V. irrubescentis* Ménard & Cl. Roux and *V. poeltiana* Clauzade & Cl. Roux, – parasitic on *Caloplaca*, and *V. lecideoides* (A. Massal.) Trevis. – a non-parasitic species. Additionally a newly described species, *Verruculopsis flavescentaria* Gueidan, Nav.-Ros. & Cl. Roux parasitic on *Caloplaca flavescens*, was described (Navarro-Rosinés *et al*. 2007). In this study one more species *Verrucaria minor* Breuss [= *V. minuta* (Hepp) Zschacke] is transferred to *Verruculopsis*.

Verruculopsis Gueidan, Nav.-Ros. & Cl. Roux

in Navarro-Rosinés *et al*., Bull. Soc. Linn. Provence **58**: 139. 2007. TYPE SPECIES: *Verruculopsis poeltiana* (Clauzade & Cl. Roux) Gueidan, Nav.-Ros. & Cl. Roux, *in* Navarro-Rosinés *et al*., Bull. Soc. Linn. Provence **58**: 139. 2007. (*Verrucaria poeltiana* Clauzade & Cl. Roux, Nova Hedvigia **79**: 194. 1984).

Prothallus absent or inconspicuous. *Thallus* superficial, areolate to squamulose-areolate, sometimes reduced, white-grey, grey-brown to dark brown. Areoles irregular, polygonal. *Upper cortex* a pseudocortex, weakly differentiated, consisting of one, two or rarely three layers of cells with pale brown walls, often covered with dead cells, rarely with crystals. *Algal* layer continuous, paraplectenchymatous, algal cells homogeneously scattered in the layer. *Medulla* K/I–, upper part colourless, lower darker reddish-brown. *Perithecia* globose, often present, numerous, sessile, on the margins of or between areoles or almost entirely immersed in the centre of areoles. *Involucrellum* absent. *Excipulum* paraplectenchymatous, pigmented throughout or pale brown at base and dark brown in the upper part. *Hymenium* colourless, K/I+ bluish changing to reddish. *Hamathecium* consisting of inconspicuous periphyses in the short ostiolar canal, and conspicuous periphsoids in the upper part of the perithecial cavity. *Asci* clavate, 8-spored, *Verrucaria*-type, two-layered, fissitunicate, upper part (tholus) thin, K/I–. *Ascospores* colourless, simple or rarely uniseptate, globose, ellipsoid to nearly oblong. *Conidiomata* present, pycnidia of *Dermatocarpon*-type, conidia simple, bacilliform.

NOTE. As a result of convergent evolution, *Verruculopsis* and *Verrucula* are morphologically and anatomically similar, and both parasitise anthraquinone-producing lichens. Individuals of both genera often grow together in the same association. The non-parasitic members of *Verruculopsis* occurring in Poland can be easily recognized by the perithecia located between areoles or at their margins. The free-living species of *Verrucula* and *Verruculopsis* have perithecia immersed in the centre of the areoles. *Verruculopsis* differs from *Verrucula* in the always I– medulla and the excipulum which at maturity is pale brown at the base and dark brown in the upper part. *Verrucula* has a pale excipulum, except for the small part around the ostiole which is pale brown.

HABITAT. *Verruculopsis* parasitizes *Caloplaca* species containing anthraquinones or grows as an independent organism, on vertical to horizontal surfaces of rocks in sunny and exposed places. Parasitic species of *Verruculopsis* occur mainly

in Mediterranean and sub-Mediterranean regions (Navarro-Rosinés *et al*. 2007), whereas non-parasitic species occur at xerothermic localities in the temperate zone.

HOST. *Caloplaca* species such as *C. aurantia*, C. *flavescens*, *C. irrubescens* (Clauzade & Roux 1984; Ménard & Roux 1991; Navarro-Rosinés *et al*. 2007).

REMARKS. Although the species of *Verruculopsis* are very similar to *Verrucula* by their adaptation to the same conditions of development, phylogentically they are closer to *Placopyrenium*. The species of *Placopyrenium* are parasitic or parasymbiotic on other lichens, especially at young developmental stages. Both *Placopyrenium* and *Verruculopsis* were sister groups in molecular phylogenetic analyses (Gueidan *et al*. 2009).

KEY TO THE SPECIES OF *VERRUCULOPSIS* IN POLAND

Key to the saxicolous, calcareous species with a distinctly areolate superficial thallus and with perithecia located between areoles or by their margins, without an involucrellum but with a dark-brown excipulum.

1. Ascospores (14–)19(–21) × (6–)7(–8.5) µm, areoles brownish, 0.3–0.8 × 0.2–0.5 mm in diam. . . . . ***Verruculopsis lecideoides***
1*. Ascospores 11–15 × 5–7 µm, areoles whitish grey, 0.2–0.3(–0.5) × 0.1–0.3 mm . . . . . ***Verruculopsis minutum***

Verruculopsis lecideoides (A. Massal.) Gueidan & Cl. Roux Fig. 61

in Navarro-Rosinés *et al*., Bull. Soc. Linn. Provence 58: 174. 2007. – *Thrombium lecideoides* A. Massal., Rich Auton. Lich.: 157. 1852. TYPE: [Italy] Ad calcem primitivam prope Bromium (Premadio) (Anzi, Lich. Rar. Langob. Exs. 366, W-2010-00138! – NEOTYPE designated here). – *Verrucaria lecideoides* (A. Massal.) Trevis., Spighe e Paglie: 19. 1853.

Prothallus brown to black. *Thallus* superficial, well developed, up to 300–700(–800) µm thick, areolate, yellowish grey, grey-brown to dark brown. Areoles sessile (wide at base), angular, 0.5–0.8 × 0.3–0.5 mm in diam. with deep pale cracks between, sides of areoles concolourous with the upper surface or slightly darker, upper surface even or slightly convex, white-pruinose. *Upper cortex* a pseudocortex, weakly differentiated, 20–30 µm thick, cell-walls brown, often covered by dead cells. *Algal* layer continuous, 100–150(–250) µm thick, algal cell 10–20 µm, uniformly scattered in the layer. *Medulla* 100–200 µm thick, with crystals giving bright polarization (pol.+ white), hyphae dense and whitish in the upper part, loose and reddish brown in the lower. *Perithecia* protruding, emerging, more or less superficial, 200–270 µm in diam., at the margin of or between areoles, single or several together, half-immersed, distinctly smaller than areoles. *Involucrellum* absent. *Excipulum* pigmented throughout, brown to dark brown, globose, often very thick 50–70 µm. *Periphyses* three-

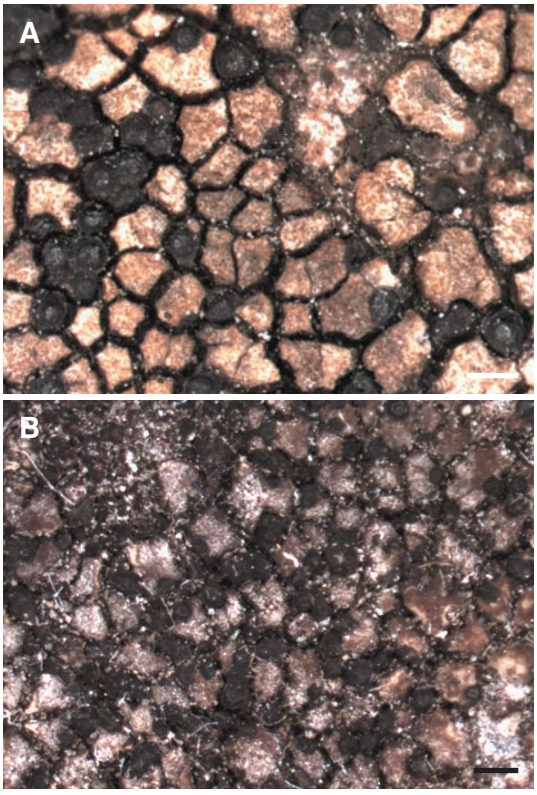

Fig. 61. *Verruculopsis lecideoides* (A. Massal.) Gueidan & Cl. Roux. A & B – habit (A – *Nowak*, KRAM; B – Anzi, Lich. Rar. Langob. Exs. 366, W, as *Thrombium lecideoides* A. Massal., neotype). Scale bars = 0.5 mm.

celled, 20–30 × 2–3 µm. *Asci* 860–75 µm long, 16–20 µm wide. *Ascospores* simple, (15–)19–21 × (6–)7–8.5 µm. *Conidiomata* not observed.

NOTE. *Verruculopsis lecideoides* is easily distinguished from *Verrucaria* and *Verrucula* spp. by an areolate thallus with perithecia placed between areoles. The only exception is *Verrucaria beltraminiana*, whose perithecia are located in the same way but differ in their distinctly larger size (0.2–0.3 mm wide), over twice as wide as the areoles (see also Breuss 2007a). *Verruculopsis lecideoides* is similar to *Verrucula* species but has a brown to dark brown excipulum and lacks perithecia in the middle of areoles. *Verruculopsis lecideoides* is distinguished from *Placopyrenium* concolorous upper surface and sides of areoles, and the paler medulla which is never dark brown to black as in *Placopyrenium*. The sides of areoles in *Placopyrenium* are black and areoles are distinctly constricted at base. *Verruculopsis minutum* is the other species in this genus known in Poland and differs in smaller ascospores (11–15 × 5–7 µm) and smaller thalline areoles [0.2–0.3(0.5) × 0.1–0.3 mm].

