

The lichen genus *Porpidia* in Poland II. Species with soredia

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Abstract: JABŁOŃSKA, A. 2009. The lichen genus *Porpidia* in Poland II. Species with soredia. – *Herzogia* 22: 135–146.

This paper presents a revision of the sorediate *Porpidia* species from Poland. *Porpidia albocaerulescens*, *P. melinodes*, *P. soredizodes*, *P. superba* and *P. tuberculosa* are treated in detail. *Porpidia superba* f. *sorediata* is reported as new to Poland and the sorediate morph of *P. albocaerulescens* is also recorded in the country for the first time. The occurrence of *P. rugosa* has not been confirmed for Poland and the status of previous records of this species remains unclear; all available Polish material filed under the name *P. rugosa* belongs to *P. soredizodes*, *P. tuberculosa* or *P. albocaerulescens*. The taxonomy, chemistry, habitat requirements, distribution and morphological variation of sorediate *Porpidia* species in Poland are described. A key for sorediate taxa in Poland, including *P. rugosa*, is provided.

Zusammenfassung: JABŁOŃSKA, A. 2009. Die Flechtengattung *Porpidia* in Polen II. Sorediöse Arten. – *Herzogia* 22: 135–146.

Vorliegende Arbeit präsentiert eine Revision der sorediösen *Porpidia*-Arten von Polen. *Porpidia albocaerulescens*, *P. melinodes*, *P. soredizodes*, *P. superba* und *P. tuberculosa* werden detailliert behandelt. *Porpidia superba* f. *sorediata* ist neu für Polen, und die sorediöse Form von *P. albocaerulescens* wird ebenfalls erstmals für das Land angegeben. Das Vorkommen von *P. rugosa* konnte für Polen nicht bestätigt werden, und der Status früherer Angaben dieser Art bleibt ungeklärt. Alles verfügbare polnische Material, was bisher unter dem Namen *P. rugosa* abgelegt war, gehört zu *P. soredizodes*, *P. tuberculosa* oder *P. albocaerulescens*. Taxonomie, Chemie, Habitatanforderungen, Verbreitung und morphologische Variation der sorediösen *Porpidia*-Arten in Polen werden beschrieben, und für alle sorediösen Taxa, einschließlich *P. rugosa*, wird ein Bestimmungsschlüssel vorgelegt.

Key words: Lichen taxonomy, chemotaxonomy, Lecideaceae, *Porpidia*, lichenized Ascomycota.

Introduction

Porpidia Körb. is a genus of crustose, saxicolous lichens widespread in Poland. According to the literature four sorediate species have been reported from Poland: *P. melinodes* (Körb.) Gowan & Ahti, *P. rugosa* (Taylor) Coppins & Fryday (as *P. glaucophaea* (Körb.) Hertel & Knoph), *P. soredizodes* (Lamy ex Nyl.) J.R.Laundon and *P. tuberculosa* (Sm.) Hertel & Knoph (see NOWAK & TOBOLEWSKI 1975, FAŁTYNOWICZ 2003). Some taxa were considered to be rather common (e.g. *P. tuberculosa*), but some were very rare, being reported from a few stands only (e.g. *P. melinodes*, *P. rugosa*).

The determination of sterile specimens of *Porpidia* causes many problems. The thallus is very often modified by various substrate and environmental factors, so that gross morphology often is a weak character for identification. Therefore, secondary lichen chemistry plays a significant role in the taxonomy of this genus (e.g. GOWAN 1989a, b, FRYDAY 2005).

Previously, the identification of Polish specimens was based mostly, or only, on differences in thallus morphology and the colour reactions with basic chemical reagents. As far as is known, no specimen was checked with thin layer chromatography (TLC).

The aims of this paper are to present the results of studies on the taxonomy, chemistry, morphology, habitat requirements and distribution of all *Porpidia* species producing soredia in Poland, with records of the species from other European countries as well. This paper is the second in a series dealing with the revision of *Porpidia* from Poland (see JABŁOŃSKA 2008).

Material and methods

All available material of *Porpidia* from Poland was studied. It was deposited in the following herbaria: B, E, GPN (Gorce National Park), KRA, KRAM, KRAP (Pedagogical University of Kraków), KTC, LOD, OLTC, OLS (Department of Botany and Nature Protection, University of Warmia and Mazury in Olsztyn), POZ, LBL, UGDA, WA, WRSL and private herbaria of K. Szczepańska, M. Dimos-Zych and M. Węgrzyn. For each taxon thickness, structure and colour of the thallus, colour, shape and size of soralia, and the presence and size, thickness, structure and colour of apothecia were studied. Secondary metabolites were examined by thin layer chromatography (TLC, in solvent C) according to the methods proposed by ORANGE et al. (2001). A spot-test-reaction with I was applied under dissecting microscope.

All examined localities are mapped according to the ATPOL grid square system (ZAJĄC 1978; modified by CIEŚLIŃSKI & FAŁTYNOWICZ 1993). For more explanations see KUKWA et al. (2002) and JABŁOŃSKA & KUKWA (2007).

Results

In the studied material from Poland, five *Porpidia* taxa producing soredia were identified. These are *P. albocaerulescens* (Wulfen) Hertel & Knoph, *P. melinodes*, *P. soredizodes*, *P. superba* f. *sorediata* Fryday and *P. tuberculosa*. The sorediate morph of *P. albocaerulescens* and *P. superba* (f. *sorediata*) are reported for the first time from Poland. Three species, *P. melinodes*, *P. soredizodes* and *P. tuberculosa* always produce soredia, but *P. albocaerulescens* and *P. superba* form them rather occasionally. In this work, sorediate and non-sorediate material of both, *P. albocaerulescens* and *P. superba*, are treated.

According to FAŁTYNOWICZ (2003) *Porpidia rugosa* (sub *P. glaucophaea*) has also been reported from Poland, however, during this revision it was found that all available Polish specimens were misidentified and belonged to *P. tuberculosa*, *P. soredizodes* or the sorediate morph of *P. albocaerulescens*. At present, the status of *P. rugosa* in Poland is unsettled and its occurrence in Poland is not confirmed.

