# The lichen genus *Porpidia* in Poland I. *P. cinereoatra* and *P. crustulata*

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**Abstract:** JABŁOŃSKA, A. 2007. The lichen genus *Porpidia* in Poland I. *P. cinereoatra* and *P. crustulata*. – Herzogia **21**: 41–49.

The taxonomy, chemistry, habitat requirements, distribution and morphological variation of *Porpidia cinereoatra* and *P. crustulata* in Poland are presented. A total of 207 specimens of *P. crustulata* and 39 of *P. cinereoatra* have been examined. Descriptions are based on Polish material. Although the two species belong to different subgroups of the *P. macrocarpa* group, there have been considerable problems in the determination of these taxa in Poland in the past. The chemical variation has been confirmed, but morphological variation is greater than previously reported. Moreover, *P. cinereoatra* appears to be not so frequent as previously noted.

**Zusammenfassung:** JABŁOŃSKA, A. 2007. Die Flechtengattung *Porpidia* in Polen I. *P. cinereoatra* und *P. crustulata*. – Herzogia **21**: 41–49.

Taxonomie, sekundäre Stoffwechselprodukte, Standortsansprüche, Verbreitung und morphologische Variabilität von *Porpidia cinereoatra* und *P. crustulata* in Polen werden behandelt. 207 Proben von *P. crustulata* und 39 von *P. cinereoatra* sind untersucht worden. Die Beschreibungen beruhen auf Material aus Polen. In der Vergangenheit hat es in Polen erhebliche Schwierigkeiten bei der Bestimmung dieser beiden Arten gegeben, obwohl sie in verschiedene Untergruppen der *P. macrocarpa*-Gruppe gehören. Die Unterschiede hinsichtlich ihrer Flechtenstoffe werden bestätigt, aber die Variabilität der morphologischen Merkmale ist größer als bisher bekannt. Ferner ist *P. cinereoatra* nicht so häufig wie vorher angegeben.

**Key words:** Lichenized Ascomycota, Porpidiaceae, *Lecidea* s.lat., lichen taxonomy, chemotaxonomy, secondary metabolites.

## Introduction

The genus *Porpidia* Körb. (Lecanorales, Ascomycota), a segregate from one of the largest lichen genera, *Lecidea* Ach. s.lat., includes obligate saxicolous, crustose taxa, most of which occur mainly on siliceous to slightly calcareous rocks, and very rarely on bark, lignum and consolidated soil (INOUE 1983a, b, c, FRYDAY 2005). Members of *Porpidia* are inhabitants of exposed to shaded, but always humid, localities in temperate to arctic zones (BUSCHBOM & MUELLER 2004). Despite the fact that *Porpidia* is one of the most studied segregates of *Lecidea* s.lat. (e.g. HERTEL 1975, INOUE 1983a, 1983b, 1983c, GOWAN 1989a, 1989b, HERTEL 1984, MAKAROVA 1998, BUSCHBOM & MUELLER 2004, FRYDAY 2005), it is still poorly understood due to the difficulty in recognizing the characters at the species level (FRYDAY 2005).

*Porpidia* species are characterized by their crustose, thick to inconspicuous, tartareous, continuous to areolate-cracked, grey, white or occasionally orange thalli. Apothecia are rather large, sometimes 4 mm in diameter with pruinose or epruinose dark brown to black discs.

Anatomically the genus is characterized by thick hymenia, darkly pigmented hypothecia moderately to heavily pigmented exciples in most species, relatively large, simple, ellipsoidal ascospores and, the main distinguishing feature, the 8-spored asci of *Porpidia*-type (Galloway & Coppins 1992, Gowan & Ahti 1993, Rambold 1989, Makarova 1998, Fryday 2005). Soredia are produced in a few species [e.g. *P. soredizodes* (Lamy ex Nyl.) J.R.Laundon, *P. tuberculosa* (Sm.) Hertel & Knoph]; isidia are also known, but they seem to be rare and in Europe are only produced by *P. nadvornikiana* (Vězda) Hertel (Fryday 2005).

Lichen substances play a very important role in the determination of *Porpidia* species since many are superficially similar (see Gowan 1989a, Fryday 2005). Eighteen secondary products of known structure have been identified in *Porpidia* and related genera; these can be divided into eight chemosyndromes, each consisting of either β-orcinol depsidones, short-sidechain orcinol depsides, or long orcinol depsides (Gowan 1989a).

Despite recent work on *Porpidia*, the taxonomic limits of some taxa are still unsettled. Identification is often difficult, requiring thin sectioning of ascomata and thin-layer chromatography (TLC). However, the delimitation of many species has been clarified by recent studies (see Gowan 1989b, Hertel & Knoph 1984, Schwab 1986), but many collections remain difficult to place (see Galloway & Coppins 1992). Other important work contributing to our knowledge of *Porpidia* are as follows: Gowan (1989b) who studied the phenotypic variation and geographic distribution of North American species of *Porpidia*; Gowan & Ahti (1993) who revised eastern Fennoscandian collections thereby providing new discriminating characters for defining the taxa as well as a key for their determination; Fryday (2005) who, in reviewing northern and western European taxa, provided valuable data on the chemistry and morphology, divided the genus into three infra-generic groups, and showed in his treatment of secondary metabolite production and the variation in the production of chemosyndromes how much more variable they were than previously reported; Buschbom & Mueller (2004), who first presented molecular studies investigating the evolutionary relationships of the genus and related allies, revealing a highly supported "*Porpidia* sensu lato", but that *Porpidia* itself is not monophyletic. Several smaller genera of the Porpidiaceae, and probably the large genus *Lecidea* (Lecideaceae), are nested within the group (Buschbom & Mueller 2004), which will necessitate several taxonomic changes in the future, but so far *Porpidia* is still accepted as a distinct genus.