HABITAT. On limestone and dolomite, on rocks more or less exposed to the sun, in slightly to moderately eutrophic environments, in association with *Aspicilion calcareae*. According to Breuss (2007a) it occurs also on siliceous rocks. The thallus colour is influenced by degree of exposure; dark brown in sun and paler, often yellowish white, in shade.

DISTRIBUTION IN POLAND. It grows at lower altitudes, at xerothermic localities in the Wyżyna Krakowsko-Częstochowska and the Wyżyna Wieluńska uplands.

The specimens reported by Toborowicz (1983) as *Verrucaria lecideoides* from the Góry Świętokrzyskie Mts in fact belong to *Verrucaria obfuscans* [= *Verrucaria deminuta* (Servít) Servít *non V. deminuta* (Arnold) Leight.] or to *Verruculopsis minutum*. The material reported from the Niecka Nidziańska basin in the Pieniny Mts (Kiszka 1987) was not available for the study and cannot be evaluated.

WORLD DISTRIBUTION. The species is known in Central and southern Europe, e.g. Austria, France, Germany, Italy Slovakia and Spain (Clauzade & Roux 1985; Hafellner & Türk 2001; Llimona & Hladun 2001; Nimis & Martellos 2003; Lisická 2005) and in North America (Breuss 2007a).

REMARKS. A specimen of *Verrucaria lecideoides* from Anzi *Lichenes rariores Langobardi exsiccati* no. 366 in the W is marked as 'typus', but no other information is provided on the label. This exsiccatae material was collected in Italy in Premadio by M. Anzi. Describing *Thrombium lecideoides*, Massalongo (1852a) cited a specimen collected in Tregnago in the Province of Verona (Italy) by M. Cagalati (the type material was not found in VER). Because the original material was probably missing Anzi exsiccatae no. 366 (W) must have been considered as a type of the name. This typification most likely has never been formalized, therefore a single specimen is designated here as a neotype of *Thrombium lecideoides* A. Massal. As there are three pieces of rock in envelope no. 366 (W), the neotype is marked with an arrow on the herbarium sheet.

EXSICCATAE SEEN. Anzi, Lich. Rar. Langob. Exs. 366 (as *Verrucaria lecideoides*) (TO); Hepp, Flechten Eur. 682 (as *Verrucaria lecideoides*) (GFW); Arnold, Lich. Exs. Lich. Jur. 80. (as *Catapyrenium lecideoides*) (W).

SPECIMENS EXAMINED. DE-51 – WYŻYNA WOŹNICKO-WIELUŃSKA UPLAND, WYŻYNA WIELUŃSKA UPLAND: Góra Świętej Genowefy near Bobrowniki, near Warta river, 23 June 1964, *J. Nowak* (KRAM); DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: valley of Prądnik stream by Ojców, 370 m, on calcareous rock, 12 Oct. 1956, *J. Nowak* (KRAM); DF-58 – Bębło near Ojców, on sunny place, 370 m, on calcareous rock, 7 Aug. 1957, *J. Nowak* (KRAM); Wierzchowie, 2 May 1956 and 7 Aug. 1957, *J. Nowak* (KRAM); Dolina Bolechowicka valley, 14 April 1959, *J. Nowak* (KRAM).

Verruculopsis minutum (Hepp) Krzewicka, ***comb. nov.*** Fig. 62

BASIONYM: *Verrucaria lecideoides* var. *minuta* Hepp, Flechten Eur. No. 683. 1860. TYPE: Mit der Stammform in der Schlucht bei Streitberg, *F. Arnold* (GFW! – ISOTYPE). – *Verrucaria minuta* (Hepp) Zschacke, Rabenh. Krypt.-Fl. **9**(1/1): 262. 1933. [*non Verrucaria minuta* (Müll. Arg.) Stizenb., Ber. Tät. St Gall. Naturw. Ges.:

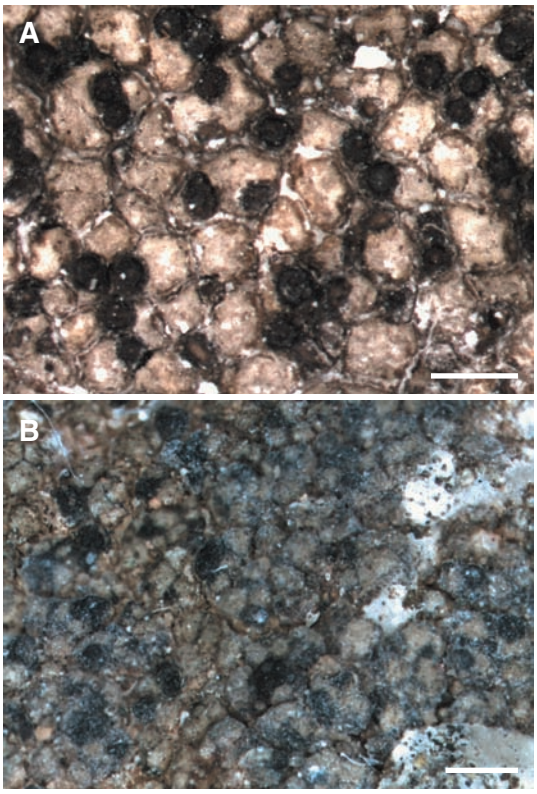

Fig. 62. *Verruculopsis minutum* (Hepp) Krzewicka. A & B – thallus (A – *Nowak*, KRAM; B – Hepp, Flechten Eur. 683, GFW, as *Verrucaria lecideoides* var. *minuta* Hepp, isotype). Scale bars = 0.5 mm.

262. 1895]. – *Verrucaria minor* Breuss, Lich. Fl. Great Sonora Desert Region **3**: 365. 2007.

Prothallus absent. *Thallus* superficial, 100–200(–300) µm thick, minutely areolate, white-yellow to pale brown. Areoles up to 0.2–0.3(–0.5) × 0.1–0.3 mm in diam., angular to nearly rounded, not crowded, the space between areoles well visible, sides of areoles and the upper cortex concolourous. *Upper cortex* a pseudocortex, weakly differentiated, 20–30 µm thick, cell walls colourless to pale brown, covered with dead cells. *Algal* layer 80–100 µm, algal cells 15–20 µm in diam., homogeneously scattered in the layer. *Medulla* colourless, K/I–, 100–150 µm, with crystals visible under crossed polars. *Perithecia* globose 150–200 µm in diam., immersed in the areole by the margin or between areoles, one or two per areole, rarely more. *Involucrellum* absent. *Excipulum* paraplectenchymatous, dark brown to black, pale brown only at the base. *Periphysoids* 10–15 × 1–1.5 µm. *Asci* 45–55 µm long, 14–18 µm wide. *Ascospores* simple, 11–15 × 5–7 µm. *Conidiomata* not observed.

NOTE. This species is characterized by a thin, areolate, white-yellow to pale brown thallus (200 µm thick) with small perithecia located between areoles. It differs from *V. lecideoides* in the smaller areoles (reaching a maximum diameter of 0.5 mm) with cracks between areoles up to 0.1–0.15 µm (the substrate between areoles is often easily visible). Areoles often are tetragonal rather than polygonal (5-, 6-, 7-gonal) as in *V. lecideoides*. The sides of areoles are white whereas the upper surface is rather dirty white. Additionally *V. lecideoides* has larger ascospores [(15–)19–21 × (6–)7–8.5 µm] and asci (60–75 × 16–20 µm), and larger perithecia 200–270 µm in diam.

Material from Poland has shorter ascospores and longer and thinner asci compared to the ranges reported by Servít (1954) (ascospores 16–20 × 6–7 µm; asci 43–46 × 18–20 µm) and Zschacke (1933) (ascospores 14–16 × 5–7 µm). This species has its northern limit range in Poland and the specimens grow in slightly poorer environmental conditions, which may explain these differences. Australian material is also said to have larger ascospores (9–18 × 5–8 µm) (McCarthy 1994). However, the specimens observed by McCarthy (1994) grow on atypical substrates on non-calcareous rocks, and McCarthy reported a thick black (25–40 µm) involucrellum contiguous with the excipulum and extending to its base, whereas the type material (GFW) and the specimens examined in Poland have no involucrellum. However, the dark thick excipulum in this taxon was often mistaken for an involucrellum. Nowak and Tobolewski (1975) also incorrectly used the presence of an involucrellum in *V. minutum* and *V. lecideoides* as a key character in the Polish monograph of lichens following Servít (1954).

HABITAT. It occurs on limestone, dolomite and also on non- or weakly calcareous substrata, mainly in sunny places.

DISTRIBUTION IN POLAND. Found on scattered localities, such as in the Carpathian Mts, where it was recorded in the Pieniny Mts. Outside the Carpathians it was found in the calcareous regions in the Wyżyna Krakowsko-Częstochowska upland and the Wyżyna Kielecko-Sandomierska upland.

WORLD DISTRIBUTION. The species is known in Central and southern Europe, e.g. Austria, France, Germany, Italy and Spain (Clauzade & Roux 1985; Hafellner & Türk 2001; Llimona & Hladun 2001; Nimis & Martellos 2003). It was also reported from North Africa, Australia, North America (McCarthy 1994; Breuss 2007a). This species has its centre of distribution in the Mediterranean and sub-Mediterranean region while it occurs only in xerothermic areas in the temperate zone.