In the absence of apothecia, the main difference between those taxa is their chemistry. Only *Porpidia rugosa* produces glaucophaeic and 2'-O-methylsuperphyllinic acids or confluent acid and methyl 2'-O-methylmicrophyllinate and lacks an amyloid medulla. *Porpidia tuberculosa* contains confluent acid accompanied with minor amounts of 2'-O-methylmicrophyllinic and 2'-O-methylperlatolic acids and its medulla reacts blue with I, whereas *P. soredizodes* contains stictic acid with related substances (e.g. GALLOWAY & COPPINS 1992, FRYDAY 2005; see also below under those species). *Porpidia albocaerulescens* also contains stictic acid as a major constituent together with cryptostictic acid, but it can also produce norstictic and connorstictic acids (*P. albocaerulescens* var. *polycarpiza* (Vain.) Rambold & Hertel) (see GOWAN 1989a, b, RAMBOLD 1989, FRYDAY 2005). Diagnostic characters of all sorediate taxa are summarized in Table 1.

Table 1: Discriminating characters of sorediate *Porpidia* taxa reported from Poland.

| <i>Porpidia</i> | main secondary metabolites | thallus | medulla | soralia | apothecia |
|---------------------------------------|--|--|---------|---|---|
| <i>albocaerulescens</i> | stictic acid | thin to medium thick, continuous, smooth to cracked, light greenish to grey or dark olive grey | I– | whitish grey or concolorous with thallus, slightly convex | usually present, innate, pruinose, disc usually black |
| <i>melinodes</i> | confluent acid and 2'-O-methylperlatolic acid | medium thick, cracked-areolate, orange to pale orange-grey | I– | whitish to bluish-grey | rare, not seen in Polish material |
| <i>rugosa</i> | glaucophaeic acid, 2'-O-methylsuperphyllinic acid or confluent acid, methyl 2'-O-methylmicrophyllinate | medium thick whitish, glaucous, continuous to cracked-areolate, creamy-grey | I– | whitish to grayish | immersed at first, becoming sessile, disc usually black, often pruinose |
| <i>superba</i> f. <i>sorediata</i> | stictic acid or no substances detected | usually medium thick continuous-cracked, creamy white | I– | concolorous with thallus, in cracks of thallus | rare, disc usually brown |
| <i>soredizodes</i> | stictic acid or no substances detected | small, continuous to subcontinuous, grey | I– | white, light grey to greenish, excavated or flat | rare, usually sessile, non-pruinose, disc usually black |
| <i>tuberculosa</i> | confluent acid and 2'-O-methylperlatolic acid | medium thick, cracked rimose, rimose-areolate, tones of gray | I+ blue | white, gray, or concolorous with thallus | rare, usually innate, sometimes pruinose disc usually black |

Additional specimens of *Porpidia rugosa* examined for comparison (selected): Italy. An Augitporphyrbloeken im Fichtenwalde zwischen Seiss und Razzes in Südtirol, 29.08.1879, F. Arnold (B–39695). **Great Britain.** Scotland, West Ross (V.C. 105), Dorine, Carr Brae, W-facing crags, c. 140 m alt., on rocks, 31.05.2005, B. J. Coppins, (E). England, South Somerset (V.C. 5), Shircombe Brake, (EWS 638), S side, c. 270 m alt., on sheltered rock, 21.07.2002, B. J. & A. M. Coppins 20620 (E 260015).

Exsiccate of *Porpidia rugosa* examined: Pišút, Lich. Slovak. Exs. 233 (UGDA)

The species

Porpidia albocaerulescens (Wulfen) Hertel & Knoph in Hertel

Beih. Nova Hedwigia 79: 433 (1984). – *Lichen albo-caerulescens* Wulfen, in Jacquin, Coll. Bot. III: 184 (1788).

Descriptions: Thallus light greenish to grey or dark olive grey, thin to medium thick, continuous, smooth to very finely cracked, subrimose, non-sorediate or rarely sorediate; soralia rounded, slightly convex, concolorous with the thallus or brighter and whitish grey; prothallus sometimes present; medulla I–; apothecia 0.6–1.2(–2,0) mm in diam., abundant, often contiguous or clustered, sunken in thallus when young, later usually become sessile; disc black or dark brown, with thick white or light grey pruina, often flat; margin not pruinose, ± thick, exciple with a dark pigmented cortex, epithecium olivaceous to brownish grey, containing granular material, N+ orange, K–; hymenium 60–90(–100) µm tall; asci *Porpidia* type, often immature; spores 5–8 × 11–18(–23) µm.

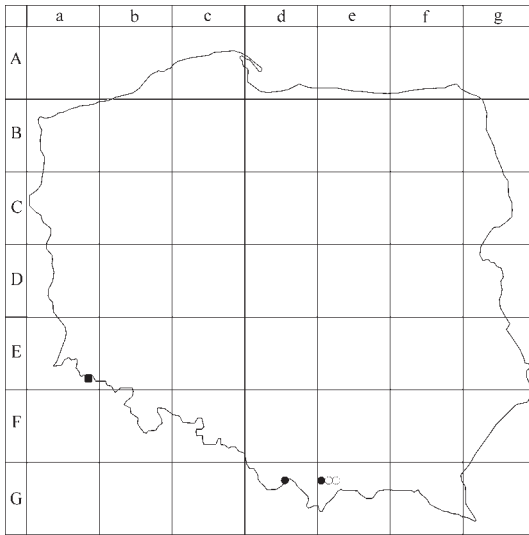


Fig. 1: Distribution of *Porpidia albocaerulescens* (black circles – specimens without soredia, white circles – specimens with soredia) and *P. melinodes* (square) in Poland given in ATPOL grid square system.

Chemistry: According to GOWAN (1989b) two chemotypes are known in *Porpidia albocaerulescens*, the first one with stictic acid as a major secondary metabolite, which is often accompanied with cryptostictic acid, and the second chemotype with norstictic acid and a trace of connorstictic acid. The norstictic acid chemotype shows different distribution patterns than the stictic acid chemotype (southern Mediterranean region, Philippines, India, China, Indonesia and North America; see GOWAN 1989, HERTEL 1977, RAMBOLD 1989) and is treated as a distinct variety, *P. albocaerulescens* var. *polycarpiza* (Vain.) Rambold & Hertel (RAMBOLD 1989). In Poland in all studied specimens only stictic acid was detected.

