

MYCENA JUNIPERINA (AGARICALES, BASIDIOMYCOTA), NEW FOR THE POLISH AND CENTRAL EUROPEAN MYCOBIOTA

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Abstract. *Mycena juniperina* Aronsen was collected in March 2013 in the *Origano-Brachypodietum* association from trunks of living *Juniperus communis* in the Pieniny Mts (S Poland). The species is described and illustrated based on Polish specimens, its ecology and general distribution are outlined, and it is compared with similar species: *M. meliigena* (Berk. & Cooke) Sacc., *M. pseudocorticola* Kühner, and others.

Key words: Tricholomataceae, *Mycena cupressina*, wood-inhabiting fungi, Polish mycobiota, Pieniny National Park, Carpathians, Poland, Europe

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INTRODUCTION

Mycena juniperina Aronsen was originally described from material from the west bank of the Oslo fjord in southern Norway (Aronsen 1996). Together with *M. conicoalba* M. Villarreal & Esteve-Rav., *Mycena cupressina* Antonín & Maas Geest., *M. meliigena* (Berk. & Cooke) Sacc., *M. pseudocorticola* Kühner, *M. supina* (Fr.: Fr.) Quél., and *M. venustula* Quél. it belongs to section *Supinae* Konrad & Maubl., characterized by a corticolous habit, globose to subglobose, smooth, amyloid basidiospores, clavate to irregularly shaped cheilocystidia with evenly or unevenly spaced, short to very long and flexuous excrescences, the absence of pleurocystidia, and warty or diverticulate elements in the cortical layer of the pileus and stipe (Maas Geesteranus 1992; Robich 2003).

Macroscopically, *M. juniperina* is marked by its pale brown or yellowish brown color. Its microscopic characters show a resemblance to the widely distributed European (and North American) species *M. meliigena* and *M. pseudocorticola*, but those differ in the color of the lamellae, pileus and stipe (Miersch *et al.* 2004; Aronsen 2008) and grow almost exclusively on bark of frondose trees

(cf. Ludwig 2012b). *Mycena cupressina* has basidiomata similar in color but is said to differ from *M. juniperina* by having paler lamellae, smoother hyphae of the stipitipellis, cheilocystidia covered with generally unbranched, short, cylindrical excrescences, and growth on bark of *Cupressus sempervirens* or rarely *Arbutus unedo* (Robich 2003; Miersch *et al.* 2004; Friebe 2010; Ludwig 2012b). It appears to be a Mediterranean species (Antonín & Maas Geesteranus 1998; Onofri 2005; Ludwig 2012b; Wilhelm, unpublished). Emmett *et al.* (2008) and Moreno and Esteve-Raventós (2008) consider *M. juniperina* and *M. cupressina* to be conspecific, however. This seems to us the most reasonable taxonomical concept at present and is followed here.

Most likely due to its small size and somewhat specialized habitat, *M. juniperina* was only discovered in the latter years of the 20th century from Northern Europe. Undoubtedly it was reported earlier as the color form of *Mycena meliigena* from northernmost regions of Africa (Morocco, Middle Atlas Mts) (Malençon & Bertault 1975; cf. Robich 2003, 2009). It was subsequently reported from

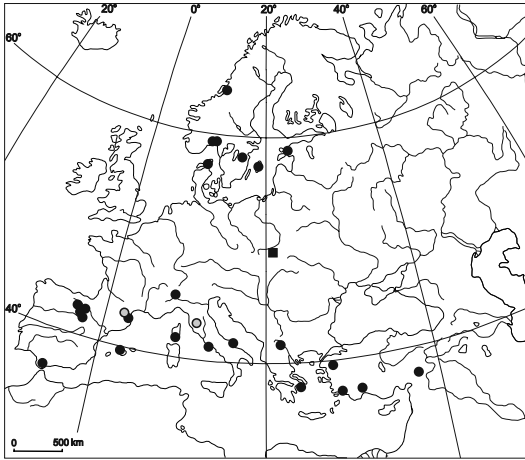


Fig. 1. Distribution of *Mycena juniperina* Aronsen in Europe (based on available literature data and reliable WEB sources): circle sign – previously known localities (black – indicated as *M. juniperina*, grey – reported as *M. cupressina*), square – new locality in Poland.

Sweden (Kummer & Miersch 2001; Læssøe 2005; Krikorev 2008), Denmark (Læssøe 2005), Italy (Robich 2003), Spain (including Balearic Islands; Moreno & Esteve-Raventós 2008; Pérez-De-Gregorio i Capella *et al.* 2009; Salom & Siquier 2011) and Turkey (Doğan & Karadelev 2006; Sesli & Denchev 2008; Doğan *et al.* 2011). It was noted from Estonia (Aronsen 2008; Anonymous 2013), France (including Corsica; Moreau *et al.* 2007; Aronsen 2008; Fridlender & Louis 2010; Wuilbaut 2012), Greece (Konstantinidis 2012), and an imprecisely specified locality in the Former Yugoslav Republic of Macedonia (Karadelev, unpublished). Recently we discovered a new locality of this rare fungus in Pieniny National Park in southern Poland (Fig. 1). In this paper we describe the morphology of the first collections of *M. juniperina* from Poland, and compare their characters with published data. We discuss similar taxa and evaluate the ecology of the species.