REMARKS. The variety *minuta* of *Verrucaria lecideoides* is transferred here to the genus *Verruculopsis*. This taxon is distinguished by the characters typical for the genus *Verruculopsis*, namely the areolate thallus with pseudocortex, a pale brown base to the excipulum at maturity and I– medulla; it is non-parasitic but grows with *Caloplaca* with anthraquinones.

EXSICCATAE SEEN. Rabenhorst, Lich. Europ. Exs. 947 (as *Verrucaria lecideoides*) (KRAM, TO); Hepp, Flechten Eur. 683 (as *Verrucaria lecideoides* var. *minuta*) (GFW); Arnold, Lich. Exs. Lich. Jur. 266 (as *Catapyrenium lecideoides* var. *minutum*) (W).

SPECIMENS EXAMINED. DF-48 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, WYŻYNA OLKUSKA UPLAND: valley of Prądnik stream by Ojców, 370 m, on calcareous rock, 16 Aug. 1958 and 16 Sept. 1958, *J. Nowak* (KRAM); DF-58 – Dolina Bolechowicka valley, 14 April 1959, *J. Nowak* (KRAM); Dolina Kobylańska, 14 Apr. 1959 and 17 Oct. 1967, *J. Nowak* (KRAM); DF-68 – WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, GARB TENCZYŃSKI HUMMOCK: Dolina Mnikowska valley, 7 Sept. 1957, *J. Nowak* (KRAM); EE-83 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, GÓRY ŚWIĘTOKRZYSKIE MTS: Góra Zamkowa near Chęciny, 6 Oct. 1976, *K. Toborowicz* (KTC); EE-83 – WYŻYNA KIELECKO-SANDOMIERSKA UPLAND, POGÓRZE SZYDŁOWSKIE FOOTHILLS: Kurozwęki near Szydłów, 1984, *G. Sikora* (KTC); EG-33 – OBNIŻENIE ORAWSKO-PODHALAŃSKIE DEPRESSION, PIENINY MTS: Trzy Korony, 4 May 1957, *J. Nowak* (KRAM).

EXCLUDED TAXA

Listed below are species excluded for one of the following reasons: (*i*) they are considered to have been mistakenly reported, based on a revision of herbarium material; (*ii*) they are not confirmed, because herbarium material is missing and no recent records are known; (*iii*) their systematic position has changed.

Bagliettoa limborioides A. Massal.

Mem. Lichenogr.: 147. Fig. 168. Tab. 25. 1853. TYPE: [Italy] Vive sulle roccie calcaree nel Bosco Bagato presso Genova, *F. Baglietto* (VER – HOLOTYPE). – *Thrombium limborioides* (A. Massal.) Zschacke, Rabenh. Krypt. Fl. **9**(1/1): 563. 1934. – *Verrucaria limborioides* (A. Massal.) Clauzade & Cl. Roux, Bull. Soc. Bot. Centre-Ouest. **7**: 787. 1985.

Verrucaria sphinctrina var. *bavarica* Servít, Beih. Bot. Cbl. **59**: 121. 1939. TYPE: [Germany] Bavaria, Mittenwald, *Krempelhuber* (M – HOLOTYPE). – *Polyblastia sphinctrina* var. *bavarica* (Servít) Servít, Preslia **24**: 381. 1952. – *Bagliettoa sphinctrina* var. *bavarica* (Servít) J. Nowak & Tobol., Porosty Polskie: 1117. 1975.

The species *Bagliettoa limborioides* is easily distinguished by the ochre-colored thallus and the large perithecia (300–400 µm in diam.), covered by the involucrellum (350–450 µm in diam.) which is ± as wide as excipulum, the colourless excipulum, and ellipsoid ascospores 17–35 × 10–13 µm. *Bagliettoa calciseda* and *Verrucaria hochstetteri* are similar to *B. limborioides* in the endolithic calcicolous thallus and immersed perithecia, but they differ in the dark brown to black excipulum and the absence of an involucrellum. Additionally, *V. hochstetteri* has larger perithecia (375–700 µm). Other *Bagliettoa* species occurring in Poland (*B. baldensis*, *B. marmorea* and *B. parmigerella*) are easily distinguished by the distinctly smaller perithecia, narrower involucrellum and differently coloured thalli.

Bagliettoa limborioides was mistakenly included in Polish checklists (e.g. Bielczyk 2003; Fałtynowicz 2003) based on the reports of *Verrucaria sphinctrina* by Motyka (1927). Following

Clauzade & Roux (1985), the name *Verrucaria sphinctrina* auct. was considered synonymous with *B. limborioides*. However, herbarium material (LBL) from Poland named *Verrucaria sphinctrina* (Motyka 1927) belongs to *B. baldensis*. In this study *Bagliettoa limborioides* was not identified in any Polish collections. For this reason the species should be excluded from the list of lichens of Poland.

Verrucaria apomelaena (A. Massal.) Hepp

Flechten Eur. No. 684. 1860. – *Lithoicea apomelaena* A. Massal., Symmic. Lich.: 89. 1855.

Taxon not confirmed in Poland. It is a currently accepted species (Breuss & Berger 2010), easily recognized by perithecia completely immersed in papillae of the thallus. In Poland it was reported by Eitner (1901) from Silesia ('Sacrauer Berg bei Gogolin') under the synonym *Lithoicea apomelaena*. However, Eitner's specimens were not available in the WRSL herbarium and no other specimens were found during the revision.

EXSICCATAE SEEN. Hepp, Flechten Eur. 684 (GFW).

Verrucaria barrandei Servít

Sbor. Nar. Mus. **5B**(9; Bot. 3): 15. 1949. TYPE: Bohemia: Praha, Chuchle. Ad lapides calc. in vivicinitate tabulae in memoriam palaeontologi J. Barrande-i hic positae, 260 m, 1891, *E. Bayer* (PRM 858070!, 858071! – SYNTYPES).

Mistakenly reported from Poland. The specimens labelled as this taxon in fact belong to *Verrucaria cataleptoides* (material from the Pieniny Mts) or *V. ochrostoma* (from the Gorce Mts). *Verrucaria barranderi* is very similar to *V. cataleptoides* in appearance but differs by lacking a brown basal layer and by smaller ascospores (16–24 × 10–12 µm). The taxonomic position of the species needs more attention.

Verrucaria beltraminiana (A. Massal.) Trevis.

Conspectus Verruc.: 7. 1860. – *Lithoicea beltraminiana* A. Massal., Symmicta Lich.: 93. 1855. TYPE: Ad muros et tegulas lateritias Prov. Patavinae nec non in ipsa urbe ad moenia, *Fr. Beltramini* (VER).

Taxon not confirmed in Poland. It is a good species easily recognized by an areolate thallus with perithecia distinctly placed between areoles (Breuss 2007a). However, no specimens were found in any of the investigated herbaria. The taxon was included on the Polish checklist of lichens (Fałtynowicz 2003) based on Körber's (1863) historical material from the suburbs of Wrocław. This material was revised by Stein (1879) and recognized by him as *Lithoicea ochrostoma*, a taxon currently accepted as *Verrucaria ochrostoma*. For this reason Körber's record cannot be accepted here.

Verrucaria buellioides Servít

Sbornik Narodniho Musea v Praze **5**(9): 17. 1949. TYPE: Germania: Heidelberg, auf Porphyrfelsen bei Handschuhsheim, *Zwackh-Holzhausen* (Zwackh, Lich. Exs. 151, M). – *Verrucaria mauroides sensu* Körb., Syst. Lich. Germaniae: 348. 1855. [*non Verrucaria mauroides* Schaer. Lich. Helv. Spicil. **7**: 335. 1836].

Mistakenly reported from Poland. The name *V. buellioides* was proposed by Servít (1949) to distinguish the specimens previously reported by Körber (1855) as *V. mauroides*. Furthermore, the name *V. buellioides* was incorrectly used by Nowak & Tobolewski (1975) for an amphibious lichen occurring in mountain streams on siliceous rocks in the splash zone. However, the type specimen of *V. buellioides* (Zwackh, Lich. Exs. 151, M) was collected in a non-aquatic habitat from Heidelberg (Germany) which is a rather sunny and dry place (H. Thüs, *in litt.*). It is obvious that this individual is not an amphibious species. Consequently, this name was incorrectly included on the Polish checklist of lichens as an aquatic taxon (Fałtynowicz 2003). The taxonomic status of the species is unclear.

Verrucaria crassiuscula Servít

Stud. Bot. Čech. **9**(2–4): 78. 1948.

Mistakenly reported from Poland. The specimens labelled as this taxon in fact belong to *Bagliettoa calciseda* (KRAM, KRAP) and *Thelidium* sp. (material from the Pieniny Mts KRAP).

Verrucaria erichsenii Zschacke

Verh. Bot. Vereins Prov. Brandenburg **70**: 192. 1928.

Taxon not confirmed in Poland. It was reported by Erichsen (1933) only from one locality in Świnoujście city. However, neither herbarium nor fresh material of this species was found during this study. Field investigations were conducted in Świnoujście in 2009 but the taxon was not confirmed there. This species is of uncertain taxonomic position.

Verrucaria fatrana Servít

Československé Lišenjníky Čeledi Verrucariaceae: 86. 1954. TYPE: [Slovakia] Malá Fatra, na vápenci Fatranského Krivaně 1550 m, 1936, *Suza* (PRM).