Notes: *Porpidia albocaerulescens* is characterized by a continuous, smooth to very finely cracked thallus, apothecia with pruinose disc that are sunken in the thallus when young, excipulum of thin, filamentous hyphae with a dark pigmented cortex and unpigmented medulla, non-amyloid thallus medulla and the presence of stictic acid or norstictic acid (that chemotype not found in

Poland) as major secondary metabolites (GOWAN 1989b, FRYDAY 2005). Sometimes, the species can produce soredia (GOWAN 1989b, FRYDAY 2005). The sorediate morph of *P. albocaerulescens* also occurs in Poland, but was represented by only two specimens.

In Polish herbarium-material, five specimens of *P. albocaerulescens* were found, four of which were filed under *P. rugosa* (as *P. glaucophaea*). These two species have a superficially similar thallus, pruinose apothecia that are sunken in thallus when young and the same type of excipulum, but they have different secondary chemistry (FRYDAY 2005; see also above and Table 1).

When sorediate, the chemotype of *P. albocaerulescens* with stictic acid is chemically identical to *P. soredizodes*, but *P. albocaerulescens* has a paler, creamy to pale gray, smooth and continuous thallus with slightly convex soralia, which is usually much thicker than in *P. soredizodes*. Soralia in the latter species are usually excavated or flat. Additionally, *P. albocaerulescens* usually produces apothecia, which are pruinose, whereas those of *P. soredizodes* lack pruina (GOWAN 1989b, FRYDAY et al. 2007; see also under *P. soredizodes*).

Also *P. superba* f. *sorediata* can contain stictic acid, but that species in Poland can be separated by continuous-cracked, creamy white thallus and soredia formed in the cracks of the thallus (Table 1; FRYDAY 2005).

Habitat requirements: As reported by FRYDAY (2005) this taxon prefers siliceous rocks in damp habitats. *P. albocaerulescens* is restricted to areas both with a damp humid and a winter-mild, summer-warm climate (see e.g. HERTEL 1981, WIRTH 1995). In Poland it was found only on acid rocks in forest conditions.

Distribution in Poland: The species has been reported only rarely from few stands in the Sudety Mts and the Carpathians in southern Poland (FAŁTYNOWICZ 2003 and literature cited therein). After revision of available material it has been confirmed only in the Carpathians (Fig. 1). No material from the Sudety Mts has been located so far.

World distribution: *Porpidia albocaerulescens* is rather widely distributed. In Europe it occurs in southern and continental regions (see FRYDAY 2005) and it has been also reported from eastern North America (GOWAN 1989b), eastern to south-eastern Asia, Himalaya Mts, Australia and New Zealand (e.g. HERTEL 1977, INOUE 1983, HERTEL & KNOPH 1984).

Number of specimens examined – 5

Specimens examined (specimens with asterisk have soredia): [**Gd–25**] – Pilsko Mt., 10 km S of Jeleśnia village, c. 1130 m, on stone, 14.07.1966, J. Nowak (KRAM-L–17717); [**Ge–20**] – Gorce Mts, Gorce National Park, by the border of the Turbacz nature reserve, 760 m, on sandstone, 23.10.1997, P. Czarnota (GPN 1883); [**Ge–21**]* – Gorce Mts, Gorce National Park, in the vicinity of Olszowy Potok stream below Hala Turbacza glade, 1150 m, on sandstone, 03.08.1996, P. Czarnota (GPN 1323); [**Ge–22**]* – Gorce Mts, N slope of Lubań Mt., on rock, 11.05.1959, K. Glanc (KRAM-L–48270). Additionally one esorediate specimens lacking data from POZ was examined.

Additional specimen examined: U.S.A. North Carolina, Durham, Duke Forest, between Constitution Drive and highway NC 751, 36°00'46"78°58'26"W, deciduous forest, on stone, 20.11.2005, M. Kukwa 4782 (UGDA-L–14630).

***Porpidia melinodes* (Körb.) Gowan & Ahti**

Ann. Bot. Fennici **30**: 67 (1993). – *Aspicilia melinodes* Körb., Sitzungsber. Österr. Akad. Wiss., Math.-Naturwiss. Kl., Abt. I **71**: 3 (1872).

Description: Thallus usually moderately thick, cracked-areolate, orange to pale orange-grey, smooth to cracked rimose, subrimose to rimose-areolate; prothallus black often visible between scattered areoles; medulla I–; soralia discrete, scattered, often rounded; soredia whitish to bluish-gray, granular; apothecia not seen in Polish material.

Chemistry: Thallus usually containing confluent acid, although other chemotypes with 2'-O-methylperlatolic acid and norstictic acid have been also reported (FRYDAY 2005). The Polish material contains confluent and 2'-O-methylperlatolic acids.

Notes: *Porpidia melinodes* has an obligate orange thallus with a non-amyloid (I–) medulla containing confluent acid (GOWAN & AHTI 1993, FRYDAY 2005). The species belongs to the *P. speirea* group, and within this group into the *flavicunda* subgroup (see BUSCHBOM & MUELLER 2004). Members of the *flavicunda* subgroup are characterized by an orange thallus containing confluent acid and an I– medulla. In Poland only *P. flavicunda* (Ach.) Gowan belongs to that group, but that species differs in the absence of soredia (FRYDAY 2005). *Porpidia flavicunda* was rarely reported from the country (FAŁTYNOWICZ 2003 and literature cited therein), but no material of it has been found so far and its occurrence in Poland is not confirmed during this study.

Habitat requirements: According to FRYDAY (2005) *Porpidia melinodes* usually occurs on metal-rich siliceous rocks in upland areas, however, in Poland it was reported on sandstone in an open area in the Carpathians (FAŁTYNOWICZ 2003) although I have not seen this material. At the new locality in Sudety Mts this species was found on metal-rich fragment of rock on boulder slopes of Śnieżka Mt.

