

Contribution to the knowledge of some poorly known lichens in Poland. II. The genus *Psilolechia*

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Abstract: *Psilolechia leprosa* is reported as new to Poland and Sudetes Mts. It was found on metal enriched melaphyre rocks. The distribution of *P. clavulifera* is reviewed and the new records show it has been very much undercollected. The chemistry of *P. lucida* in Poland was investigated and it was found to produce more substances of unknown structure, than previously reported.

Kokkuvõte: Panus Poola vähetuntud samblike tundmisse. II. Perekond *Psilolechia*.

Teatatakse *Psilolechia leprosa* esmaliust Poolas ja Sudeedi mägedes. Antakse ülevaade *P. clavulifera* levikust koos uute leidudega. *P. lucida* keemilise koostise uurimisel leiti Poola materjalist uusi tundmatu struktuuriga aineid.

INTRODUCTION

Although a review of the genus *Psilolechia* A. Massal. was presented almost 20 years ago (Coppins & Purvis, 1987) no new species have since been recognized. So far only four taxa are known in the genus: *P. clavulifera* (Nyl.) Coppins, *P. leprosa* Coppins & Purvis, *P. lucida* (Ach.) M. Choisy and *P. purpurascens* Coppins & Purvis. The last one is still known only from Tasmania and seems to be very rare (Coppins & Purvis, 1987). The others are widespread throughout Europe, and all are known from Poland. However, only *P. lucida* was more frequently recognized so far and reported from different, mainly mountainous regions in the country (Fałtynowicz, 2003 and literature cited therein). Nevertheless, in Poland the secondary chemistry of that taxon was never studied. The first Polish report of *P. clavulifera* was published only recently (Nowak, 1998), but the record was based on a find from 1964, when the species was not recognized by Polish lichenologists. It has since been reported few times (see Fałtynowicz, 2003 and literature cited therein; Czarnota et al., 2005) (Fig. 1). Hitherto, *P. leprosa*, considered as probably an 'Atlantic' species, has not been found in this part of Europe. The new locality from western Poland extends its geographical range to the East. More intensive lichenological explorations of old mines and mineral-rich rocks, the sub-

strata preferred by the species, are required to ascertain the real distribution of the species in this part of Europe.

The aim of this paper is to present new information and new records of three species of *Psilolechia* in Poland. The work is the second one in a series contributing to the knowledge of some poorly known lichens in the country (see Czarnota & Kukwa, 2008).

MATERIAL AND METHODS

Specimens from GPN, KRAM, KTC, POZ and UGDA were revised. Secondary substances were analyzed by TLC according to the methods of Orange et al. (2001). Solvent systems A and B were used for the identification of substances present in *P. leprosa*, whereas A and C in the case of *P. lucida*. To investigate the chemical variation of *P. lucida*, only a part of Polish collection was revised with representative gatherings from northern (lowland) and southern (mountainous) distributional ranges. The localities of all taxa are presented in the ATPOL grid square system (see Cieśliński & Fałtynowicz, 1993; see also Kukwa et al., 2002).

A key for the identification of all taxa was presented by Coppins and Purvis (1987, 1992).

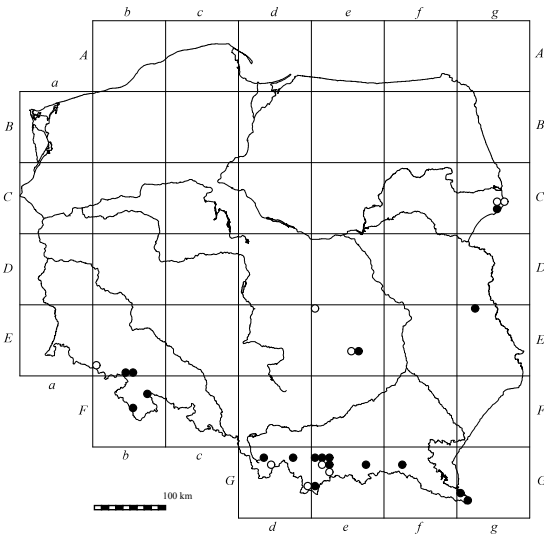


Fig. 1. Known distribution of *Psilolechia clavulifera* in Poland; O – localities reported prior to this publication, ● – new findings.