Mistakenly reported from Poland. The material reported from Poland as *V. fatrana* by Nowak (1961; KRAM L–71 and 31552) in fact belongs to two different species: *Parabagliettoa cyanea* and *Verrucaria caerulea* respectively. Unfortunately, the type material of *V. fatrana* was not available during this study. Based on the description of *V. fatrana* (Servít 1954), the species similarly to *P. cyanea* is characterized by a calcareous endolithic to partially superficial white thallus, half to ¾ immersed perithecia with an apical involucrellum, a globose and colourless excipulum, and ascospores similar in size. The name *V. fatrana* should probably be placed in synonyms of *Parabagliettoa cyanea*.

Verrucaria funckiana Servít

Ann. Mus. Civ. St. Nat. Genova **64**: 53. 1950. *illegit*. BASIONYM: *Lithoicea funckii* A. Massal. Memor. Lich. 143. 1853. TYPE: [Germany] 658 *Pyrenula funckii* von Steinen in klaren Gebirgsbächen, [*H. C. Funck*] (FR! – SYNTYPE). – *Verrucaria collematodes* f. *funckii* Servít, Stud. Bot. Čech. **7**(2–4): 66. 1946.

The name *Verrucaria funckiana* is illegitimate since it is a homotypic synonym of a currently known species, *Verrucaria funckii* (BASIONYM: *Pyrenula funckii* Spreng. TYPE: 658, *Pyrenula funckii*). Servít proposed a new status in the genus *Verrucaria* for a taxon introduced by Massalongo (1853) as *Lithoicea funckii*: first at form level (Servít 1946) and next at species level (Servít 1950). He proposed a new name, *Verrucaria funckiana*, as the name *Verrucaria funckii* (Spreng.) Zahlbr. (Zahlbruckner 1921) already existed. Servít may not have noticed that Massalongo (1853) had proposed only a new combination for the taxon previously described by Sprengel (1826) as *Pyrenula funckii*. Consequently, both species, *Verrucaria funckiana* and *Verrucaria funckii*, are based on the same type collection. For this reason the name *Verrucaria funckiana* is illegitimate and should be rejected as it was nomenclaturally superfluous when published.

Verrucaria funckiana was included in the recent Polish checklist of lichens (Fałtynowicz 2003) following two reports. One was based on the material from the Beskid Mały Mts named as *V.* cf. *funckiana* (Nowak 1965), however, the specimen was revised here and recognized as *V. tectorum*. The second report was from the Beskid Żywiecki Mts (Nowak 1998). The later one was probably based only on Nowak's field-work notes because no reference material was found in KRAM. Therefore, *V. funckiana* was in any case mistakenly reported from the country.

Verrucaria fusconigrescens Nyl.

Bull. Soc. Linn. Normandie, sér. 2, **6**: 313. 1872. – *Lithoicea fusconigrescens* (Nyl.) Flagey, Rev. Mycol. (Toulouse) **17**: 111. 1895. [*non Lithoicea fusconigrescens sensu* Eitner, Jahresber. Schles. Ges. Vaterl. Cultur **88**: 56. 1911].

Verrucaria fusconigrescens is currently known as a maritime species characterized by a brown superficial thallus, regularly areolate, with a conspicuous black prothallus. It has perithecia often sessile and arising directly on the prothallus, or semi-immersed in the areoles, and 0.2–0.4 mm in diam. It is also has a thick and brown-black involucrellum, that is 40–60 µm near the apex and extends beyond the excipulum, at the base up to 60–80 µm, and by ascospores of size 6–26 × 7–12 µm.

In Poland this taxon was mistakenly reported from the Sudeten Mts (Eitner 1911) in the south under its synonym *Lithoicea fusconigrescens*.

However, according to Zschacke (1934), the specimens reported by Eitner (1911) as *Lithoicea fusconigrescens* in fact belong to *Verrucaria praesudetica*, a newly distinguished taxon by Zschacke (see also below). Eitner's material was not available in WRSL and was probably lost during the Second World War.

Verrucaria glaucovirens Grumm.

Cat. Lich. Germ.: 16. 1963.

Taxon not confirmed in Poland. It is a good species recognized by a thick (0.4–0.6 mm), cracked-areolate thallus with areoles subangular in outline and secondarily subdivided into smaller units; the upper surface of thallus is uneven to warty-verrucose; perithecia are immersed, several per areole, without involucrellum (Breuss 2007a). No specimens were found in any of the investigated herbaria. The specimens labelled as this taxon in fact belong to *Verrucaria muralis* and *Verrucaria caerulea* (material from the Pieniny Mts KRAP).

Verrucaria halizoa Leight.

Lich. Fl. Great Brit. Irel. (London): 436. 1871.

Taxon not confirmed at present but likely to occur in Poland. It is a currently accepted species, characterised by maritime habitat and a thin, uncracked, pale olive-green to brown superficial thallus, without ridges or punctae. Perithecia of this species form conical-hemispherical projections up to 140–260 μm in diam. The involucrellum is dark and spreading, the excipulum is pale at the base, and the spores are small, oblong-ellipsoid to narrowly oblong-ellipsoid, 8–10 × 3.5–4.5 μm. This species was included in the Polish checklist of lichens (Fałtynowicz 2003) based on the material collected by Erichsen (1933) from Świnoujście city but the reference material could not be traced. The species was not found during a recent field investigation. Further studies at the Polish seashore may yield, however, confirmation of this taxon.

Verrucaria infidula Zschacke

Rabenh. Krypt.-Fl. **9**(1/1): 135. 1933. TYPE: Sudetenvorland: Eichberge bei Reichenbach; katzbachgebirge: Kitzelberg bei Kauffung auf Kalk, *Eitner* (WRSL – missing, probably lost).

Taxon not confirmed in Poland. *Verrucaria infidula* was described by Zschacke (1933) based on Eitner's (1911) collections from Silesia (Góra Połom Mt. near Wojcieszów – 'Kitzelberg by Kauffung and Eichberge by Reichenbach') and recognized by Eitner as *Verrucaria infumata*. However, specimens of this taxon are not available in the herbarium (WRSL) and the type material was probably lost during the Second World War. Taxonomic status of the species remains uncertain.

Verrucaria infumata Nyl.

Flora **64**: 452. 1881.

Mistakenly reported from Poland. It is a currently accepted species. *Verrucaria infumata* is known in Fennoscandia, where it grows on bricks in Sweden and Finland (Santesson *et al*. 2004; Pykälä 2008). In Poland this taxon was reported by Eitner (1911) from Silesia. During revision of *Verrucariaceae* Zschacke (1934) noted, however, that the specimens collected by Eitner as *V. infumata* from Góra Połom Mt. near Wojcieszów (Silesia) did not belong to this species. The author proposed to recognize them as a new species, *Verrucaria infidula* (see above). This fact was overlooked by Fałtynowicz (1993, 2003), who incorrectly included the name *V. infumata* in the Polish checklists.

Verrucaria körberi Hepp

Hepp, Flechten Eur. No. 692. 1860. TYPE: [Germany] an Dolomitfelsen in Laubwäldern bei Eichstätt (Baiern), *F. Arnold* (Hepp, Flechten Eur. 692, GFW! – ISOTYPE). – *Amphoridium körberi* (Hepp) Arnold, Flora **68**: 146. 1885.

Taxon not confirmed. This name was placed on Polish checklist of the Carpathian lichens (Bielczyk 2003) based on the information in Nowak and Tobolewski (1975). However, no material of this species was found in Polish herbaria.

Verrucaria longicollis (Eitner) Zahlbr.

Cat. Lich Univ. **1**: 56. 1921. – *Amphoridium longicollum* Eitner, Jahresber. Schles. Ges. Vaterl. Cultur **88**: 55.

1911. TYPE: [Poland] Kitzelberg bei Kauffung [Góra Połom near Wojcieszów] und Seitendorfer [Poniatów-Wałbrzych] Kalkberg, Kr. Schönau, *Eitner* (WRSL – missing, probably lost).

Taxon not confirmed in Poland. The species was described by Eitner (1911) as *Amphoridium longicollum*. It is characterized by greenish thallus, completely immersed parithecia and large ellipsoid ascospores 30–35 × 15–17 µm. Unfortunately, like other Eitner's collection, the type material was perhaps destroyed during the Second World War.

Verrucaria maculata Zschacke

Rabenh. Krypt.-Fl. **9**(1/1): 305. 1933. TYPE: [Poland] Schlesien: Leschnitz [Leśnica near Strzelce Opolskie], im WaldeJaszone auf Kalkbrocken (WRSL – missing, probably lost).

Taxon not confirmed in Poland. *Verrucaria maculata* was described by Zschacke (1933) based on herbarium material from Silesia collected and labelled by Eitner as *V. fusconigrescens*. However, no reference specimen was found.

Verrucaria mortarii Lamy

Bull. Soc. Bot. France **25**: 498. 1878.

Taxon not confirmed in Poland. This species was reported from one locality in the Polish Tatra Mts (Alstrup & Olech 1990). Unfortunately, the herbarium specimen was not available for the study in KRA.

Verrucaria obnigrescens Nyl.

Flora, Jena **58**: 362. 1875.