Distribution in Poland: According to FAŁTYNOWICZ (2003) *Porpidia melinoides* was reported only from the Carpathians, however, the corresponding material was not available for this study. A new locality for this species was found during the field work in Karkonosze Mts (Fig. 1). It is the first record of *P. melinoides* for Polish part of the Sudety Mts.

World distribution: *Porpidia melinodes* is widespread and common throughout the boreal-arctic zones. The distribution range of the species is circumpolar in Northern Hemisphere (HERTEL 1977, HERTEL & KNOPH 1984, SCHWAB 1986, GOWAN & AHTI 1993).

Number of specimens examined – 3

Specimens examined: [**Ea–89**] – Karkonosze Mts, Karkonoski National Park, slope of Śnieżka Mt., 1443 m, on rock, 01.05.2007, A. Jabłońska (UGDA-L–14489, 14490 & 14491).

Additional specimens examined: **Greenland.** Kususuk, 64°43'N/51°18'W, on gneissic rock, 04.08.1997, E. S. Hansen (B–112572). **Spitsbergen.** Hornsund, on stones, 1958, M. Kuc (KRAM-L–34199 & 34201). Fuglebergsletta, 80 m, on pebbles, 09.1963, A. Środoń (KRAM-L–238 & 99).

***Porpidia soredizodes* (Lamy ex Nyl.) J.R.Laundon**

Bot. J. Linn. Soc. **101**: 104 (1989). – *Lecidea crustulata* [susp.] * *soredizodes* Lamy ex Nyl., Flora **66**: 534 (1883).

Description: Thallus usually of small patches, thin to patchily disappearing, light to dark grey or olive grey, subcontinuous, smooth to cracked rimose; prothallus present, black; medulla I–; soralia scattered, rounded to irregular; soredia white, light grey to greenish, farinose to granular; apothecia

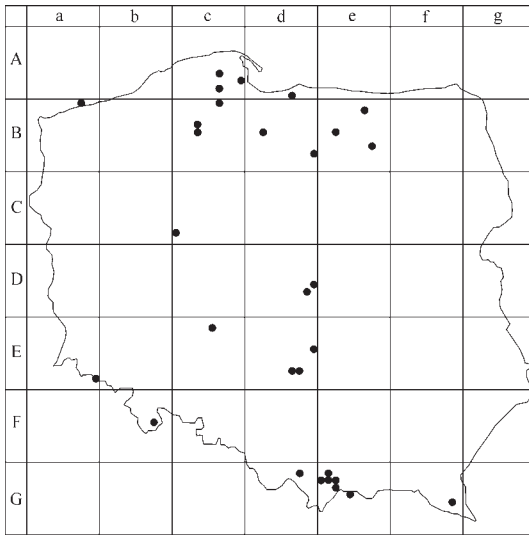


Fig. 2: Distribution of *Porpidia soledizodes* in Poland given in ATPOL grid square system.

rare, 0.4–0.7(–1.8) mm in diam., scattered, solitary to sessile; disc dark brown or black, non-pruinose, flat; proper margin thin, black; epithecium brownish to olive, N+ orange, K–; hymenium 65–90(–100) μm tall; asci *Porpidia*-type; mature spores not seen.

Chemistry: According to FRYDAY (2005) *Porpidia soledizodes* produces stictic acid, sometimes with traces of cryptostictic acid, or no lichen products can be detected. The thallus reacts K+ yellow and Pd+ red (FRYDAY 2005, FRYDAY et al. 2007, MAKAROVA et al. 1998). Stictic acid was detected in most of the Polish specimens, but in six samples no substances were found.

Notes: *Porpidia soledizodes* is characterized by a thin, gray thallus with a non-amyloid medulla, and by the presence of numerous, small (c. 0.3 mm diam.), discrete, usually excavate soralia containing blue-grey or cream-colored soredia and the production of stictic acid (sometimes absent) (see FRYDAY et al. 2007).

In Polish material ten specimens of *Porpidia soledizodes* were filed under *P. tuberculosa* and four under *P. glaucophaea* (*P. rugosa*). Although these three species can look similar in thallus morphology, they have different chemistries. The thallus of *P. soledizodes* has stictic acid and lacks an amyloid medulla, whereas *P. tuberculosa* contains confluent acid, 2'-O-methylperlatolic acid and has an amyloid (I+ blue) medulla. The last taxon, *P. rugosa* is easily distinguished by the thallus containing 2'-O-methylsuperphyllinic, glaucophaeic acids or confluent acid and methyl 2'-O-methylmicrophyllinate (FRYDAY 2005).

Porpidia soledizodes is chemically similar to *P. albocaerulescens* and *P. superba* f. *sorediata* and for the differences between these taxa see under *P. albocaerulescens* and Table 1.

Habitat requirement: *Porpidia soledizodes* grows on siliceous rocks, stonework, pebbles, and slate (GALLOWAY & COPPINS 1992, FRYDAY 2005, FRYDAY et al. 2007). In Poland it was found on several types of rock forms (boulders, pebbles, rock outcrops), including granite and sandstone, but also on bricks. The species usually grows in light forests (e.g., pine forests) or open places.

Distribution in Poland: The species is not common, but rather widespread in Poland and known from all parts of the country (Fig. 2). The results of the present study more or less confirm its previous distribution summarized by FAŁTYNOWICZ (2003).

World distribution: *Porpidia soledizodes* is a frequent species in northern and central Europe, where it occurs on siliceous rocks and pebbles in lowland situations (GALLOWAY & COPPINS 1992, FRYDAY 2005). It has also been reported from Australia (RAMBOLD 1989) and North America (GOWAN & BRODO 1988, FRYDAY et al. 2007).