THE SPECIES

Psilolechia clavulifera (Nyl.) Coppins

This species was rather neglected in the past, but is better known since Coppins (1983) conducted a detailed taxonomic study of *Lecidea clavulifera* Nyl. Similar to the other European representatives of the genus, *P. clavulifera* is characterized by almost mealy, leprose thallus, small, immarginate, convex apothecia, one type of stout, multiseptate paraphyses, dactyoid ascospores and a *Psora*-type ascus (see e.g. Coppins & Purvis, 1987; Coppins, 1988; Ekman et al., 2004). It differs from other *Psilolechia* species in having conidiogenous cells arising directly from thallus hyphae (hyphomycetous anamorph like that of *Chaenotheca furfuracea*), dark coloured (mostly black) apothecia and greenish, K⁺ dulling hymenial pigment ('Ciner-eorufa-green' according to the nomenclature of Meyer & Printzen, 2000). In Poland *P. clavulifera* prefers consolidated soil, siliceous rocks and roots in dry underhangs or the root systems of upended trees. The same habitat preferences were reported also by Coppins (1983) and Coppins and Purvis (1987).

The species was rarely found in Poland (Fałtynowicz, 2003 and literature cited therein) and for that reason it was included in the general (Cieśliński et al., 2003) as well as in a few re-

gional red lists of threatened lichens (Czyżewska, 2003; Czyżewska & Cieśliński, 2003; Kiszka & Leśniński, 2003). However, the new data presented here clearly shows that this ephemeral species is much more widespread, and especially in mountains it should be regarded as a quite common lichen. In this paper it is reported as new for many regions of Poland, including e.g. the whole Tatra Mts (see Bielczyk, 2003; Lisická, 2005).

Until recently *P. clavulifera* has been considered elsewhere as a rare species; only in Great Britain and the Czech Republic has it been reported more frequently (e.g. Coppins, 1983; Motiejūnaitė, 1999; Palice, 1999). At present it is reported throughout Europe and moreover is known in both Americas and Australoecania (Coppins & Purvis, 1987; Flakus et al., 2006). Most probably it was overlooked several times because of its similarity to other leprose, sterile species (e.g. *Chaenotheca stemonea*, *Lepraria* spp.) and very specific ecological requirements. In the light of the present data it does not seem to belong in the 'west-European' element as previously considered by Berger and Türk (1995).

Specimens examined. [Cg-65] – Równina Bielska plain, Białowieża Primeval Forest, Białowieża forest district, forest section No. 494, pine forest *Vaccinio vitis-idaeae-Pinetum*, on roots and soil among root-system of fallen *Picea abies*, 13.08.2002, leg. P. Czarnota 3031 (GPN); [Eb-80] – Western Sudetes, Karkonosze Mts, Łomniczka Valley, 50°45.52'N/15°45.62'E, alt. 750 m, on granite rocks within shady spruce forest, 7.07.2003, leg. P. Czarnota 3681 (GPN); *ibid.*, alt. 800 m, on shaded vertical wall of granite boulder, 7.07.2003, leg. P. Czarnota 3455 (GPN); *ibid.*, 50°44.60'N/15°43.98'E, alt. 1200 m, at the base of shaded granite boulders by stream, 7.07.2003, leg. P. Czarnota 3453 (GPN); *ibid.*, Karpacz-Wilcza Poręba near Storczyk student hostel, 50°45'N/15°45'E, alt. ca 700 m, in underhangs on vertical wall of granite boulder within shady spruce plantation, 7.07.2003, leg. P. Czarnota 3540 (GPN); see Dimos-Zych & Czarnota 2007); *ibid.*, 2.05.2002, leg. M. Kukwa 1520 (UGDA); [Eb-94] – Middle Sudetes, Góry Kamienne Mts, ca 1 km W of Grzmiąca village, by Rybnica stream, 50°42'20"N/16°18'55"E, alt. ca 450 m, on vertical walls of melaphyre rocks in shaded valley, 21.04.2005, leg. P. Czarnota 4468 (GPN); [Eb-95] – Middle Sudetes, Góry Sowie Mts, S slope of Wielka Sowa Mt., above Sokolec village, 50°40'01"N/16°29'43"E, alt. 770 m, on wood of spruce root in underhang, 21.04.2005, leg. P. Czarnota 4686 (GPN); *ibid.*, 50°39'50"N/16°29'16"E, alt. ca 690 m, on metamorphic boulders within artificial spruce forest, 21.04.2005, leg. P. Czarnota 4700 (GPN); [Ee-66] – Wyżyna Kielecka upland, Góry