Taxon not confirmed in Poland. The specimens reported by Eitner (1911) from Silesia as *Lithoicea obnigrescens* in fact were distinguished by Zchacke (1933) as a new taxon *Verrucaria confusa*. Eitner's collection was not available during this study and it is probably missing.

Verrucaria podzimeki Servít

Vest. Kr. C. Spol. Nauk: 12. 1929. TYPE: Bohemia, Quarzit des Nižbor, 1928, *J. Podzimek* (PRM 756712! – HOLOTYPE). – *Amphoridium podzimekii* (Servít) Servít, Československé Lišenjníky Čeledi Verrucariaceae: 44. 1954. – *Phaeosporis podzimeki* (Servít) Clauzade, Diederich & Cl. Roux, Bull. Soc. Linn. Provence, Numero Special **1**: 71. 1989.

Taxon excluded from *Verrucaria*. The name *Verrucaria podzimeki* Servít was included into the synonyms of *Roselliniella microthelia* (Wallr.) Nik. Hoffm. & Hafellner by Hoffmann and Hafellner (2000). They observed that the specimen reported by Servít as a type of *Verrucaria podzimeki* (PRM 756712) was in fact a parasitic taxon growing on *Trapelia* cf. *obtegens* and should be classified as *Roselliniella microthelia*.

In Poland Toborowicz (1983) reported *Amphoridium podzimekii* from the Chęciny region in the Góry Świętokrzyskie Mts. However, the herbarium material was not available during this study in KTC and it is probably missing.

Verrucaria praesudetica Zschacke

Rabenh. Krypt.-Fl. **9**(1/1): 305. 1933. TYPE: [Poland] Schlesien Vorsudeten: Kreis Frankenstein, Wartha [Bardo] unter dem Bergsturz, *Eitner* (WRSL – missing, probably lost).

Taxon not confirmed in Poland. Based on Eitner's (1911) material reported as *Lithoicea fusconigrescens*, Zschacke (1933) distinguished a new species, *Verrucaria praesudetica*. However, specimens of this taxon were not available in WRSL and they were probably lost during the Second World War, including the type material.

Verrucaria pulicaris A. Massal.

Miscellanea Lichenologica: 28. 1856.

Taxon not confirmed in Poland. It was included in the Polish lichen checklists (Bielczyk 2003; Fałtynowicz 2003) based on published records (Stein 1879). However, no material was found under this name in any of the investigated herbaria.

Verrucaria pulvinata Eitner

Jahresber. Schles. Ges. Vaterl. Cultur **88**: 58. 1911. TYPE: [Poland, Sudeten] Sattlerschlucht [Borowy Jar] b. Hirschberg [Jelenia Góra] an Felsblöcken im Bett des Bober, *Eitner* (W! – HOLOTYPE).

Taxon excluded from the currently recognized genus *Verrucaria*. The type specimen of *V. pulvinata* is a lichenicolous fungus on *Rhizocarpon* (Thüs & Schultz 2008). For this reason the species should be excluded from the list of Polish *Verrucaria*.

Verrucaria pustulifera Servít

Stud. Bot. Čech **11**(3): 120. 1950. TYPE: Slovakia: Ztratená, vall. flum. Hnilec, 800 m, calc., 1933, *J. Suza*. (PRM 858074! – SYNTYPE).

Mistakenly reported from Poland. The material reported from the Góry Słonne Mts as *Verrucaria pustulifera* (Kiszka & Piórecki 1992) and available in KRAM in fact belongs to *Placopyrenium*.

Verrucaria tapetica Körb.

Syst. Lich. Germaniae: 349. 1855. TYPE: [Germany] An sonnig gelegenen trockenen Granitblöcken in Vorgebirge unter der Rosstrappe im Harz (Herb. Flk.) (WU! – SYNTYPE).

Species of uncertain status. *Verrucaria tapetica* should probably be synonymized with *V. nigrescens* due to the size of ascospores and the presence of a black basal layer. Unfortunately, the thallus of the type material (WU) is damaged, and it may never be determined with certainty. The specimen represents an eroded form of a terrestrial *Verrucaria* grazed by snails.

Taxon not confirmed in Poland. Nowak and Tobolewski (1975) treated this taxon as a freshwater *Verrucaria*, likely to occur in mountain streams on siliceous and non-calcareous rocks. However, Körber (1855) reported the type specimens of *V. tapetica* from dry and sun-exposed granite boulders. According to H. Thüs (*in litt*.) the type locality indicated in the protologue is situated on top of a high cliff by the river Bode. Ecological conditions observed on the cliff top are considerably different from those 200 meters below by the water where amphibious lichens occur. H. Thüs (*in litt*.) confirms that this taxon does not have a freshwater habitat. Because no herbarium material under this name was traced to be verified the species should be excluded from the Polish checklist.

SUMMARY

In Poland *Verrucaria* s.l. comprises seven genera and sixty two species in the study area. These are: *Bagliettoa baldensis*, *B. calciseda*, *B. marmorea*, *B. parmigerella*; *Hydropunctaria maura*, *H. rheitrophila*, *H. scabra*; *Parabagliettoa cyanea*, *P. disjuncta P. dufourii*; *Placopyrenium canellum*, *P. fuscellum*, *P. trachyticum*; *Verrucaria acrotella*, *V. amylacea*, *V. andesiatica*, *V. aquatilis*, *V. bryoctona*, *V. caerulea*, *V. cataleptoides*, *V. cernaesis*, *V. cincta*, *V. denudata*, *V. dolosa*, *V. elaeina*, *V. elaeomelaena*, *V. funckii*, *V. latebrosa*, *V. macrostoma*, *V. maculiformis*, *V. madida*, *V. margacea*, *V. muralis*, *V. myriocarpa*, *V. nigrescens*, *V. nigroumbrina*, *V. obfuscans*, *V. ochrostoma*, *V. pachyderma*, *V. pinguicula*, *V. policensis*, *V. polonica*, *V. polysticta*, *V. praetermissa*, *V. procopii*, *V. sphaerospora*, *V. sublobulata*, *V. submauroides*, *V. submersella*, *V. tectorum*, *V. tristis*, *V. umbrinula*, *V. viridicans*, *V. viridula*, *V. xyloxena*; *Verrucula elegantaria*, *V. helvetica*, *V. polycarparia*, *V. protearia*; *Verruculopsis lecideoides* and *V. minutum*. Three of them, *Parabagliettoa disjuncta*, *Verrucula elegantaria* and *V. polycarparia*, are reported the first time from the country. Twenty five taxa are excluded from the study because they were mistakenly reported or not confirmed for the study area: *Bagliettoa limborioides*, *Verrucaria apomelaena*, *V. barrandei*, *V. beltraminiana*, *V. buellioides*, *V. crassiuscula*, *V. erichsenii*, *V. fatrana*, *V. funckiana*, *V. fusconigrescens*, *V. glaucovirens*, *V. halizoa*, *V. infidula*, *V. infumata*, *V. körberi*, *V. longicollis*, *V. maculata*, *V. mortarii*, *V. obnigrescens*, *V. podzimeki*, *V. praesudetica*, *V. pulicaris*, *V. pulvinata*, *V. pustulifera* and *V. tapetica*.

Numerous nomenclatural and taxonomic clarifications were made in the survey. Two new combinations are proposed: *Parabagliettoa disjuncta* and *Verruculopsis minutum*. Three taxa were typified: *Verrucaria timkoii* (PRM, lectotype), *Thrombium lecideoides* (W, neotype), *Verrucaria aquatilis* var. *aerimontana* (PRM, lectotype). The synonymy of the following taxa are proposed: *Lithoicea nigrescens* var. *acrotella* with *Verrucaria nigrescens*; *Verrucaria amylacea* f. *compacta* with *Verrucaria*

amylacea; *Verrucaria aquatilis* var. *aerimontana* with *Verrucaria aquatilis*; *Verrucaria atroviridis* with *Verrucaria aquatilis*; *Verrucaria denudata* f. *dissulta* with *Verrucaria funckii*; *Verrucaria elaeina* var. *determinata* with *Verrucaria praetermissa*; *Verrucaria elaeina* var. *effusa* with *Verrucaria submersella*; *Verrucaria hoffmanni* with *B. marmorea*; *Verrucaria maura* var. *opaca* with *Hydropunctaria scabra*; *Verrucaria nigrofusca* with *Verrucaria nigroumbrina*; *Verrucaria sublobulata* var. *robustior* with *Verrucaria sublobulata*; *Verrucaria timkoii* with *Bagliettoa calciseda*. Finaly, the name *Verrucaria funckiana* is rejected because it proved illegitimate as it was nomenclaturally superfluous when published.

In Poland members of *Verrucaria* s.l. grow on calcareous or siliceous rocks, or occasionally on soil and bark, or parasitically on other lichens. They develop in terrestrial or aquatic freshwater and maritime habitats. The genera classified within *Verrucaria* s.l. have diverse habitat preferences and play an important role in a variety of ecosystems. The genus *Bagliettoa* contains species growing on calcareous or mortar substrates exposed to the sun, in low to moderate eutrophic environments. They are saxicolous, calcicolous, xerophilous, photophilous, and slightly to moderately nitrophilous species. The genus *Hydropunctaria* comprises saxicolous, hydrophilic (aquatic or amphibious), non-calcicole species, colonizing either marine or freshwater habitats. *Parabagliettoa* contains species growing on calcareous rocks, in both moderately sunny and shady sites. Species of *Placopyrenium* often grow parasitically, especially at young developmental stages, or later parasymbiotically on lichen hosts growing on different substrate types, often on both calcareous and siliceous rocks. *Verrucaria* species occur on various rocks, rarely on bark or soil, in terrestrial, maritime or freshwater habitats. *Verrucula* contains exclusively parasitic species growing on thalli or rarely on apothecia of lichens containing anthraquinones. *Verruculopsis* is another mostly parasitic genus, but only its non-parasitic members have been recorded in Poland on vertical to horizontal surfaces of rocks in sunny and exposed places.