Number of specimens examined – 45

Specimens examined (selected; all saxicolous): [Ac-66] – Between Paraszyno village and Strzebielino Morskie town, 04.08.2004, M. Kukwa 3405 (UGDA-L-10968); Porzeczce village by Łeba river, 20.07.1985, W. Fałtynowicz (UGDA-L-2885); [Ac-79] – Dolina Kaczej valley, 11.1994, M. Kukwa (UGDA-L-9732); [Ac-86] – Stanisławskie Błoto nature reserve, forest section No. 210g, 17.10.2006, M. Kukwa 5467 (UGDA-L-14984); [Ad-96] – Elbląg forest inspectorate, Górki forest district, forest section no. 214, valley of Grabianka river, 26.06.2003, R. Szymczyk (OLS-L-190). Kadyny forest district, forest section no. 184, valley of Grabianka river, 29.04.2007, R. Szymczyk (OLS-L-509); [Ba-07] – Niechorze village, on bricks, 12.06.1986, W. Fałtynowicz (UGDA-L-2926); [Be-06] – Węsiory village, Kamienne Kregi nature reserve, 16.06.2006, M. Kukwa 5204 (UGDA-L-12994); [Be-33] – Bory Tucholskie Forest, Asmus forest district, forest section no. 39c, 03.04.1975 & 28.03.1975, W. Fałtynowicz

(UGDA-L-625 & 645); [Bc-43] – Bory Tucholskie Forest, Popówka forest district, forest section no. 292b/c, 05.04.1978, W. Fałtynowicz (UGDA-L-362); [Bd-42] – C. 1, 5 km E of Ryjewo village, Lisewo forest district, forest section no. 212, 21.08.1996, M. Kukwa (UGDA-L-14301); [Bd-79] – 2 km NNW of Klonowo village, 09.2002, Sz. Karandys, J. Kiszka, M. Kukwa, A. Łubek (UGDA-L-9077); [Be-16] – C. 2 km W of Stopy village, 07.05.1989, J. Nowak (KRAM-L-31791); [Be-42] – Olsztyn town, 06.2001, D. Kubiak (OLTCL-); [Be-67] – Kuklanka range, by the road between Marksoby and Babięta villages, 01.05.1989, J. Nowak (KRAM-L-26218); [Cc-80] – Zielonka village near Poznań town, forest section no. 23, 16.07.1963 & 14.07.1962, K. Glanc (KRAM-L-39614 & 37415); [Dd-59] – Kwarna Buczyna nature reserve, 19.09.2006, D. Kubiak (OLTCL-); [Dd-68] – Tadzín village, forest section no. 110a, 16.11.2006, K. Czyżewska (LOD-L-12136); [Ea-89] – Karkonosze Mts, Karkonoski National Park, by the Kocioł Łomniczki cirque, 1075 m, 01.05.2007, M. Kukwa (UGDA-L-14502); Kocioł Łomniczki cirque, 02.05.2002, M. Kukwa 1528 (UGDA-L-13449); Slope of Śnieżka Mt., 1443 m, 02.05.2007, M. Kukwa (UGDA-L-14501); [Ee-15] – Ostrzeszów village, 28.03.1934, F. Krawiec (POZ); [Ed-49] – Bąkowa Góra village, 13.05.1970, R. Olaczek (LOD-L-1633); [Ee-76] – Świętokrzyskie Mts, Świętokrzyski National Park, S slope of Łysica Mt., 07.1957, B. Halicz, S. Kuziel (KTC); Św. Krzyż forest district, forest section no. 118, 03.07.2000, A. Donica (KTC); [Fb-47] – Masyw Śnieżnika Mts, 07.2003, K. Szczepańska (herb. Szczepańska); [Gd-17] – Policzne village, na glazie piaszkowym, 21.07.1974, J. Nowak (KRAM-L-29460). Okraglica Mt., c. 1240 m, on rock, 09.05.1965, J. Nowak (KRAM-L-16091); [Ge-11] – Gorce Mts, Gorczański National Park, valley of Turbacz stream, 760 m, 22.05.1996, P. Czarnota (GPN1388/94); [Ge-20] – Gorce Mts, Gorczański National Park, by Olszowy Potok stream, 760 m, 06.09.1994, P. Czarnota (GPN515/94); [Ge-21] – Gorce Mts, by Gajówka Mikołaja game-keeper's cottage, by Łopuszanka stream, 850 m, 12.11.1997, P. Czarnota (GPN1891/94). Turbacz nature reserve, by Turbacz stream, 940 m, 30.05.1996, P. Czarnota (GPN1748/94); [Ge-32] – Gorce Mts, Wdżar Mt., 49°27'17"N/20°19'09"E, 26.09.2007, M. Kukwa 5942a, A. Flakus, P. Czarnota (UGDA-L-14299); [Ge-22] – Gorce Mts, N slope of Lubań Mt., on rock, 11.05.1959, K. Glanc (KRAM-L-48270); [Ge-44] – Pieniny Mts, Wysokie Skałki nature reserve, 24.09.2002, J. Kiszka (KRAP, two specimens); [Gf-58] – Bieszczady Mts, Bieszczadzki National Park, valley of the Hulski stream, 660 m, 08.07.2002, J. Kiszka (KRAP); Połonina Wetlińska pasture, 1206 m, 11.09.2004, J. Kiszka (KRAP).

Porpidia superba (Körb.) Hertel & Knoph

In Hertel, Beih. Nova Hedwigia **79**: 438 (1984). – *Lecidea superba* Körb., Syst. Lich. Germ.: 248 (1855).

two forms are distinguished:

f. *superba*

f. *sorediata* Fryday

Lichenologist **79**: 23 (2005).

Description: Thallus moderately thick, scabrid, consisting of continuous to dispersed bullate areoles, surface weakly cracked, white to creamy white; prothallus black; medulla I-; soralia absent (f. *superba*) or present (f. *sorediata*), irregular, formed in the cracks of the thallus; soredia granular, concolorous with the thallus; apothecia present in Polish sorediate material, abundant on esorediate thalli, scattered among areoles, immersed at margins of areoles at first, later become sessile, 0.5–1.2(–2.0) mm in diam.; disc brown to dark brown, sometimes with white pruina, often flat; margin not pruinose, ± thick, mostly dark brown to blackish in section, epithecium brownish to orange-brown, N+ orange, K– (superba-brown; MEYER & PRINTZEN 2000); hymenium 90–140(–150) μm tall; asci *Porpidia* type; spores 16–20(–21) × 6–9 μm.