The world distribution of *Porpidia* is poorly understood. It is reasonably well investigated in only western, northern and central Europe. Species grow predominantly in oroboreal and mountain zones in temperate regions of both hemispheres (e.g. Hertel 1984, Rambold 1989, Galloway & Coppins 1992), but many regions remain to be investigated.

There has been no detailed study of *Porpidia* in Poland. Previously, specimens were determined using only thallus characters and spot test reaction, and very rarely was the ascus type studied; this led to many misidentifications. Additionally, sterile sorediate *Porpidia* were commonly ignored during field studies as not attractive and difficult to determine, and are therefore not very well represented in herbaria. Many species are still largely under-recorded, and usually reported in a "wide sense" [e.g. *P. macrocarpa* (DC.) Hertel & A.J.Schwab s.l.]; therefore it is difficult to determine their real distribution and any possible threat to them. There are 16 taxa reported from Poland (see Fałtynowicz 2003), but very few of them have been confirmed by TLC. Some species were considered to be rather common [e.g. *P. macrocarpa*, *P. crustulata* (Ach.) Hertel & Knoph] and were very rarely reported [e.g. *P. albocaerulescens* (Wulfen) Hertel & Knoph, *P. flavicunda* (Ach.) Gowan]; however, according to unpublished results of the author, it seems that their frequency is different to that previously reported.

The results of studies on the commonest *Porpidia* in Poland, *P. crustulata* and *P. cinereoatra* (Ach.) Hertel & Knoph, are presented in this paper. Previous studies have shown that the genus *Porpidia* could be divided into three infra-generic groups: *P. macrocarpa* group, *P. speirea* group and *P. albocaerulescens* group (FRYDAY 2005). The first group is mainly characterized by thick excipular hyphae and can be further divided into the *macrocarpa* (with *P. crustulata*) and *cinereoatra* (with *P. cinereoatra*) subgroups. The *cinereoatra* subgroup produces confluentic acid or methyl 2'-O-methylmicrophyllinate chemosyndromes and the *macrocarpa* subgroup is characterized by the presence of stictic/norstictic acid chemosyndromes or there are no substances detectable (see FRYDAY 2005 for more information). Although *P. crustulata* and *P. cinereoatra* belong to different subgroups of *P. macrocarpa* group, in the past there were considerable problems in the determination of these taxa in Poland, leading to incorrect pictures of their distribution and frequency. Determinations were based mainly on morphological characters, which very often overlap in *P. crustulata* and *P. cinereoatra*; chemistry, which is a discriminating feature, was studied only by spot test reactions, which are unreliable.

The aim of this paper is to present the results of studies on the taxonomy, chemistry, morphology, habitat requirements and distribution of *P. crustulata* and *P. cinereoatra* in Poland, with a few records of them elsewhere. This paper is the first of a series of articles devoted to a revision of *Porpidia* in Poland.

## Material and methods

All available material deposited in the following herbaria: GPN, KRAM, KTC, POZ, LBL, OLS, UGDA, WRSL and herb. Kukwa was studied, together with comparative specimens from B and E.

Morphological characters were examined under the stereo microscope and the thickness, morphology and colour of thallus, colour, shape and size of soralia and the presence, size of apothecia were noted. Apothecia were sectioned and examined under light microscopy. Reagents were applied to check the reaction of apothecial pigments. All diagnostic features were noted. The lichen substances were extracted from thalli and chemical analyses were performed by thin-layer-chromatography (TLC in solvent C) according to the methods of ORANGE et al. (2001).

Localities of all Polish material examined are mapped according to the ATPOL grid square system (ZAJĄC 1978; modified by CIEŚLIŃSKI & FAŁTYNOWICZ 1993); for further details see KUKWA et al. (2002) and JABŁOŃSKA & KUKWA (2007).

## Results

A total of 241 specimens of *P. crustulata* and *P. cinereoatra* were examined, 202 of the former and 39 of the latter. Since morphological characters overlap between those two taxa, many misidentified specimens were found in Polish herbaria: about half of the specimens previously determined as *P. cinereoatra* belong to *P. crustulata* or *P. macrocarpa*; on the other hand, several samples of *P. crustulata* were misidentified as *P. macrocarpa*, because the size of apothecia, which is not a reliable character, was used as the discriminating feature in the key in NOWAK & TOBOLEWSKI (1975). For more details see under *P. crustulata*.

***Porpidia cinereoatra*** (Ach.) Hertel & Knoph

In Hertel, Beih. Nova Hedwigia **79**: 437 (1984). – *Lecidea cinereoatra* Ach., Lichenogr. Univ.: 17 (1810).

**Type:** Germany, Lausitz, Mosig 52 (H–ACH 100 – lectotype, not seen; see Fryday 2005).

For more synonyms see Fryday (2005).