Świętokrzyskie Mts, Świętokrzyski National Park, Podgórze forest district, 'Czarny Las' nature reserve, forest section No. 42, on root-system of fallen tree, leg. A. Donica, 16.07.2001 (KTC); [**Eg-02**] – Polesie, Równina Łęczyńsko-Włodawska plain, Poleski National Park, Kochanowskie forest division, forest section no.192 b, 51°25'35"N/23°10'49"E, on bark of *Pinus sylvestris*, 27.04.2004, leg. P. Czarnota 3885 (GPN); [**Fb-27**] – Eastern Sudetes, Góry Złote Mts, by the road between Złota Góra and Łądek Zdrój towns, 50°23'23"N/16°50'46"E, alt. ca 590 m, on metamorphic rocks within forest, 19.04.2005, leg. P. Czarnota 4615 (GPN); [**Fb-45**] – Middle Sudetes, Góry Bystrzyckie Mts, by the road between Poręba village and Spalone Pass, 50°14'10"N/16°34'29"E, alt. ca 610 m, on decaying bark of roots of *Picea abies* in underhangs, 20.04.2005, leg. P. Czarnota 4773 (GPN); *ibid.*, on metamorphic rocks 'gneiss', leg. P. Czarnota 4400 (GPN); [**Gd-13**] – Western Beskidy Mts, Beskid Śląski Mts, E slope of Barania Góra Mt., on clayey soil and roots of fallen *Picea abies* root-system within shady spruce-beech forest, 10.05.2002, leg. P. Czarnota 2797 (GPN); [**Gd-17**] – Western Beskidy Mts, Pasma Babiogórskie Range, NE slope of Polica Mt., Skawica forest district, forest section no. 23, alt. 770 m, on roots and soil in underhang, 4.06.2004, leg. P. Czarnota 3934 (GPN); [**Gd-24**] – Beskid Żywiecki Mts, Pilsko range, Romanka Mt., alt. ca 1200 m, on vertical, shaded walls of sandstone boulders, 09.1964, leg. J. Nowak (KRAM-L-16948; see Nowak 1998); [**Gd-59**] – Rów Podtatrzański depression, Magura Witowska range, N of Hawryłówka glade; 49°17'30"N/19°50'37"E, alt. 890 m, on roots of *Picea abies*, 17.07.2004, leg. L. Śliwa 3246 (KRAM; see Śliwa 2006); [**Ge-10**] – Western Beskidy Mts, Gorce Mts, Rabka – Zaryte settlement, by Raba River below Królewska Góra hill, alt. 480 m, on roots and soil in underhang, 16.12.2006, leg. P. Czarnota 4949 (GPN); [**Ge-11**] – Western Beskidy Mts, Gorce Mts, E slope of Kudłoń Mts, the beginning of Rosocha stream, alt. 1120 m, clayey soil and roots of fallen spruce, 6.11.2001, leg. P. Czarnota 2684 (GPN); *ibid.*, E slope of Gorc Troszacki Mt., the beginning area of Gorcowy Potok stream, alt. 1080 m, on clayey soil and roots of fallen spruce, 20.12.2000, leg. P. Czarnota 2692 (GPN); *ibid.*, alt. 1100 m, leg. P. Czarnota 2387 (GPN); [**Ge-12**] – Western Beskidy Mts, Beskid Wyspowsy Mts, W slope of Modyń Mt., ca 0.5 km E of Zalesie village, 49°37'23"N/20°22'37"E, alt. 890 m, in underhang on bark of stump and roots of *Picea abies* within spruce-fir mountain forest, 2.07.2005, leg. P. Czarnota 4596 (GPN); [**Ge-21**] – Western Beskidy Mts, Gorce Mts, Kamienica Valley below Bieniowe glade, alt. 840 m, on clayey soil, 15.05.1997, leg. P. Czarnota 1680 (GPN; see Czarnota 2000); *ibid.*, W slope of Kudłoń Mt., alt. 1240 m, on clayey soil and roots of fallen spruce within upper spruce forest, 6.11.2001, leg. P. Czarnota 2683 (GPN); *ibid.*, on small sandstone pebbles in fallen root-system of *Picea abies*, leg. P. Czarnota 2681 (GPN); *ibid.*, S slope of Kudłoń Mt., alt. 1150 m, in root-system of *Picea abies*, leg. P. Czarnota 2680 (GPN); [**Ge-22**] – Gorce Mts. Lubań Range, val-