Chemistry: Stictic acid usually present, but often in small amounts or patchily distributed in thalli (FRYDAY 2005). In Polish material stictic acid was detected in five specimens, in the rest of the specimens no substances were detectable by TLC.

Notes: According to FRYDAY (2005), two forms of *Porpidia superba* are distinguished: f. *superba* and f. *sorediata* Fryday. The first taxon is a lichen of dry to shaded habitats and basic rocks, with well-developed, white, bullate thallus, and apothecia that are constricted at the base and have a brown disc. However, when the species grows in dumper places, the thallus can be less prominent and the apothecial disc darker. The characters in common between those two extremes are the large ascospores and orange-brown (superba brown) epihymenium and exciple (FRYDAY 2005). In Polish material all specimens were characterized by well-developed, white, bullate thallus and apothecia with a brown disc.

The sorediate morph of *Porpidia superba* has a thinner thallus than typical non-sorediate material, and occurs on flushed, siliceous rocks. The rank of forma, f. *sorediata*, was proposed by FRYDAY (2005). In the single Polish sorediate specimen the thallus was very similar to the non-sorediate specimens. This is contrary to the result of FRYDAY (2005), although he does mention that soredia are sometimes present on the form with a thick bullate thallus.

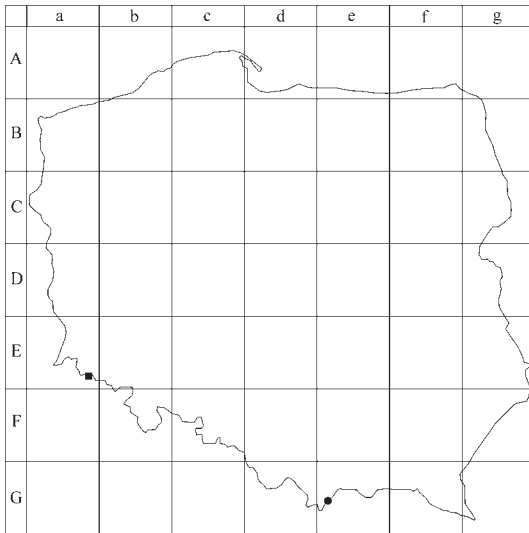


Fig. 3: Distribution of *Porpidia superba* (black square – locality with sorediate and non-sorediate specimens, black circle – specimens without soredia) in Poland given in ATPOL grid square system.

Ascospores in the Polish material of *Porpidia superba* are smaller [$16\text{--}20\text{--}21) \times 6\text{--}9\mu\text{m}$] than reported by HERTEL (1967) [$(16.5\text{--})19\text{--}28\text{--}33) \times 8.5\text{--}14\mu\text{m}$]. However, GALLOWAY & COPPINS (1992) reported slightly different size of spores [$17\text{--}25\text{--}33) \times 8\text{--}12\text{--}14\mu\text{m}$], more similar to that found in Polish specimens. Perhaps ascospores in Polish material were not fully developed, as the specimens were represented by evidently young individuals with small apothecia, or the range of spore size in this species has not been fully recognized. In general, in Polish material of some other *Porpidia* species, length and especially the width are smaller than reported in literature (Jabłońska, unpubl. results).

Porpidia albocaerulescens and *P. soredizodes* also can produce stictic acid, but they differ morphologically; for the differences see under *P. albocaerulescens* and Table 1.

Habitat requirements: According to FRYDAY (2005) *Porpidia superba* f. *superba* usually occurs on shaded basic rocks, whereas *P. superba* f. *sorediata* usually prefers vertical,

flushed acidic or slightly basic rocks. In Poland, both forms occur in similar habitats on basalt and on mylonite rocks.

Distribution in Poland: *Porpidia superba* was described from Poland by KOERBER (1855) and the material from the type locality was distributed in Koerber, Lich. Sel. Germ. 48. In Poland *P. superba* occurs in the southern part of the country (Fig. 3). FAŁTYNOWICZ (2003) reported this taxon from the Carpathians and Sudety Mts. The results of the present study confirm this.

World distribution: *Porpidia superba* f. *superba* was reported as widespread and locally common in Northern and NW Europe (HERTEL 1977, FRYDAY 2005), and also in China (HERTEL 1977) and North America (GOWAN 1989b).

Porpidia superba f. *sorediata* is less common than the non-sorediate form and is reported from British Isles, Sweden, Svalbard and northeast North America (Maine) (FRYDAY 2005).

Number of specimens examined – 17

Specimens of *Porpidia superba* f. *sorediata* examined: [Ea–88] – Karkonosze Mts, Karkonoski National Park, Mały Śnieżny Kocioł cirque, on basalt, 08.2006, M. Kossowska, W. Fałtynowicz (WRSL).

Specimens of *Porpidia superba* f. *superba* examined: [Ea–88] – Karkonosze Mts, Karkonoski National Park, Mały Śnieżny Kocioł cirque, on basalt, 08.2006, M. Kossowska, W. Fałtynowicz (WRSL three specimens); **[Ge–60]** – The High Tatra Mts, Tatra National Park Przełęcz pod Zadnim Mnichem pass, N aspect, slope 80°, the subnival belt, alt. 2135 m, $49^{\circ}11'19''\text{N}/20^{\circ}03'06''\text{E}$, on mylonite rocks, 16.08.2003, A. Flakus 1900 & 3138 (KRAM-L-52444 & 52443 & 52450); below Mięszowicka Przełęcz pod Chłopkiem Pass, NW aspect, slope 90°, the subnival belt, alt. 2300 m, $49^{\circ}11'02''\text{N}/20^{\circ}03'55''\text{E}$, on mylonite rocks, 03.08.2003, A. Flakus 1283 & 849 (KRAM-L-52440 & 52437); Hińczowy Żleb gully, below Hińczowa Przełęcz pass, NE aspect, slope 90°, the subnival belt, alt. 2250 m, $49^{\circ}11'10''\text{N}/20^{\circ}03'21''\text{E}$, on mylonite rocks, 17.08.2003, A. Flakus 2043 & 2066 & 2828 (KRAM-L-52445 & 52447 & 52449).