**Description:** Thallus epi- to endo-substratal, light to ash-grey, thick and even to ± thin, continuous, rimose, cracked- to verrucose-areolate, thallus margin often distinct, thinner than thallus center; black prothallus sometimes visible between areoles; medulla I–; apothecia 0.3–0.9(–1.7) mm in diam., numerous, pruinose when young, round to slightly irregular, usually innate or convex; true exciple black; epithecium olive, olive-brown, greenish, orange-red with nitric acid, K–; hymenium 75–100(–110) µm tall; exciple in section mostly black or dark brown; asci *Porpidia*-type; ascospores 10–20 × 4–9 µm.

**Chemistry:** The species always produces confluentic acid and in minor amount 2'-O-methylperlatolic acid (Fryday 2005). The chemistry of Polish specimens agrees with that reported earlier.

**Notes:** In Poland *P. cinereoatra* is decidedly uniform in terms of its chemistry, but it is diverse in morphology. Usually specimens are ± thick cracked-areolate or verrucose-areolate, but sometimes they develop fairly thin continuous, smooth thalli; apothecia are also variable, as they can be pruinose and innate when young or rarely non-pruinose and sessile. In the past, determination of these taxa in Poland was based mainly on morphological characters, and this led to many misidentifications. These two taxa have a different chemistry, which is very important diagnostic character: *P. crustulata* produces stictic acid or no substances, whereas *P. cinereoatra* produces confluentic acid. *P. cinereoatra* was previously reported as frequent in lowland in Poland (Fałtynowicz 2003 and literature cited therein), but it is a rare lichen.

Gowan & Ahti (1993) accepted *P. musiva*, a taxon reported also from Poland, as a distinct species. They separated it from *P. cinereoatra* by its thicker, warted thallus and larger ascospores. Gowan (1989b) reported ascospore dimensions for *P. cinereoatra* as 13.0–13.6–18.0 × 6.0–6.6–9.0 µm, and smaller for two other species, *P. herteliana* Gowan (now synonyms of *P. cinereoatra*, see Fryday 2005) and *P. lowiana* Gowan (see Fryday 2005). However, Fryday (2005) investigated the type collections of *P. cinereoatra*, *P. herteliana*, *P. lowiana*, *P. musiva* and other material identified by Gowan (1989b) and found that the spores were (15–)18–20 × (7–)8–9 µm with no differences in size between all taxa. Therefore, as stated by Fryday (2005) and suggested earlier by Galloway & Coppins (1992), *P. musiva* is a variant of *P. cinereoatra* with an unusually thick thallus and therefore its synonym.

**Habitat requirements:** *P. cinereoatra* is a typical saxicolous species, which prefers rather exposed and open habitats. In Poland it has been reported from rock outcrops and boulders, its frequency on different substrata as follows: stones and boulders (29), sandstone rocks (8), granite rock (1).

**Distribution in Poland:** *P. cinereoatra* is a rather rare mountain species (Fig. 1); it is also widely scattered in lowland localities in areas subjected to the last glaciations. Its distribution is similar to that of other montane lichens (see e.g. Jabłońska & Kukwa 2007) and vascular plants (Zając 1996). According to Fałtynowicz (2003), *P. cinereoatra* was quite common in Poland, but several previous records appear to belong to *P. crustulata* or other species of *Porpidia* and *Lecidea* s.lat.

**World distribution:** *P. cinereoatra* is an eastern hemiboreal to southern boreal species, especially common in oceanic areas (see Gowan & Ahti 1993). It is rather widespread in the Northern Hemisphere, but many records, especially older ones, need revision.