The species of *Verrucaria* s.l. are widespread throughout Poland and their ranges well correspond with the spatial distribution of various habitats in the country. The species of *Bagliettoa* occur on calcareous outcrops in Poland, such as in the Wyżyna Śląsko-Krakowska upland, and at scattered localities in the mountainous region in the Pieniny Mts, the Tatra Mts, and the Góry Świętokrzyskie Mts. The freshwater species of *Hydropunctaria* were discovered mainly in the Carpathian Mts in S Poland whereas the maritime species were recorded in NW Poland on the seashore of the Baltic See. The species of *Parabagliettoa* occur mainly in the Western Tatra Mts. They were also found at scattered localities in the Pieniny Mts and the Wyżyna Krakowsko-Częstochowska upland. The species of *Placopyrenium* occur in the mountainous regions of Poland: in the southern part of the Sudeten Mts and in the Carpathian Mts. They were also recorded in Central Poland in the Góry Świętokrzyskie Mts, the Wyżyna Woźnicko-Wieluńska upland and the Wyżyna Krakowsko-Częstochowska upland. The members of *Verrucaria* are widespread throughout the country and their distribution depends on their ecological requirements. Some species of *Verrucaria* are common and widespread and occur on natural and anthropogenic substrates throughout the country in both mountainous and lowland regions (e.g. *V. aquatilis*, *V. elaeina*, *V. maculiformis*, *V. muralis*). The spatial distribution of some other species depends on the occurrence of suitable habitats in Poland. For example, the distribution of *V. praetermissa* is related to the occurrence of freshwater mountain springs while the distribution of *V. polonica* is connected with the occurrence of calcareous outcrops at xerothermic localities. However, data on the distribution of all *Verrucaria* species in Poland are still incomplete and do not reflect actual distribution patterns. The species of *Verrucula* grow at xerothermic localities mainly in the Wyżyna Woźnicko-Wieluńska upland and the Wyżyna Krakowsko-Częstochowska upland in central Poland and at scattered localities the Western Tatra Mts and the Pieniny Mts. The species of *Verruculopsis* occur at lower altitudes, at xerothermic localities in the Wyżyna Kielecko-Sandomierska upland and the Wyżyna Śląsko-

Krakowska uplands, and at scattered localities in the Pieniny Mts in the Carpathian Mts.

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CHECKLIST

Amphoridium calcisedum (DC.) Servít → ***Bagliettoa calciseda*** (DC.) Gueidan & Cl. Roux
Amphoridium carneum (Arnold) Servít → ?***Verrucaria hochstetteri*** Fr.
Amphoridium deminutum (Servít) Servít → ***Verrucaria obfuscans*** (Nyl.) Nyl
Amphoridium deminutum f. *policense* (Serví) Servít → ***Verrucaria policensis*** Servít
Amphoridium detersum (Kremp.) Servít → ***Verrucaria macrostoma*** Dufour *ex* DC.
Amphoridium dolomiticum A. Massal. → ?***Verrucaria hochstetteri*** Fr.
Amphoridium hochstetteri (Fr.) A. Massal. → ***Verrucaria hochstetteri*** Fr.
Amphoridium impurum J. Nowak → ***Verrucaria obfuscans*** (Nyl.) Nyl
Amphoridium ionospicarpum J. Nowak, → ?***Verrucaria hochstetteri*** Fr.
Amphoridium marmoreum (Scop.) Baroni → ***Bagliettoa marmorea*** (Scop.) Gueidan & Cl. Roux
Amphoridium mastoideum A. Massal. → ***Verrucaria hochstetteri*** Fr.
Amphoridium obfuscans (Nyl.) Servít → ***Verrucaria obfuscans*** (Nyl.) Nyl
Amphoridium polygonium (Körb.) Servít → ***Verrucaria viridula*** (Schrad.) Ach.
Amphoridium praecellens Arnold → ***Verrucaria hochstetteri*** Fr.
Amphoridium saprophilum A. Massal. → ***Verrucaria hochstetteri*** Fr.
Amphoridium timkoi (Servít) Servít → ***Bagliettoa calciseda*** (DC.) Gueidan & Cl. Roux
Amphoridium viridulum (Ach.) Servít → ***Verrucaria viridula*** (Schrad.) Ach.
Bagliettoa baldensis (A. Massal.) Vězda
Bagliettoa calciseda (DC.) Gueidan & Cl. Roux
Bagliettoa marmorea (Scop.) Gueidan & Cl. Roux
Bagliettoa parmigera (J. Steiner) Vězda & Poelt → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Bagliettoa parmigerella (Zahlbr.) Vězda & Poelt
Bagliettoa sphinctrina (Duf.) Körb. → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Bagliettoa steineri (Kušan) Vězda → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Catapyrenium trachyticum (Hazsl.) R. Sant. → ***Placopyrenium trachyticum*** (Hazsl.) Breuss
Dermatocarpon anzianum Servít → ***Verrucaria sphaerospora*** Anzi
Dermatocarpon serpentini (Servít) Servít → ***Placopyrenium fuscellum*** (Turner) Gueidan & Cl. Roux
Dermatocarpon subfuscellum (Nyl.) Servít → ***Verrucaria polysticta*** Borrer
Dermatocarpon subfuscellum var. *serpentini* Servít → ***Placopyrenium fuscellum*** (Turner) Gueidan & Cl. Roux
Dermatocarpon subpruinosum (Servít) Servít → ***Verrucaria polysticta*** Borrer
Dermatocarpon trachyticum (Hazsl.) Vain → ***Placopyrenium trachyticum*** (Hazsl.) Breuss
Endocarpon viridulum Schrad. → ***Verrucaria viridula*** (Schrad.) Ach.
Endopyrenium helveticum B. de Lesd. → ***Verrucula helvetica*** (B. de Lesd.) Nav.-Ros. & Cl. Roux
Endopyrenium trachyticum Hazsl. → ***Placopyrenium trachyticum*** (Hazsl.) Breuss
Hydropunctaria maura (Wahlenb.) Keller, Gueidan & Thüs
Hydropunctaria rheitrophila (Zschacke) Keller, Gueidan & Thüs
Hydropunctaria scabra (Vězda) Keller, Gueidan & Thüs
Involucrothele maculiformis (Kremp.) Servít → ***Verrucaria maculiformis*** Kremp.
Involucrothele margacea (Wahlenb.) Servít → ***Verrucaria margacea*** (Wahlenb.) Wahlenb.
Involucrothele plumbea (Ach.) Servít → ***Verrucaria caerulea*** DC.
Involucrothele velutinoides (Hellb.) Servít → ***Verrucaria xyloxena*** Norman
Leiophloea praetermissa Trevisan → ***Verrucaria praetermissa*** (Trevisan) Anzi
Lichen fuscellus Turner → ***Placopyrenium fuscellum*** (Turner) Gueidan & Cl. Roux
Lichen marmoreus Scop. → ***Bagliettoa marmorea*** (Scop.) Gueidan & Cl. Roux
Limboria sphinctrina Duf. → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Lithoicea aquatilis (Mudd) Stein → ***Verrucaria aquatilis*** Mudd
Lithoicea cataleptoides (Nyl.) Arnold → ***Verrucaria cataleptoides*** (Nyl.) Nyl.
Lithoicea cataleptoides f. *alutacea* (Hepp) Arnold → ***Verrucaria cataleptoides*** (Nyl.) Nyl.
Lithoicea elaeomelaena A. Massal. → ***Verrucaria elaeomelaena*** (A. Massal.) Arnold
Lithoicea elaeomelaena var. *alpina* Arnold → ***Verrucaria margacea*** (Wahlenb.) Wahlenb.
Lithoicea macrostoma var. *detersa* (Kremp.) Stein → ***Verrucaria macrostoma*** Dufour *ex* DC.
Lithoicea margacea (Wahlenb.) A. Massal. → ***Verrucaria margacea*** (Wahlenb.) Wahlenb.

Lithoicea maura Stein → ***Hydropunctaria scabra*** (Vězda) Keller, Gueidan & Thüs

Lithoicea nigrescens (Pers.) A. Massal. → ***Verrucaria nigrescens*** Pers.

Lithoicea nigrescens var. *acrotella* A. Massal. → ***Verrucaria nigrescens*** Pers.

Lithoicea nigrescens var. *umbrina* A. Massal. → ***Verrucaria nigroumbrina*** (A. Massal.) Servít

Lithoicea ochrostoma (Borrer) Stein → ***Verrucaria ochrostoma*** Borrer

Lithoicea tectorum A. Massal. → ***Verrucaria tectorum*** (A. Massal.) Körb.

Lithoicea tristis A. Massal. → ***Verrucaria tristis*** (A. Massal.) Kremp.