Additional specimens examined: Austria. Tirol, Pitztal, along trail from Braunschweiger Hütte to Mittelberg, alt. c. 2200 m, on rockridge, 02.08.1993, H. Sipman 34662 (B–93553). **Great Britain.** Scotland, Midlothian (V.C. 83), Pentland Hills, Hobbies Howe - Logan Burn SSSI, 300 m alt., on basic rocks, 24.01.2004, B.J. Coppins & C. Ellis & J. Hope 21596 (E–260030).

***Porpidia tuberculosa* (Sm.) Hertel & Knoph**

In Hertel, Beih. Nova Hedwigia **79**: 438 (1984). – *Spiloma tuberculosa* Sm., in Sm. & Sowerby, Engl. Bot. **36**: tab 2556 (1814).

Description: Thallus usually medium thick, continuous to patchy, light to dark grey, rarely papillate, sometimes white to bluish grey, smooth to cracked-rimose, subrimose or rimose-areolate; prothallus black, often visible between scattered areoles; medulla I+ violet-blue; soralia discrete, scattered, rounded to irregular; soredia white or gray, often with bluish tinge, farinose to granular; apothecia rare, rounded to slightly irregular, scattered, soon becoming sessile, occasionally gray pruinose, 0.8–0.9(–1.2) mm in diam.; epithecium brownish-olive, N+ orange red, K–; hymenium 70–110(–130) μm tall; asci *Porpidia*-type; spores 9–13(–16) × 4–6 μm.

Chemistry: The species always produce confluent acid and in minor amounts 2'-O-methylmicrophillinic and 2'-O-methylperlatolic acids, and additionally very rarely it can contain stictic or norstictic acids (FRYDAY 2005). In most of the Polish specimens confluent acid and 2'-O-methylperlatolic acid was detected, but in seven specimens 2'-O-methylmicrophillinic acid was also found in trace amounts. Additionally two samples also contained norstictic acid. The medulla of *Porpidia tuberculosa* always reacts I+ blue.

Notes: *Porpidia tuberculosa* is the only sorediate species in Poland which has an amyloid medulla. That character, as well as the presence of confluent acid with minor to trace amounts of additional substances, make this species very distinct. Several specimens were misidentified in the past as *P. soredizodes* or *P. rugosa* because of a false negative reaction with I. Most probably the reagent was applied on the cortex or algal layer, and those do not give the characteristic amyloid reaction. For more differences see above, Table 1 and FRYDAY (2005).

Habitat requirements: *Porpidia tuberculosa* occurs on siliceous rocks, walls, pebbles, rarely on worked timber in different environmental conditions (GALLOWAY & COPPINS 1992). According to GOWAN & AHTI (1993) it grows in rather dry, but often shaded rocks in forests and along shores. The species was also very rarely found on tree bark (TØNSBERG 1992).

In Poland *Porpidia tuberculosa* was found on different types of siliceous rocks (sandstone, basalts, granite, mylonite rocks) in open habitats and forests.

Distribution in Poland: The species is the most common sorediate *Porpidia* in Poland, where it is widely distributed and known from most regions (Fig. 4). During this study its previous distribution (see FAŁTYNOWICZ 2003) has been confirmed, although several specimens were misidentified.

World distribution: *Porpidia tuberculosa* occurs commonly in Europe (e.g. FRYDAY 2005) and also North America (GOWAN 1989b). It has also been reported from the Falkland Islands (FRYDAY 2002).

Number of specimens examined – 74

Specimens examined (selected; all saxicolous): [Ac–66] – C. 1 km S of Porzecze village, 04.08.2004, M. Kukwa 3418 (UGDA-L–10981); Porzecze village, 13.07.1985, W. Fałtynowicz (UGDA-L–2923); C. 1.5 km S of Porzecze village, 11.07.1985, W. Fałtynowicz (UGDA-L–2920). [Ac–89] – Gdańsk-Oliwa town, Dolina Ewy valley, forest sections nos 92/93, na glazie, 09.07.1984, W. Fałtynowicz (UGDA-L–2639); [Af–97] – Głazowisko Bachanowo nad Czarną Hańczę nature reserve, S of Barchanowo village, 03.07.1999, W. Fałtynowicz, M. Kukwa (UGDA-L–8497);

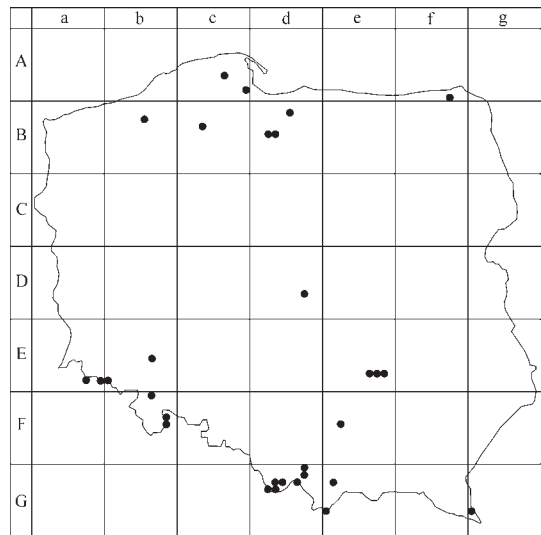


Fig. 4: Distribution of *Porpidia tuberculosa* in Poland given in ATPOL grid square system.