## Number of specimens examined – 39

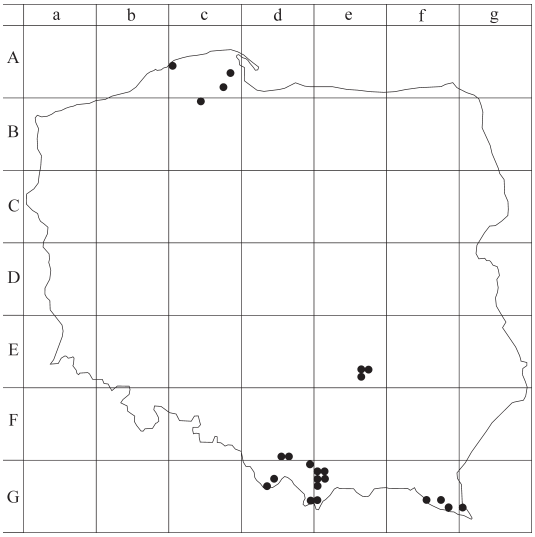


**Fig. 1**: Distribution of *Porpidia cinereoatra* in Poland given in ATPOL grid square system.

**Specimens examined: [Ac–50] –** by the road from Gąbion village to Dębiny village, on stone, 17.08.1930, F. Krawiec (POZ); **[Ac–68] –** near Reszki village, on stone, 21.08.1930, F. Krawiec (POZ); Rumia Zagórze settlement, on stone, 19.08.1930, F. Krawiec (POZ); **[Ac–87] –** Staniszewo village, on stone, 28.07.1934, F. Krawiec (POZ); **[Bc–04] –** by the road to Sulęczyno village, near Żukowo town, on stone, 27.07.1935, F. Krawiec (POZ); **[Ee–76] –** Świętokrzyski National Park, N slope of Łysica Mt., c. 300 m, by forest section No. C1-C2, on rocks, 19.07.1983 & 20.09.1982, S. Cieśliński (KTC); **[Ee–77] –** Świętokrzyski National Park, Św. Katarzyna forest division, forest section No. C2, Łysica Mt., on rocks, 05.09.1999, A. Donica (KTC); Łysa Góra Mt., forest section No. 117, on rocks, 26.07.1983, S. Cieśliński (KTC); Dębno forest division, forest section No. 125, on rocks, 19.07.2001, A. Donica (KTC); Św. Krzyż forest division, forest section No. 116, on rocks, 03.07.2000, A. Donica (KTC); N slope of Łysogóry range, forest section Nos 124 and 125, on rocks, 30.06.1983, S. Cieśliński (KTC); **[Fd–95] –** Beskid Mały Mts, Potrójon Mt., c. 880 m, on sandstone boulders, 05.08.1960, J. Nowak (KRAM-L–6259); Przełęcz Kocierska pass, c. 710 m, on sandstone boulders, 05.08.1960, J. Nowak (KRAM-L–6258); **[Fd–96] –** Beskid Mały Mts, Zwalisko Mt., c. 700 m, on sandstone, 12.05.1960, J. Nowak (KRAM-L–6255); **[Gd–09] –** Beskid Makowski Mts, Pcim town, Kotki range, c. 420 m, on sandstone boulders, 24.08.1996, J. Nowak (KRAM-L–43009); **[Gd–24] –** Beskid Żywiecki Mts, Złatna village, Boraczy Wierch (Buracza) Mt., c. 1240 m, on sandstone boulders, 27.09.1964, J. Nowak (KRAM-L–15319); **[Gd–33] –** Beskid Żywiecki Mts, Zimna Woda village, Parszywa valley, c. 650 m, on stones, 12.08.1964, J. Nowak (KRAM-L–14360); **[Gd–59] –** Gorce Mts, NE slope of Wielka Góra Mt., c. 710 m, on stones, 29.06.1967, K. Glanc (KRAM-L–36032); **[Ge–10] –** Gorce Mts, by the tourist path from Niedźwiedź village to Turbaczyk Mt., c. 700 m, on stones, 08.09.1964, K. Glanc (KRAM-L–36023); W slope of Groników village, c. 1020 m, on stones, 18.09.1965, K. Glanc (KRAM-L–36030); **[Ge–11] –** Gorce Mts, NE slope of Frączków Groń Mt., c. 680 m, by the road, near Konina village, on stones, 16.09.1965, K. Glanc (KRAM-L–36028); **[Ge–20] –** Gorce Mts, Kowaniec Mt., c. 680 m, on stone, 14.09.1959, K. Glanc (KRAM-L–36021); Obidowiec-Groniki ridge, c. 1100 m, on stones, 18.09.1965, K. Glanc (KRAM-L–36025); **[Ge–21] –** Gorce Mts, Furcówka Mt., on stones, 02.01.1959, K. Glanc (KRAM-L–36439). Waksmundzka Mt., c. 990 m, on rocks, 11.09.1959, K. Glanc (KRAM-L–36019); **[Ge–30] –** Gorce Mts, Góra Ostrowska Mt., c. 860 m, on stones, 09.09.1959, K. Glanc (KRAM-L–36440); **[Ge–50] –** Tatry Mts, Dolina Olczyska valley, on N slope of the valley, on stones, 23.06.1972, K. Waydowska (KRAM-L–21922); **[Gf–55] –** Beskid Niski Mts, Łupków village, S slope of Terpiak Mt., c. 640 m, on sandstone boulders, 21.06.1974, J. Nowak (KRAM-L–32131); **[Gf–57] –** Bieszczady Mts, SE slope of Połonina Caryńskia Mt., near Caryńska village, c. 800 m, on stones, 24.09.1958, K. Glanc (KRAM-L–36017); **[Gf–68] –** Bieszczady Mts, by Beskidnik stream, on stones, 20.07.1956, K. Glanc (KRAM-L–36013); Przełęcz Wetlińska pass, on stones, 27.08.1957, K. Glanc (KRAM-L–36424). Puszcza Bukowa Forest, by Wielki Lutowy stream, c. 750 m, on boulders, 18.08.1958, J. Nowak (KRAM-L–36022); **[Gg–60] –** Bieszczady Mts, Szeroki Wierch Mt., on stones, 25.08.1957, K. Glanc ( KRAM-L–36015).

**Additional specimens examined** (selected)**: Ireland**. Co. Donegal, V.C. 35, Grid ref. 24/03.20 Glen Veagh Park, along road from L. Veagh to L. Garten, ca 200 m., on vertical face of exposed boulder, 16.07.1991, H. Sipman (B–82346). **United Kingdom**. England, South Somerset, Pinkworthy, S of Pinkery Farm, 390 m, on shale outcrops, 09.09.2000, B.J. & A.M. Coppins (E). **Svalbard.** Råistoranda, Låkpynten, 12 m, on sea shore, on rocks, 12.08.1957, A. Środoń (KRAM-L–43527).