Parabagliettoa cyanea (A. Massal.) Gueidan & Cl. Roux

Parabagliettoa disjuncta (Arnold) Krzewicka

Parabagliettoa dufourii (DC.) Gueidan & Cl. Roux

Placopyrenium canellum (Nyl.) Gueidan & Cl. Roux

Placopyrenium fuscellum (Turner) Gueidan & Cl. Roux

Placopyrenium trachyticum (Hazsl.) Breuss

Protobagliettoa bagliettoaeformis (Hazsl.) Servít *ex* J. Nowak & Tobol. → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt

Protobagliettoa bagliettoaeformis var. *istriana* (Servít) Servít *ex* J. Nowak & Tobol. → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Protobagliettoa baldensis (A. Massal) Servít *ex* J. Nowak & Tobol. → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Protobagliettoa gyelnikii (Servít) Servít *ex* J. Nowak & Tobol. → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Protobagliettoa inaequata (Servít) Servít *ex* J. Nowak & Tobol. → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt

Protobagliettoa kutakiana Servít → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt

Protobagliettoa lactea (Arnold) Servít → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Protobagliettoa obscurata (Servít) Servít → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Protobagliettoa parmigera (J. Steiner) Servít → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Protobagliettoa parmigera var. *bohemica* (Servít) J. Nowak & Tobol. → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Protobagliettoa parmigera var. *pieninensis* (Servít) J. Nowak & Tobol. → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt

Protobagliettoa parmigerella (Zahlbr.) Servít → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt

Protobagliettoa steineri (Kušan) Servít *ex* Nowak & Tobolewski → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Pyrenula funckii Spreng. → ***Verrucaria funckii*** (Spreng.) Zahlbr.

Thelidium bryoctonum Th. Fr. → ***Verrucaria bryoctona*** (Th.Fr.) Orange

Thelidium dufourii (DC.) Servít → ***Parabagliettoa dufourii*** (DC.) Gueidan & Cl. Roux

Thelidium velutinoide (Hellb.) Servít → ***Verrucaria xyloxena*** Norman

Thelidium xyloxenum (Norman) Norman → ***Verrucaria xyloxena*** Norman

Thelotrema margaceum Wahlenb. → ***Verruccaria margaceum*** (Wahlenb.) Wahlenb.

Thrombium lecideoides A. Massal. → ***Verruculopsis lecideoides*** (A. Massal.) Gueidan & Cl. Roux

Thrombium murorum A. Massal. → ***Verruccaria macrostoma*** Duffour *ex* DC.

Verrucaria acrotella auct. *non* Ach.

Verrucaria acrotella f. *terrestris* Arnold → ***Verrucaria xyloxena*** Norman

Verrucaria aethiobola auct. → ***Verrucaria cernaensis*** Zschacke

Verrucaria aethioboloides Zschacke → ***Verrucaria funckii*** (Spreng.) Zahlbr.

Verrucaria alpicola Zschacke → ***Verrucaria margacea*** (Wahlenb.) Wahlenb.

Verrucaria alutacea sensu Körb. → ***Verrucaria cataleptoides*** (Nyl.) Nyl.

Verrucaria amylacea Hepp

Verrucaria amylacea f. *compacta* Arnold → ***Verrucaria amylacea*** Hepp

Verrucaria amylacea f. *evanida* Arnold → ***Verrucaria cincta*** Hepp

Verrucaria andesiatica Servít

Verrucaria annulifera Eitner → ***Verrucaria praetermissa*** (Trevisan) Anzi

Verrucaria anziana Garov. → ***Verrucaria latebrosa*** Körb.

Verrucaria aquatilis Mudd

Verrucaria aquatilis var. *aerimontana* Servít → ***Verrucaria aquatilis*** Mudd

Verrucaria atroviridis Servít → ***Verrucaria aquatilis*** Mudd

Verrucaria atroviridis Servít *ex* J. Nowak & Tobol. → ***Verrucaria aquatilis*** Mudd

Verrucaria bagliettoaeformis (Hazsl.) Servít → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt

Verrucaria bagliettoaeformis var. *istriana* Servít → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Verrucaria baldensis A. Massal. → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Verrucaria basaltica Servít → ***Verrucaria latebrosa*** Körb.
Verrucaria bryoctona (Th.Fr.) Orange
Verrucaria caerulea DC.
Verrucaria calciseda DC. → ***Bagliettoa calciseda*** (DC.) Gueidan & Cl. Roux
Verrucaria calciseda f. *bagliettoaeformis* Hazsl. → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt
Verrucaria calciseda var. *lactea* Arnold → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Verrucaria canella Nyl. → ***Placopyrenium canellum*** (Nyl.) Gueidan & Cl. Roux
Verrucaria canella Nyl. → ***Placopyrenium canellum*** (Nyl.) Gueidan & Cl. Roux
Verrucaria carnea (Arnold) Servít → ?***Verrucaria hochstetteri*** Fr.
Verrucaria catalepta var. *alutacea* Hepp → ***Verrucaria cataleptoides*** (Nyl.) Nyl.
Verrucaria cataleptoides (Nyl.) Nyl.
Verrucaria cataleptoides var. *alutacea* (Hepp) Servít → ***Verrucaria cataleptoides*** (Nyl.) Nyl.
Verrucaria cataleptoides var. *ochrostoma* (Borrer *ex* Leight.) Servít → ***Verrucaria ochrostoma*** Borrer
Verrucaria cernaensis Zschacke
Verrucaria chlorotica var. *pachyderma* Arnold → ***Verrucaria pachyderma*** (Arnold) Arnold
Verrucaria cincta Hepp
Verrucaria cincta var. *subcincta* (Nyl.) Servít → ***Verrucaria cincta*** Hepp
Verrucaria concinna Borrer → ***Parabagliettoa dufourii*** (DC.) Gueidan & Cl. Roux
Verrucaria congregata Hepp → ***Verrucaria myriocarpa*** Hepp
Verrucaria cyanea A. Massal. → ***Parabagliettoa cyanea*** (A. Massal.) Gueidan & Cl. Roux
Verrucaria deminuta (Servít) Servít → ***Verrucaria obfuscans*** (Nyl.) Nyl.
Verrucaria denudata Zschacke
Verrucaria denudata f. *dissulta* Servít → ***Verrucaria funckii*** (Spreng.) Zahlbr.
Verrucaria denudata f. *mougeotii* Servít → ***Verrucaria funckii*** (Spreng.) Zahlbr.
Verrucaria denudata var. *mougeotii* Zschacke → ***Verrucaria funckii*** (Spreng.) Zahlbr.
Verrucaria detersa (Kremp.) Stizenb. → ***Verrucaria macrostoma*** Dufour *ex* DC.
Verrucaria disjuncta Arnold → ***Parabagliettoa disjuncta*** (Arnold) Krzewicka
Verrucaria dolomitica (A. Massal.) Kremp. → ***Verrucaria hochstetteri*** Fr.
Verrucaria dolosa Hepp
Verrucaria dufourii DC. → ***Parabagliettoa dufourii*** (DC.) Gueidan & Cl. Roux
Verrucaria elaeina Borrer
Verrucaria elaeina var. *determinata* Körb. → ***Verrucaria praetermissa*** (Trevisan) Anzi
Verrucaria elaeina var. *effusa* Körb. → ***Verrucaria submersella*** Servít
Verrucaria elaeomelaena (A. Massal.) Arnold
Verrucaria elaeomelaena f. *silicicola* Zschacke → ***Verrucaria funckii*** (Spreng.) Zahlbr.
Verrucaria elegantaria Zehetl. → ***Verrucula elegantaria*** (Zehetl.) Nav.-Ros. & Cl. Roux
Verrucaria foveolata (Flörke) A. Massal. → ?***Verrucaria hochstetteri*** Fr.
Verrucaria funckii (Spreng.) Zahlbr.
Verrucaria fuscella (Turner) Winch → ***Placopyrenium fuscellum*** (Turner) Gueidan & Cl. Roux
Verrucaria fuscella f. *subpruinosa* Servít → ***Verrucaria polysticta*** Borrer
Verrucaria fuscella var. *nigricans* Nyl. → ***Verrucaria polysticta*** Borrer
Verrucaria fuscoatroides Servít → ?***Verrucaria nigroumbrina*** (A. Massal.) Servít
Verrucaria guestphalica auct. → ***Verrucaria elaeina*** Borrer
Verrucaria guestphalica Servít → ***Verrucaria praetermissa*** (Trevisan) Anzi
Verrucaria gyelnikii f. *obscurata* Servít → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Verrucaria gyelnikii Servít → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Verrucaria helveticorum Zehetl. → ***Verrucula helvetica*** (B. de Lesd.) Nav.-Ros. & Cl. Roux
Verrucaria hochstetteri Fr.
Verrucaria hoffmanni Hepp → ***Bagliettoa marmorea*** (Scop.) Gueidan & Cl. Roux
Verrucaria hydrela auct. → ***Verrucaria denudata*** Zschacke
Verrucaria inaequata (Servít) Servít → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt
Verrucaria kernstockii f. *minutipuncta* (Erichsen) Servít → ***Hydropunctaria rheitrophila*** (Zschacke) Keller, Gueidan & Thüs
Verrucaria kernstockii Zschacke → ***Hydropunctaria rheitrophila*** (Zschacke) Keller, Gueidan & Thüs
Verrucaria laevata Körber → ***Verrucaria praetermissa*** (Trevisan) Anzi
Verrucaria latebrosa Körb.