[Bb–25] – Krępa village near Białogard town, 17.10.1987, W. Faltnowicz, J. Miądlukowska (UGDA-L-3764); [Bc–33] – Bory Tucholskie Forest, vicinity of Laska village, 17.10.1979, W. Faltnowicz (UGDA-L-1542); [Bd–42] – SE of Ryjewo village, Biały Dwór forest district, forest section no. 245, 19.08.1997, M. Kukwa (UGDA-L-14300); [Bd–43] – SW of Nowa Wieś village, Lisewo forest district, forest section no. 187A, 27.07.1996, M. Kukwa (UGDA-L-14306); [Dd–77] – Grabina Górna village, 14.07.2004, K. Czyżewska (LOD-L-12231); [Ea–88] – Karkonosze Mts, Karkonoski National Park, Dolina Łomniczki valley, 707 m, 01.05.2007, M. Kukwa (UGDA-L-14506); Karkonoski National Park, Mała Szrenica Mt., Końskie Lby rocks, 08.2007, M. Kossowska (WRSL); Mały Śnieżny Kocioł cirque, 08.2006, M. Kossowska, W. Faltnowicz (WRSL); [Ea–89] – Karkonosze Mts, Karkonoski National Park, near Kocioł Łomniczki cirque, 1006 m, on rock, 01.05.07, M. Kukwa (UGDA-L-14507); [Eb–56] – Masyw Śnieżnika Mts, 740 m, Jodłów village, 29.08.2003, K. Szczepańska (herb. Szczepańska 350); [Eb–80] – Karkonosze Mts, S of Karpacz Wilcza Poręba settlement, 680 m, 01.05.07, M. Kukwa (UGDA-L-14503, 14504 & 14505); [Ee–76] – Świętokrzyskie Mts, Świętokrzyski National Park, Agata boulder field, 07.1957, B. Halicz, S. Kuziel (KTC); S slope of Łysica Mt., 15.04.1967, S. Cieśliński (KTC). [Ee–77] – Świętokrzyskie Mts, Świętokrzyski National Park, Łysa Góra Mt., 27.12.1983, S. Cieśliński (KTC). [Ee–78] – Świętokrzyskie Mts, Góry Świętokrzyskie Mts, Szczytniak Mt., 1981, E. Pietrzyk (KTC); [Fb–06] – Góry Sowie Mts, S slope of Wielki Chochół Mt., on rock, 22.04.2004, M. Kukwa 3116 (UGDA-L-10799, dupl. BG); [Fb–38] – Góry Bialskie Mts, Gierałtów village near Czernica Mt., c. 760 m, 28.07.2003, K. Szczepańska (herb. Szczepańska); [Fb–48] – Góry Bialskie Mts, Nowa Morawa nature reserve, c. 900 m, 07.2003, K. Szczepańska (herb. Szczepańska 324); [Fd–95] – Potrójna Mt., c. 880 m, 05.08.1985, J. Nowak (KRAM-L-31809); [Fe–42] – Kościelec Mt., c. 550 m, 24.08.1960, J. Nowak (KRAM-L-6335); [Gd–07] – Kubasiaki village, 690 m, 02.09.1965, s.coll. (KRAM-L-15412); [Gd–17] – Okraglica Mt., c. 1240 m, 09.05.1965, J. Nowak (KRAM-L-15180); [Gd–23] – Rachowiec Mt., c. 950 m, 11.08.1964, J. Nowak (KRAM-L-13926); [Gd–24] – Romanka Mt., 1260 m, 20.09.1964, J. Nowak (KRAM-L-16480 & 14496); [Gd–26] – Masyw Babiej Góry, J. Nowak, (KRAM-L-1195); [Gd–32] – Góra Magura Mt., 28.09.1964, J. Nowak (KRAM-L-16591); [Gd–33] – Beskid Żywiecki Mts, N slope of Łysica Mt., c. 1100 m, 22.05.1965, J. Nowak (KRAM-L-16246); ibidem, c. 630 m, 05.08.1964, J. Nowak (KRAM-L-14314); [Ge–21] – Gorce Mts, Dolina Kamienicy valley, 29.06.1995, M. Kukwa (UGDA-L-9202); [Ge–60] – Tatra Mts, Mięguszowiecki Szczyt Mt., 2438 m, 17.08.2003, A. Flakus (KRAM-L-52453). Ciemnosmreczyńska Przełęcz pass, 2115 m, 16.08.2003, A. Flakus (KRAM-L-52452). Czarny Mięguszowiecki Szczyt Mt., 2409 m, 11.08.2003, A. Flakus (KRAM-L-52451); [Gg–60] – Bieszczady Zachodnie Mts, Bieszczadzki National Park, Mała Tarnica Mt., 1321 m, 18.07.2005, J. Kiszka (KRAP).

Additional specimens examined (selected): **Czech Republic.** District Rejšejn, Losenice stream, Šafářův vršek, alt. 850 m, Popelna Obří hrad, 15.04.2000, M. Kukwa (UGDA-L-8124). Karkonoše Mts, National Park, below Vysoké Kolo Mt., c. 1480 m, 50°46'35"N/15°34'09"E, 25.09.2004, M. Kukwa (UGDA-L-11257). **Finland.** Tavastia Australis, Lammi: Evo, Haarajärvi Nature Reserve, 61°14'12"N/25°11'15"E, alt 140–180 m, 11.08.2007, A. Jabłońska (UGDA).

Key to sorediate *Porpidia* species occurring in Poland, including *P. rugosa*

- 1 Thallus contains stictic acid (K+ yellow, Pd+ orange), or rarely lacking secondary compounds 2
- 1* Stictic acid absent (K–, Pd–), other secondary metabolites present 4
- 2 Thallus medium thick (c. 0.2–0.6 mm), smooth, but in Polish material areolate, continuous, cracked, creamy white; soralia formed in the thallus cracks; apothecia with constricted base, disc brown *P. superba* f. *sorediata*
- 2* Thallus usually thin (c. 0.1–0.2 mm) and smooth, often almost completely endolithic, light to dark grey or olive grey, disc black 3
- 3 Often sterile in Poland; apothecia sessile, disc non-pruinose; thallus in shades of grey; soralia usually urceolate, but also tuberculate *P. soredizodes*
- 3* Fertile in Poland; apothecia usually innate, disc heavily pruinose; thallus with distinct beige tinge; soralia tuberculate in Polish specimens *P. albocaerulescens*
- 4 Glaucophaea and 2'-O-methylsuperphyllinic acids (+ unknown substance) or confluent acid and methyl 2'-O-methylmicyllinate; medulla I–; thallus whitish, creamy-grey, glaucous grey; not correctly reported from Poland *P. rugosa*
- 4* Confluent acid and 2'-O-methylperlatolic acid present; medulla I+ or I– 5
- 5 Thallus in shades of gray; medulla I+ blue *P. tuberculosa*
- 5* Thallus orange; medulla I– *P. melinodes*

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