## ***Porpidia crustulata*** (Ach.) Hertel & Knoph

In Hertel, Beih. Nova Hedwigia **79**: 435 (1984). – *Lecidea parasema* var. *crustulata* Ach., Lichenogr. Univ.: 176 (1810). – *Lecidea crustulata* (Ach.) Spreng., Syst. Veget., edit. **16**: 258 (1827).

**Type:** Switzerland, Schleicher 690 (H–ACH – lectotype, not seen; see Fryday 2005).

For more synonyms see Fryday (2005).

**Exsiccates examined:** Nowak, Lich. Polon. Merid. Exs. 128 (LBL). Zahlbruckner, Krypt. Exs. 449b (UGDA).

**Description:** Thallus epilithic, rarely endolithic, light to dark grey or olive-grey, occasionally weakly oxidized orange, thin to patchily disappearing, rarely ± thick, continuous, smooth to crecked rimose; prothallus sometimes present; medulla I–; apothecia 0.3–0.8(–1.4) mm in diam., abundant, often clustered in small groups or in a concentric line, usually sessile, disc black or dark brown, non-pruinose or rarely weakly pruinose; proper margin thin and barely raised, less than 0.08 mm wide; epithecium olivaceous to brownish, greenish, orange with nitric acid, K–; hymenium 60–90(–110) µm tall; exciple internally mostly dark brown; asci *Porpidia*-type; spores 10–16(–19) × 4–7 µm.

**Chemistry:** *P. crustulata* produces stictic acid in major to trace amounts, sometimes together with traces of cryptostictic acid, or no lichen products are detected. The thallus reacts K+ yellow and Pd+ red (Fryday 2005). Stictic acid was detected in most of the Polish specimens, but in 35 specimens no substances were found; it was probably produced in all examined specimens, but the concentration was too low to be detected.

**Notes:** This species is usually characterized by a light greenish-grey to whitish or darker grey, continuous to patchy, rarely subrimose thallus, small, usually not pruinose apothecia frequently arranged in concentric rings, and the production of stictic acid (see Fryday 2005). As suggested by Buschbom & Mueller (2004), *P. crustulata* is very closely related to *P. macrocarpa*.

In Polish material, ten specimens of *P. crustulata* were filed under *P. macrocarpa.* Both species can look similar, but *P. crustulata* is distinguished by its smaller apothecia, smaller ascospores and shorter hymenium, but the most important character is the thickness of the proper margin: in *P. crustulata* it is more delicate and smaller in size, thinner and less than 0.08 mm wide, whereas in *P. macrocarpa* margin is thicker and raised, always wider than 0.1 mm (Fryday 2005).

Fryday (2005) investigated the type collections of *P. crustulata* and *P. macrocarpa* and confirmed that the pigmentation of the exciple, width of excipular hyphae, size of ascospores and height of hymenium depend on the size of the apothecia. Thus, the separation of *P. crustulata* from *P. macrocarpa* based on those characters as proposed by Vainio (1934), Hertel (1977), Inoue (1983a, 1983b, 1983c) and Gowan (1989b) cannot be considered as reliable. The size of apothecia, width of proper margin and distribution appear to be the only discriminating characters. Both type collections differ in two morphological characters. The lectotype of *Lecidea parasema* var. *crustulata* has small apothecia with a thin proper margin, whereas the holotype of *Patellaria macrocarpa* has large apothecia with a thick tumid margin. The smaller as well as larger apothecia of *Patellaria macrocarpa* have the same thick, raised proper margin; due to the thick margin, the disc is invisible in smaller apothecia. In contrasts to that, apothecia of *Lecidea parasema* var. *crustulata* with the same dimensions have a thin proper margin and a well-developed disc (see Fryday 2005).

**Habitat requirements:** In Poland *P. crustulata* occurs on siliceous rocks, especially pebbles, seeming to prefer exposed places and open habitats. It has been reported on the following substrata: non-calcareous rocks, e.g. sandstone, granite (91), stones and erratics (105), bricks (2), mortar (2), leather of old shoe (1), wood (1).

**Distribution in Poland:** *P. crustulata* frequently occurs in the northern, north-eastern and southern parts of the country, but appears to be rare in central Poland (Fig. 2).

**World distribution:** *P. crustulata* has been reported throughout the world, from temperate to alpine or arctic regions (e.g. HERTEL 1977, GOWAN 1989b, GALLOWAY & COPPINS 1992).