ley of Rolnicki stream, alt. 660 m, 18.10.2004, leg. P. Czarnota 5235 & A. Wojnarowicz (GPN); [**Ge-27**] – Beskid Niski Mts, Experimental Forest of Agriculture University in Kraków, Kopciowa forest district, vicinity of Krzyżówka settlement by the road to Tylicz village, 49°29'03"N/20°56'57"E, on bark at the base of *Abies alba* trunk within fir-spruce mountain forest, 25.09.2005, leg. P. Czarnota 4562 (GPN); [**Ge-32**] – Western Beskidy Mts, Gorce Mts, Mrażnica glade, SE slope of Lubań, alt. 950 m, 9.08.1968, leg. K. Glanc (KRAM-L-36976; see Czarnota et al. 2005); [**Ge-50**] – Tatra Mts, High Tatra Mts, Rostoka Valley near Wodogrzmoty Mickiewiczka waterfall, 49°13'N/20°04'E, alt. 1120 m, on small underhanged roots of *Picea abies* within shady upper spruce forest, 8.08.2003, leg. P. Czarnota 3331 (GPN); [**Gf-22**] – Middle Beskidy Mts, Beskid Niski Mts, S slope of Piotruś Mt., above Stasianie settlement, 49°28'11"N/21°44'57"E, alt. ca 670 m, on sandstone outcrop within shady Carpathian beech forest, 5.08.2004, leg. P. Czarnota 4053 (GPN); [**Gg-60**] – Eastern Beskidy Mts, Bieszczady Mts, S of Stuposiany village, SE of former village Pszczeliny, alt. ca 650 m, on decaying stump inside mixed mountain forest, 29.07.1959, leg. Z. Tobolewski (POZ); [**Gg-71**] – Bieszczady Mts, Bieszczadzki National Park, Sianki forest district, forest sec. no 78i, on clayey soil among root-system of fallen *Picea abies* within mixed forest, 19.06.2002, leg. P. Czarnota 2862 (GPN); *ibid.*, Górny San forest division, E slope of Piniaskowy Garb Mt., alt. 880 m, 24.08.1999, on soil between roots of fallen fir tree, leg. J. Kiszka (KRAP; published as *Micarea bauschiana*; specimen originally labeled: Sianki, by stream, loc.12).

***Psilolechia leprosa* Coppins & Purvis**

Psilolechia leprosa is regarded as a saxicolous lichenized fungus confined to metal-enriched habitats and occurring especially frequently on underhangs, shaded siliceous or slightly calcareous rocky walls contaminated by copper or other heavy metals (e.g. iron), mainly in artificial (e.g. in old mines), but also in natural habitats (Coppins & Purvis, 1987; Purvis & Halls, 1996). In the oceanic area of Europe it has also been found on bricks (e.g. Boom & Boom, 2006). Here it is reported as new to Poland and the Sudetes Mts.

In Poland the species has been collected only once, in Góry Kamienne Mts, a part of the Sudetes Mts. It is probably common in that region as that mountain range has many metal-enriched geological formations, e.g. iron-rich red melaphyre, a substratum of the Polish finding. In Poland *P. leprosa* was accompanied by *Lepraria* sp., *Micarea botryoides*, *M. lignaria*, *M. myriocarpa*, *M. sylvicola* and *Psilolechia clavulifera*.

Considering its whitish-green, mealy, usually leprose and sterile thallus, *P. leprosa* morphologically resembles many species of the genus *Lepraria* as also previously suggested by Coppins and Purvis (1987). Particularly, *L. crassissima* is similar, as it also reacts C+ red. Those taxa differ chemically and ecologically; gyrophoric acid is responsible for the red reaction in *P. leprosa* (Coppins & Purvis, 1987), while in *L. crassissima* nordivarcatic acid reacts in the same way (Kukwa, 2006). *P. leprosa* grows usually on metal-enriched, siliceous rocks, whereas *L. crassissima* usually prefers calcareous substrata including sandstone and pure limestone (Czarnota & Kukwa, 2001; Kukwa, 2006).