Verrucaria lecideoides (A. Massal.) Trevis. → ***Verruculopsis lecideoides*** (A. Massal.) Gueidan & Cl. Roux

Verrucaria lecideoides var. *minuta* Hepp → ***Verruculopsis minutum*** (Hepp) Krzewicka

Verrucaria leightonii Hepp → ***Verrucaria margacea*** (Wahlenb.) Wahlenb.

Verrucaria leightonii var. *carnea* Arnold → ?***Verrucaria hochstetteri*** Fr.

Verrucaria limitata Kremp. → ***Parabagliettoa cyanea*** (A. Massal.) Gueidan & Cl. Roux

Verrucaria litorea (Hepp) Zschacke → ***Verrucaria submersella*** Servít

Verrucaria macrostoma Dufour *ex* DC.

Verrucaria macrostoma var. *detersa* Kremp. → ***Verrucaria macrostoma*** Dufour *ex* DC.

Verrucaria maculiformis Kremp.

Verrucaria madida Orange

Verrucaria margacea (Wahlenb.) Wahlenb.

Verrucaria margacea var. *cataleptoides* Nyl. → ***Verrucaria cataleptoides*** (Nyl.) Nyl.

Verrucaria marmorea (Scop.) Arnold → ***Bagliettoa marmorea*** (Scop.) Gueidan & Cl. Roux

Verrucaria mastoidea (A. Massal.) Trevisan → ***Verrucaria hochstetteri*** Fr.

Verrucaria maura Wahlenb. → ***Hydropunctaria maura*** (Wahlenb.) Keller, Gueidan & Thüs

Verrucaria maura var. *memnonia* Körb. → ?***Verrucaria aquatilis*** Mudd

Verrucaria maura var. *opaca* Körb. → ***Hydropunctaria scabra*** (Vězda) Keller, Gueidan & Thüs

Verrucaria melaenella Vain. → ***Verrucaria xyloxena*** Norman

Verrucaria memnonia (Körb.) Arnold → ?***Verrucaria aquatilis*** Mudd

Verrucaria minor Breuss → ***Verruculopsis minutum*** (Hepp) Krzewicka

Verrucaria minuta (Hepp) Zschacke → ***Verruculopsis minutum*** (Hepp) Krzewicka

Verrucaria minutipuncta Erichsen → ***Hydropunctaria rheitrophila*** (Zschacke) Keller, Gueidan & Thüs

Verrucaria mougeotii (Zschacke) Servít → ***Verrucaria funckii*** (Spreng.) Zahlbr.

Verrucaria muralis Ach.

Verrucaria murina auct. *non* Leight. → ***Verrucaria myriocarpa*** Hepp

Verrucaria murorum auct. *non* (A. Massal.) Lindau. → ***Verrucaria macrostoma*** Dufour *ex* DC.

Verrucaria myriocarpa Hepp

Verrucaria nigrescens Pers.

Verrucaria nigrescens f. *tectorum* (A. Massal.) Coppins & Aptroot → ***Verrucaria tectorum*** (A. Massal.) Körb.

Verrucaria nigricans (Nyl.) Zschacke → ***Verrucaria polysticta*** Borrer

Verrucaria nigrofusca Servít → ***Verrucaria nigroumbrina*** (A. Massal.) Servít

Verrucaria nigroumbrina (A. Massal.) Servít

Verrucaria nigroumbrina f. *acrotella* (A. Massal.) Servít → ***Verrucaria nigrescens*** Pers.

Verrucaria nuda Zschacke → ***Verrucaria funckii*** (Spreng.) Zahlbr.

Verrucaria obfuscans (Nyl.) Nyl.

Verrucaria obfuscans var. *deminuta* Servít → ***Verrucaria obfuscans*** (Nyl.) Nyl

Verrucaria ochrostoma Borrer

Verrucaria opiziana Servít → ***Verrucaria nigrescens*** Pers.

Verrucaria pachyderma (Arnold) Arnold

Verrucaria papillosa Ach. → ***Verrucaria viridula*** (Schrad.) Ach.

Verrucaria parmigera J. Steiner → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Verrucaria parmigera var. *bohemica* Servít → ***Bagliettoa baldensis*** (A. Massal.) Vězda

Verrucaria parmigera var. *pieninensis* Servít → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt

Verrucaria parmigerella Zahlbr. → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt

Verrucaria pinguicula A. Massal.

Verrucaria plumbea Ach. → ***Verrucaria caerulea*** DC.

Verrucaria policensis Servít

Verrucaria polonica J. Nowak

Verrucaria polygonia Körb. → ***Verrucaria viridula*** (Schrad.) Ach.

Verrucaria polysticta Borrer

Verrucaria praecellens (Arnold) Servít → ***Verrucaria hochstetteri*** Fr.

Verrucaria praetermissa (Trevisan) Anzi

Verrucaria procopii Servít

Verrucaria protearia Zehetl. → ***Verrucula protearia*** (Zehetl.) Nav.-Ros. & Cl. Roux

Verrucaria psammophila Erichsen → ***Verrucaria bryoctona*** (Th.Fr.) Orange

Verrucaria rheitrophila Zschacke → ***Hydropunctaria rheitrophila*** (Zschacke) Keller, Gueidan & Thüs

Verrucaria rivalis Zschacke → ***Verrucaria submersella*** Servít

Verrucaria rupestris Schrader → ***Verrucaria muralis*** Ach.

Verrucaria rupestris var. *calciseda* (DC.) Schaer. → ***Bagliettoa calciseda*** (DC.) Gueidan & Cl. Roux

Verrucaria sagedioides Servít → ***Hydropunctaria rheitrophila*** (Zschacke) Keller, Gueidan & Thüs
Verrucaria saprophila (A. Massal.) Trevisan → ***Verrucaria hochstetteri*** Fr.
Verrucaria scabra Vězda → ***Hydropunctaria scabra*** (Vězda) Keller, Gueidan & Thüs
Verrucaria scotinodes Zschacke → ***Hydropunctaria rheitrophila*** (Zschacke) Keller, Gueidan & Thüs
Verrucaria shinctrinella Zschacke → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt
Verrucaria silicea Servít → ***Verrucaria funckii*** (Spreng.) Zahlbr.
Verrucaria silicicola (Zschacke) Servít → ***Verrucaria funckii*** (Spreng.) Zahlbr.
Verrucaria silvatica Zschacke → ***Verrucaria viridula*** (Schrad.) Ach.
Verrucaria sphaerospora Anzi
Verrucaria sphinctrinella Zschacke → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt
Verrucaria steineri Kušan → ***Bagliettoa baldensis*** (A. Massal.) Vězda
Verrucaria steineri var. *inaequata* Servít → ***Bagliettoa parmigerella*** (Zahlbr.) Vězda & Poelt
Verrucaria subcincta Nyl. → ***Verrucaria cincta*** Hepp
Verrucaria subdolosa auct. → ***Verrucaria dolosa*** Hepp
Verrucaria subfuscella Nyl. → ***Verrucaria polysticta*** Borrer
Verrucaria subhydrela Servít → ***Verrucaria denudata*** Zschacke
Verrucaria sublobulata Servít
Verrucaria sublobulata var. *robustior* Servít → ***Verrucaria sublobulata*** Servít
Verrucaria submauroides auct.
Verrucaria submersa Schaer. → ***Verrucaria submersella*** Servít
Verrucaria submersa var. *litorea* Hepp → ***Verrucaria submersella*** Servít
Verrucaria submersella Servít
Verrucaria subpruinosa (Servít) auct. → ***Verrucaria polysticta*** Borrer
Verrucaria tapetica var. *fluvialis* Eitner → ***Verrucaria praetermissa*** (Trevisan) Anzi
Verrucaria tectorum (A. Massal.) Körb.
Verrucaria terrestris (Arnold) Vain. → ***Verrucaria xyloxena*** Norman
Verrucaria timkoii Servít → ***Bagliettoa calciseda*** (DC.) Gueidan & Cl. Roux
Verrucaria tristis (A. Massal.) Kremp.
Verrucaria turicensis Zschacke → ***Verrucaria praetermissa*** (Trevisan) Anzi
Verrucaria umbrinula Nyl.
Verrucaria velana (A.Massal.) Zahlbr. → ?***Verrucaria macrostoma*** Dufour *ex* DC.
Verrucaria velutinoides Hellb. → ***Verrucaria xyloxena*** Norman
Verrucaria virens var. *obfuscans* Nyl. → ***Verrucaria obfuscans*** (Nyl.) Nyl.
Verrucaria viridicans Servít
Verrucaria viridula (Schrad.) Ach.
Verrucaria xyloxena Norman
Verrucaria zahlbruckneri Zschack → ***Verrucaria praetermissa*** (Trevisan) Anzi
Verrucula elegantaria (Zehetl.) Nav.-Ros. & Cl. Roux
Verrucula helvetica (B. de Lesd.) Nav.-Ros. & Cl. Roux
Verrucula polycarparia Nav.-Ros. & Cl. Roux
Verrucula protearia (Zehetl.) Nav.-Ros. & Cl. Roux
Verruculopsis lecideoides (A. Massal.) Gueidan & Cl. Roux
Verruculopsis minutum (Hepp) Krzewicka

Index to scientific names of lichens