Number of specimens examined – 207

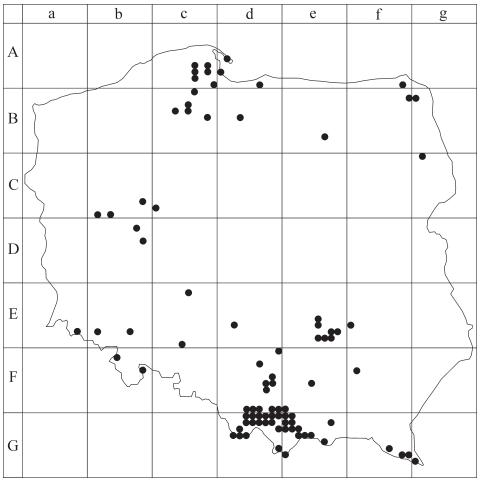


**Fig. 2**: Distribution of *Porpidia crustulata* in Poland given in ATPOL grid square system.

**Specimens examined** (selected)**: [Ac–66] –** Porzecze village, on stone, 17.07.1985, W. Fałtynowicz (UGDA-L–3309); **[Ac–68] –** near Reszki village, on stone, 21.08.1930, F. Krawiec (POZ); **[Ac–76] –** Osiek village, on stones, 23.07.1985, W. Fałtynowicz (UGDA-L–2946); **[Ac–78] –** SE of Kielno village, on stone, 12.05.1934, F. Krawiec (POZ); **[Ac–86] –** Staniszewskie Błoto nature reserve, on stone, 23.04.1977, W. Fałtynowicz (UGDA-L–1762); **[Ac–99] –** 'Jar Rzeki Rekinicy' nature reserve, on stone, 08.1992, P. Rutkowski (UGDA-L–4092); **[Ad–51] –** Helska split, forest section No. 256, 54°39'12"/18°46'10"E, on small stone, 16.10.2006, M. Kukwa 5403 (UGDA); **[Ad–70] –** Gdynia city, on stone, 01.08.1930 & 07.1926, F. Krawiec (POZ); **[Ad–96] –** Grabianka stream valley, Kadyny forest division, forest section No. 184, 50°16'36"N/19°31'25"E, on rocks, 29.04.2007, R. Szymczyk (OLS-L–508); **[Af–98] –** Wigierski National Park, Leszczewo village, on granite, 13.09, 1984, J. Nowak (KRAM-L–26102); **[Bc–06] –** between Węsiory and Sulęczyno villages, on stone, 26.07.1935, F. Krawiec (POZ); **[Bc–25] –** Jastrzębie forest division, on stone, 08.1935, F. Krawiec (POZ); **[Bc–33] –** Przymuszewo forest inspectorate, Asmus forest division, forest section No. 239c, on stones, 03.04.1975, W. Fałtynowicz (UGDA-L–558); **[Bc–35] –** Przymuszewo forest inspectorate, S of Wielewskie lake, on mortar, 05.04.1978, W. Fałtynowicz (UGDA-L–428); **[Bc–48] –** 2 km of Cypel village near Skórcz village, on stones, 24.07.1984, W. Fałtynowicz (UGDA-L–338); **[Bd–43] –** Lisewo forest division, forest section No. 187A, SW of Nowa Wieś village, on stone, 27.07.1996, M. Kukwa (UGDA-L–14305 & 14304); **[Be–76] –** Lemany village, on granite stones, 01.05.1989, J. Nowak (KRAM-L–26164); **[Bf–19] –** Małe Sucharki lakes, by E side of Sucharek Dębowskich lake, 54°02'25"N/23°03'35"E, on stone, 01.05.1996, M. Kukwa (UGDA-L–14302); **[Bg–10] –** Wigierski National Park, Maćkowa Ruda village, on stones, 09.1984, W. Fałtynowicz (UGDA-L–2753 & 2732); **[Cb–78] –** Oborniki village, near Poznań city, on stone, 07.05.1935, F. Krawiec (POZ); **[Cb–91] –** Notecka Forest, Borowy Młyn village, on bricks, 11.09.1995, J. Nowak (KRAM-L–42145); **[Cb–93] –** Lwówek village, on stone, 22.09.1934, F. Krawiec (POZ); **[Cc–80] –** Zielonka village near Poznań town, forest section No. 23, on stones, 16.07.1963, K. Glanc (KRAM-L–36431, 36433& 36434); **[Cg–01] –** Puszcza Knyszyńska Forest, forest section No. 100/101, on stone, 09.09.1987, I. & K. Toborowicz (KTC); **[Db–17] –** Poznań town, near Stęszewo village, on stone, 23.05.1934, F. Krawiec (POZ); **[Db–38] –** Ludwikowo village, near Poznań city, on stones, 12.09.1960, F. Krawiec (POZ); **[Ea–78] –** Karkonosze Mts, Mały Śnieżny Kocioł cirque, on basalt, 08.2006, M. Kossowska & W. Fałtynowicz (WRSL); **[Eb–71] –** Góry Kaczawskie Mts, Góry Ołowiane Mts, Janowice Stare village, on stone, 1999, M. Kossowska (WRSL); **[Eb–76] –** Ślęża massive, on rock, 19991, leg. M. Kossowska (WRSL); **[Ec–15] –** Ostrzeszów town, near Jarzynowo village, on stone, 28.03.1934, F. Krawiec (POZ); Wanda forest inspectorate, on stone, 29.03.1934, F. Krawiec (POZ); **[Ec–94] –** Żelazna village near Ożarów town, on stone, 25.06.1964, J. Nowak (KRAM-L–13350); **[Ed–62] –** Łosodno village near Kłobucko village, on stone, 21.05.1964, J. Nowak (KRAM-L–12215); **[Ee–55] –** near Bliżyno, Świnia Góra nature reserve, on sandstone boulders, 04.05.1959, J. Nowak (KRAM-L–5421); **[Ee–65] –** Góry Świętokrzyskie Mts, Brzezinki village, on rocks, 22.07.1980, J. Haczek, K. Toborowicz (KTC); **[Ee–77] –** Świętokrzyski National Park, Chełmowa Góra Mt., on stone, 07.1957, B. Halicz, S. Kuziel (KTC); Serwis-Dąbrowa range, forest section No. 4 and 7, on stones, 27.09.1982, S. Cieśliński (KTC); **[Ee–78] –** Świętokrzyskie Mts, Góra Skoszyńska Mt., on siliceous rocks, 1981, E. Pietrzyk (KTC); **[Ee–85] –** Świętokrzyskie Mts, Niwy village, on siliceous stone, 25.10.1980, I. Wrocławska, K. Toborowicz (KTC); **[Ee–86] –** Świętokrzyskie Mts, by highway from Napędowo village to Sierakowo village, on siliceous stone, 1979, J. Hruzik, K. Toborowicz (KTC); **[Ee–87] –** Świętokrzyski National Park, Łagów village, on sandstone boulder, 25.05.1981 & 24.04.1982, I. Wrocławska, K. Toborowicz (KTC); **[Ef–60] –** Świętokrzyskie Mts, Krzemionka Mt., on stone, 28.08.1926, J. Motyka (LBL); **[Fb–14] –** Góry Stołowe National Park, 692 m, 50°28'01"N/16°22'07"E, on sandstone, 2007, leg. M. Dimos-Zych, 757 (WRSL). **[Fb–38] –** Złota Mt., Lutynia village near Lądek Zdrój town, on stone, 09.10.1994, M. Kossowska (WRSL); **[Fd–09] –** Beskid Makowski Mts, Tokarnia village, U Liberdy range, c. 580 m, on sandstone boulder, 13.10.1996, J. Nowak (KRAM-L–43502); **[Fd–26] –** Podzamcze village near Tenczynek village, on stone, 26.03.1955, J. Nowak (KRAM-L–4139); **[Fd–48] –** Ojców town,