Psilolechia leprosa seems to be a widespread, regionally quite common and probably Atlantic species in Europe. It is known from British Isles, Scandinavia and Greenland (Coppins & Purvis, 1987; Seaward, 1994; Santesson et al., 2004), Iceland (Kristinsson & Heidmarsson, 2006), Belgium (Boom & Boom, 2006; Diederich et al., 2006), German Lower Saxony (Scholz, 2000), the Netherlands (Aptroot et al., 2004) and Sicily (Boom, 1992). In Central Europe it was previously known only from crystalline rocks in the Romanian Rătezat Mts (Ciurchea, 1998).

Chemistry: thallus C+ red; TLC: gyrophoric acid (major), lecanoric acid (trace), porphyritic acid (submajor), three terpenoids, one in high concentration (Rf class A 6–7; B5) and two in traces (Rf classes A6, B6 and A5–6, B6).

Specimen examined. [Eb–94] – Middle Sudetes, Góry Kamienne Mts, ca 1 km W of Grzmiąca village, by Rybnica stream, 50°42'20"N/16°18'55"E, alt. ca 450 m, on vertical walls of melaphyre rocks in shaded valley, 21.04.2005, leg. P. Czarnota 4470 (GPN).

Additional specimen examined. United Kingdom. West Cornwall, V.C. 1, Redruth, Todpool, St. Day, Poldice Mine, 10/742429, alt. c. 65 m, north-facing granite-mortar walls associated with Cu and Sn, leg. P. W. James & O. W. Purvis (BM, holotype).

***Psilolechia lucida* (Ach.) M. Choisy**

A widespread species throughout the world (e.g. Coppins & Purvis, 1987; Øvstedal & Lewis Smith, 2001; Flakus et al., 2006) growing on natural (various siliceous as well as calcareous rocks) and artificial (concrete, bricks) rocky substrata, usually in shaded places, often in sheltered underhangs. Occasionally it was found also on a hard wood, bark at the base of trees,

roots, epilithic bryophytes, humus and clayey soil (Coppins & Purvis, 1987; Tønsberg, 1992; Palice et al., 2003). In Poland it is locally common (Bielczyk, 2003; Fattynowicz, 2003 and literature cited therein). In the northern part of the country it seems to be confined to postglacial boulders and old brick walls of buildings. In southern regions it grows on natural, vertical rocky walls and stones shaded by forest.

Coppins and Purvis (1987) indicated two chemical races of *P. lucida*, first, known all over the world, with rhizocarpic acid as a major secondary substance together with some unknown substances (see also Tønsberg, 1992) and second, reported only from Australia and New Zealand, with rhizocarpic acid and zeorin. All so far examined Polish specimens represent the first chemotype. In studied material we found, however, that there are 8 unknown substances in minor to trace amounts, 7 of them being most probably terpenoids. All of them were detectable only on plates developed in solvent C. On plates in solvent A the position of some overlap, therefore the number was lower and the result similar to those reported by Coppins and Purvis (1983). Rhizocarpic acid was usually accompanied by an unknown related substance in Rf classes A5 and C5.

Substances detected by TLC (38 specimens examined): rhizocarpic acid, commonly with related substance in Rf classes A5, C5, unknown substance (pale white orange after charring in traces Rf class A4–5, C5), 7 substances, probably terpenoids (one white-blue A6, C6, three white-green A5 & C5–6, A? (not observed) & C5, A5 & C5, three white-blue A5 & C5, A? (not observed), C3–4 & A3, C3).

Rhizocarpic acid is also known from morphologically similar *Chrysothrix flavovirens* Tønsberg, recently found in Poland and other European countries, including those bordering with Baltic Sea (Kowalewska & Jando, 2004). However, this species differs in the presence of 'chrysophthalma' unknown, whereas *P. lucida* produces several unidentified substances (probably terpenoids), not found in *Ch. flavovirens*. Both species differ also in the ecology as *Ch. flavovirens* grows on tree bark, whereas *P. lucida* is mostly saxicolous and only sporadically is found as a facultative epiphyte (Tønsberg, 1992, 1994; Kowalewska & Jando, 2004).

The green algae *Stichococcus*, mentioned by Coppins and Purvis (1987) as the second, but rare photobiont in *P. lucida*, has not been observed in Polish collections.

Specimens examined. [Bc-36] – Bory Tucholskie Forest, 'Kręgi Kamienne' nature reserve, near Odry village, on granite postglacial boulder, 7.03.2004, leg. M. Kukwa (UGDA-L-9766); [Bc-70] – Pojezierze Krajeńskie lakeland, Prusinowo village, on brick wall of church, 07.1998, leg. M. Kukwa (UGDA-L-9107); [Bd-43] – Pojezierze Iławskie lakeland, Postolin village, on brick wall of gothic church, 30.09.1997, leg. W. Fałtynowicz (UGDA-L-9242); [Bd-53] – Pojezierze Iławskie lakeland, between Szadowo and Trzciano villages, SW part of the forest section no. 121A, 53°47'15"N/19°02'35"E, on granite, 28.03.2005, leg. M. Kukwa 2842 (UGDA-L-11869); [Bg-40] – Kotlina Biebrzańska basin, Puszcza Augustowska Forest, forest section no. 72, close to 'Glinka' nature reserve, on bark of *Pinus sylvestris* at the edge of forest, 21.09.1986, leg. S. Cieśliński (KRAM-L-31889); [Cg-65] – Równina Bielska plain, Białowieża village, 52°42'N/23°52'E, on brick wall and stones of orthodox church, 26.03.2001, M. Kukwa (observ.; cum apothecia); [Fb-06] – Middle Sudetes, Góry Sowie Mts, fortress in Srebrna Góra village, on shaded granite rocks, 50°34'32"N/16°38'45"E, 22.04.2003, leg. M. Kukwa 3106 (UGDA-L-10292); ibid., ca 2 km N of Nowa Wieś Kłodzka, W slope of Wielki Chochoł Mt., 50°34'54"N/16°37'22"E, on granite rock within beech forest, 22.04.2003, leg. M. Kukwa 3118 (UGDA-L-10801); [Fb-37] – Eastern Sudetes, Góry Złote Mts, near Łądek Zdrój town, on metamorphic rocks, 19.10.1959, leg. K. Glanc (KRAM-L-38769); [Fb-45] – Middle Sudetes, Góry Bystrzyckie Mts, by the road between Poręba village and Spalone Pass, on vertical walls of metamorphic outcrops and roots of spruces in underhangs, 50°14'10"N/16°34'29"E, alt. 610 m, 20.04.2004, leg. P. Czarnota 4770 (GPN); [Fc-31] – Eastern Sudetes, Góry Opawskie Mts, by Jarmołówek village, 50°17'21"N/17°26'20"E, alt. 480 m, on walls of volcanic rocks, 19.04.2005, P. Czarnota (observ.); [Fd-93] – Western Beskidy Mts, Beskid Mały Mts, Magurka glade, ca 550 m, on sandstone, 24.08.1960, leg. J. Nowak (KRAM-L-7892); [Fd-94] – Beskid Mały Mts, Cupel Mt., ca 900 m, on sandstone in rocky wall, 24.08.1960, leg. J. Nowak (KRAM-L-9429 & 9430); ibid., valley of Żarnówka Mała stream, on sandstone boulder by the bank of stream, 23.08.1960, leg. J. Nowak (KRAM-L-9426, 9427, 9428 & 9431); [Fd-99] – Western Beskidy Mts, Beskid Makowski Mts, Zawadka village, ca 470 m, on sandstone in a rocky wall, 26.04.1966, leg. J. Nowak (KRAM-L-17330); [Gd-06] – Western Beskidy Mts, Beskid Żywiecki Mts, Jałowiec range, Surzynówka Mt. near Stryszawa village, ca 670 m, on sandstone in rocky wall, 5.09.1965, leg. J. Nowak (KRAM-L-15444) and ca 800 m, on sandstone in a cheap, 3.09.1965, leg. J. Nowak (KRAM-L-15422); ibid., Surzynówka Mt. near Zasepnica village, ca 800 m, on sandstones in a cheap,