c. 360 m, on siliceous stones, 03.05.1956 & 01.05.1956, J. Nowak (KRAM-L–190 & 1382); **[Fd–57] –** Filipowiec Mt. near Krzeszowice town, c. 340 m, on rocks, 19.08.1956, J. Nowak (KRAM-L–1385); **[Fd–58] –** Dolina Szklarki valley, c. 380 m, on calcareous boulders, 27.04.1956, J. Nowak (KRAM-L–1381); **[Fd–67] –** Zalas village near Tenczynek village, c. 320 m, on rock, 26.03.1955, J. Nowak (KRAM-L–1470); **[Fd–94] –** Beskid Mały Mts, Wielki Cisownik Mt., c. 700 m, on stones, 07.08.1960, J. Nowak (KRAM-L–6265); **[Fd–95] –** Beskid Mały; Potrójna Mt., c. 750 m, on stones, 05.08.1960, J. Nowak (KRAM-L–6261); **[Fd–96] –** Beskid Mały Mts, Gołębiówka valley, S slope of Jaworawicka Mt., c. 340 m, on sandstone boulder, 18.04.1961, J. Nowak (KRAM-L–7298); **[Fd–97] –** Beskid Mały Mts, Skawce village, c. 330 m, on sandstone boulder, 06.07.1995, J. Nowak (KRAM-L–41864); **[Fd–99] –** Beskid Makowski Mts, Zawadka village, between Tajsowo range and Kotoń Mt., c. 740 m, on sandstone boulders, 31.05.1996, J. Nowak (KRAM-L–42740); **[Fe–54] –** near Włostowice town, on stones, s.dat., s.coll (KRAM-L–10271); **[Fe–90] –** Beskid Makowski Mts, Pcim village, Kudłacze range, c. 600 m, on sandstone boulders, 23.07.1996, J. Nowak (KRAM-L–42832); **[Ff–31] –** Przyłęk village near Mielec town, on part of old shoe, 07.1956, J. Nowak (KRAM-L–1429); **[Gd–04] –** Beskid Mały Mts, Kocierz Moszczanicki Mt., c. 450 m, on sandstone boulders, 08.08.1960, J. Nowak (KRAM-L–6260); **[Gd–05] –** Beskid Makowski Mts, Ślemień village, Frydziwski Las forest, c. 540 m, on sandstone boulders, 20.09.1965, J. Nowak (KRAM-L–13556); **[Gd–06] –** Beskid Żywiecki Mts, Stryszawa village, Boguniówka range, c. 660 m, on sandstone boulders, 16.08.1965, J. Nowak (KRAM-L–15780); **[Gd–07] –** Beskid Żywiecki Mts, Dolina Skawicy Sołtysiej valley, c. 510 m, on stones, 10.08.1974, J. Nowak (KRAM-L–31768); **[Gd–08] –** Beskid Żywiecki Mts, Osielec village, Łysa Góra Mt., c. 600 m, on sandstone boulders, 26.05.1965, J. Nowak (KRAM-L–16165); **[Gd–09] –** Beskid Makowski Mts, Pcim village, by the tourist path, c. 650 m, on stones, 10.08.1996, J. Nowak (KRAM-L–42901); **[Gd–14] –** Beskid Żywiecki Mts, Grojec Mt. near Żywiec village, c. 610 m, on sandstone rocks, 24.09.1964, J. Nowak (KRAM-L–16512); **[Gd–15] –** Beskid Żywiecki Mts, Korbielów village, Szelest Mt., c. 900 m, on sandstone boulders, 19.09.1964, J. Nowak (KRAM-L–15727); **[Gd–16] –** Beskid Żywiecki Mts, Zawoja Mt., 470 m, by Skawica river, on stone, 24.07.1974, J. Nowak, Lich. Polon. Merid. Exs. 128 (LBL); **[Gd–17] –** Babia Góra Mt., Sokolica Mt., c. 1500 m, on sandstone boulders, 1967, J. Nowak (KRAM-L–1577); **[Gd–18] –** Beskid Żywiecki Mts, Sidzina village, Psia Dolina valley, c. 1000 m, on sandstone boulders, 09.05.1965, J. Nowak (KRAM-L–17134); **[Gd–23] –** Beskid Żywiecki Mts, Milówka village, below Kosarzyska glade, c. 620 m, on stones, 26.09.1964, J. Nowak (KRAM-L–16757); **[Gd–29] –** Gorce Mts, Raba stream, Sieniawia village, c. 590 m, on stone, 07.07.1966, K. Glanc (KRAM-L–36437); **[Gd–32] –** Beskid Żywiecki Mts, Kikuta Mt., c. 1100 m, on sandstone boulder, 12.08.1964, J. Nowak (KRAM-L–14407); **[Gd–33] –** Beskid Żywiecki Mts, Rycerka Dolna village, Płaskonkowie (Płaskonków); range, c. 650 m, on stone, 05.08.1964, J. Nowak (KRAM-L–14104); **[Gd–34] –** Beskid Żywiecki Mts, Ujsoły village, c. 550 m, stone, 06.08.1964, J. Nowak (KRAM-L–14395); **[Gd–59] –** Tatry Mts, Dolina Strążyska valley, s.dat., s.coll. (KRAM-L–18133); **[Ge–00] –** Beskid Wyspowy Mts, Mszana Dolna village, Szarków stream, near Trzebel Mt., c. 455 m, on wood, 1967, J. Nowak (KRAM-L–5149); **[Ge–01] –** Beskid Wyspowy Mts, Ćwilin Mt., c. 1060 m, on sandstone, 15.05.1957, K. Szczepanek (KRAM-L–1469); **[Ge–10] –** Gorce Mts, Poręba Wielka village, near Niedźwiedź Mt., c. 525 m alt., on sandstone boulder, 18.09.1994, J. Nowak (KRAM-L–32119); **[Ge–11] –** Gorce Mts, by the road in Roztoka stream valley, 720 m, on sandstone boulder, 01.10.1994, P. Czarnota (GPN 809/94); **[Ge–17] –** Beskid Niski Mts, Binczarowa Mt., on stone, 10.08.1926 & 19.08.1926, J. Motyka (LBL); **[Ge–20] –** Gorce Mts, Obidowiec Mt., c. 1080 m, on rocks, 10.09.1959, K. Glanc (KRAM-L–38173); **[Ge–21] –** Gorce Mts, Ochotnica village near Kiczora Mt., 1210 m, on sandstone boulder, 01.04.1959, K. Glanc (KRAM-L–36441); **[Ge–21] –** Gorce Mts, Dolina Kamienicy valley, 970 m, on sandstone, 26.06.1997, P. Czarnota (GPN 1650/94); **[Ge–22] –** Gorce Mts, E slope of Gorzec Mt., near Młynne village, on stones, 05.09.1960, K. Glanc (KRAM-L–26026); **[Ge–32] –** Pieniny Mts, Czorsztyn Mt., on stones, s.coll. (KRAM-L–8379); **[Ge–33] –** Gorce Mts, E slope of Marszałek Mt., by stream in Księży Las forest, c. 460 m, on rocks, 12.05.1959, K. Glanc (KRAM-L–36442); **[Ge–34] –** Beskid Sądecki Mts, Radziejowa Mt., c. 1250 m, on sandstone boulders, 19.08.1960, J. Nowak (KRAM-L–9037); **[Ge–46] –** Żegiestów village, on stone, W. Boberski (KRAM-L–10253); on sandstone boulders, 1918, A. Rehmann (KRAM-L–10263); **[Ge–60] –** Tatry Wysokie Mts, Morskie Oko lake, on granite, 1884, W. Boberski (KRAM-L–10279); **[Gf–56] –** Bieszczady Mts, E slope of Kosowiec Mt., near Stuposiany village, c. 700 m, on stones, 10.08.1958, K. Glanc (KRAM-L–36426); **[Gf–68] –** Bieszczady Mts, E slope of Beskidnik Mt., c. 740 m, on boulders, 28.09.1957, K. Glanc (KRAM-L–36425); **[Gf–69] –** Bieszczady Mts, Przełęcz Wetlińska pass, on stone, 17.08.1958, J. Nowak (KRAM-L–36421); **[Gg–70] –** Bieszczady Mts, Kińczyk Bukowski Mt., c. 1250 m, on sandstone rocks, 21.06.1957, K. Glanc (KRAM-L–38164).

**Additional specimens examined** (selected)**: Germany**. Nordrhein-Westfalen, Westfalen, Sandsteinhaufen in dem Walchen bei den Dörnther Klippen bei Ibbenbüren, 03.1858, J. Lahm (B). **Norway**. Norvegia centralis, pr. Finse, 19.07.1927, J. Motyka (LBL).

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