3.09.1965, leg. J. Nowak (KRAM-L-15451) and ca 670 m, 5.09.1965, leg. J. Nowak (KRAM-L-15505); [Gd-07] – Beskid Żywiecki Mts, Jałowiec range, Magurka Mt. near Zasepnica village, ca 870 m, on sandstone in a rocky wall, 2.09.1965, leg. J. Nowak (KRAM-L-15502); [Gd-09] – Beskid Makowski Mts, Tokarnia – Libierdy settlement, ca 580 m, on sandstone, 15.10.1966, leg. J. Nowak (KRAM-L-43501); ibid., Tokarnia village, valley of Rusnaków stream, ca 480 m, 27.04.1966, leg. J. Nowak (KRAM-L-17371) and ca 460 m, both on sandstones in rocky walls, 31.05.1996, leg. J. Nowak (KRAM-L-42754); ibid., Peim – Maniakówka settlement, ca 450 m, on sandstone in rocky wall, 31.05.1996, leg. J. Nowak (KRAM-L-42747); [Gd-15] – Beskid Makowski Mts, Pewel range, Cuprynik Mt. near Koszarawa village, 740 m, on sandstone in rocky wall, 22.07.1965, leg. J. Nowak (KRAM-L-15241); [Gd-17] – Beskid Żywiecki Mts, Polica range, valley of Skawica Sołtysia stream, ca 550 m, on sandstone, 19.06.1965, leg. J. Nowak (KRAM-L-16022); [Gd-24] – Beskid Żywiecki Mts, Pilsko range, Sucha Góra Mt. near Miłówka village, ca 960 m, on sandstone in rocky wall, 27.09.1964, leg. J. Nowak (KRAM-L-16521, 16704 & 16780); ibid., Żabnica Duża – Skałka settlement, ca 600 m, on sandstones in a rocky wall, 27.09.1964, leg. J. Nowak (KRAM-L-16702); ibid., Okrągła Mt. near Złatna settlement, ca 850 m, on sandstone in a rocky wall, 5.09.1964, leg. J. Nowak (KRAM-L-14755); [Gd-33] – Beskid Żywiecki Mts, Praszynka Mt. near Będoszka village, ca 1030 m, on sandstones in a cheap, 12.08.1964, leg. J. Nowak (KRAM-L-13820 & 13821); [Gd-34] – Beskid Żywiecki Mts, Pilsko range, Złatna settlement, Pod Sobolówką glade, ca 900 m, on sandstone in a rocky wall, 5.09.1964, leg. J. Nowak (KRAM-L-14754); [Ge-10] – Western Beskidy Mts, Gorce Mts, Poręba Wielka – Zapaty settlement, ca 580 m, on sandstones by the bank of Koninka River, 19.03.1995, leg. J. Nowak (KRAM-L-41821); ibid., Rabka – Zaryte settlement, by the bank of Raba River, alt. 480 m, on vertical walls of sandstone outcrops, 24.10.2000, leg. P. Czarnota (GPN 2337); [Ge-21] – Gorce Mts, valley of Kamienica stream, alt. 1060 m, on sandstone boulders within shady beech forest, 19.07.1999, leg. P. Czarnota (GPN 2142); [Ge-22] – Gorce Mts, S slope of Twarogi Mts above Ochotnica village, on sandstone rocks in a field-block, 540 m, 7.08.1967, leg. K. Glanc (KRAM-L-38770) and 10.08.1967, leg. K. Glanc (KRAM-L-38768); ibid., alt. 510 m, 5.11.1999, leg. P. Czarnota (GPN 2151); [Ge-32] – Gorce Mts, SE slope of Lubań Mt., Mrażnica glade, on sandstone, 950 m, 9.08.1968, leg. K. Glanc (KRAM-L-36976); [Ge-36] – Western Beskidy Mts, Beskid Sądecki Mts, 'Żebracze' nature reserve, alt. 870 m, on sandstone outcrops within Carpathian beech forest, 5.07.2001, leg. P. Czarnota (GPN 2547); [Gf-22] – Middle Beskidy Mts, Beskid Niski Mts, S slope of Piotruś Mt., above Stasianie forester's lodge, 49°28'11"N/21°44'57"E, alt. ca 670 m, on shaded sandstone outcrop in underhangs, 5.08.2004, leg. P. Czarnota (UGDA-L-13162).

ACKNOWLEDGEMENTS

The authors thank all herbarium curators for the loan of specimens as well as anonymous reviewer for valuable suggestions and language improvements.

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