MATERIAL AND METHODS

The description of macroscopic features is based on fresh material specified below. Microcharacters of basidiomata were observed with a Nikon Eclipse E-400 light microscope fitted with a Nikon digital camera

(DS-Fi1). All microscopic structures were observed in dried material. Free-hand sections of rehydrated pieces of basidiomata were examined in 5% NH_3 H_2O , Congo red and Melzer's reagent. Image-grabbing and biometric analyses were done with NIS-Elements D 3.1 imaging software. Dimensions of microcharacters are given as (minimum) average \pm standard deviation (maximum), and additionally in the form of the main data range (5–95 percentile values). The Q value refers to the length/width ratio of basidiospores. Basidiospore size measurements were made from randomly selected mature spores, measured without the hilar appendix. Length of basidia was measured excluding sterigmata. Statistical computations employed Statistica software (StatSoft). Morphological terminology follows Vellinga (1988). Nomenclature of plant communities follows Pancer-Koteja *et al.* (2004). Details of the microcharacters were drawn freehand, with exact proportions and general shapes traced from photographs. The collections studied are deposited in the herbarium of the Museum of Natural History, Wrocław University (WRSU).

SPECIMENS EXAMINED: 1 – POLAND, PIENINY MTS: Podskalnia Góra Mt., on trunk of living *Juniperus communis* (directly on bark), found from base up to 0.5 m height, 10 March 2013, *leg.* P. Chachula; 2 – Popieska, on trunk of living *Juniperus communis* (directly on bark), found from base up to 0.6 m height, 2 March 2013, *leg.* P. Chachula; 3 – Wielki Cisowiec Mt., on trunk of living *Juniperus communis* (directly on bark), found from base up to 0.6 m height, 2 March 2013, *leg.* P. Chachula.

RESULTS AND DISCUSSION

Mycena juniperina Aronsen

Persoonia **16**(2): 257. 1996. – *Mycena cupressina* Antonín & Maas Geest., Persoonia **16**(4): 545. 1998. – *Mycena corticola* sensu Malençon & Bertault, Flore des champignons supérieurs du Maroc. **2**: 246–248. 1975 *p.p.* ('formes ocracées ou jaunâtres').

ILLUSTRATIONS: Robich (2003: 654 as *Mycena cupressina*, 658), Læssøe (2005: 56), Roux (2006: 575 as *Mycena cupressina*), Aronsen (2008: photo. 1–10), Krikorev (2008: 20, *fig.* 3), Kummer & Miersch (2001: 33, *fig.* 4), Moreno & Esteve-Raventós (2008: 228, *fig.* 12), Pérez-De-Gregorio i Capella *et al.* (2009: 56–57), Ludwig (2012a: 218, *figs.* 116.31, 116.32 as *Mycena cupressina*), Wuilbaut (2012: 1, 9).

Basidiomata single to scattered. Pileus 1.7–6.1 \times 0.8–2.6 mm, hemispherical to parabolic, finally

convex, occasionally somewhat depressed in center or with small papilla and campanulate, conspicuously sulcate, pruinose to white-puberulous or even \pm flocculose, pale brown or yellowish brown, often darker in center, with margin paler to whitish. Lamellae, L = 7–10, l = 1–9, reaching stipe, fairly broad, somewhat ascending or arcuate to subhorizontal, edge concave to convex, broadly adnate with decurrent tooth, sometimes decurrent far down the stipe, pale yellowish grey or beige with the edge white-pruinose. Stipe 1.5–8.6 \times 0.1–0.9 mm, cylindrical or somewhat widened below lamellae and sometimes also towards base, equal, curved, cartilaginous, fistulose, usually clearly pruinose to \pm flocculose, beige, yellow-ocher, yellow-brown to pale brown, regularly much darker towards base, base occasionally attached to substrate with a patch of radiating, fine, whitish fibrils (Fig. 2). Context very thin and delicate. Smell imperceptible. Taste not noted.

Basidiospores (6.8) 9.7 ± 1.0 (12.8) \times (6.8) 9.0 ± 1.0 (12.1) μm , $8.0\text{--}11.6 \times 7.4\text{--}11.0 \mu\text{m}$, Q = (0.8) 1.1 ± 0.1 (1.5), Q = 0.9–1.3 ($n = 139$),

subglobose to globose, smooth, amyloid. Basidia (19.8) 27.9 ± 3.0 (32.5) \times (6.2) 10.1 ± 1.4 (16.0) μm , $23.8\text{--}31.9 \times 8.0\text{--}11.7 \mu\text{m}$ ($n = 44$), clavate, 2-spored (infrequently 4-spored), with sterigmata (6.2)–(14.1) μm , 4.1–13.1 μm long, generally not clamped, sporadically inconspicuously clamped. Cheilocystidia (13.0) 22.9 ± 5.4 (47.1) \times (4.1) 7.7 ± 1.2 (12.1) μm , $16.2\text{--}31.2 \times 5.6\text{--}9.8 \mu\text{m}$ ($n = 151$), forming a sterile band, clavate, covered with unevenly spaced, simple to branched, curved to tortuous, often irregularly shaped excrescences, generally not clamped, exceptionally inconspicuously clamped. Pleurocystidia absent. Lamellar trama dextrinoid, brownish vinescent in Melzer's reagent. Pileipellis a cutis made up of cylindrical to inflated, (1.8)–(10.3) μm , 2.4–7.2 μm ($n = 101$) μm wide hyphae, clampless, covered with simple to furcate or branched, (0.5)–(13.3) μm , 1.4–7.4 μm ($n = 101$) long excrescences, which may grow to coralloid masses. Hyphae of stipeipellis (1.4)–(5.0) μm , 1.9–3.9 μm ($n = 77$) wide, with abortive clamps or clampless, covered with \pm scattered cylindrical excrescences,



Fig. 2. *Mycena juniperina* Aronsen from the Pieniny Mts, Poland (WRS�-10032013; photo R. Rutkowski). Scale bars = 2.5 mm.

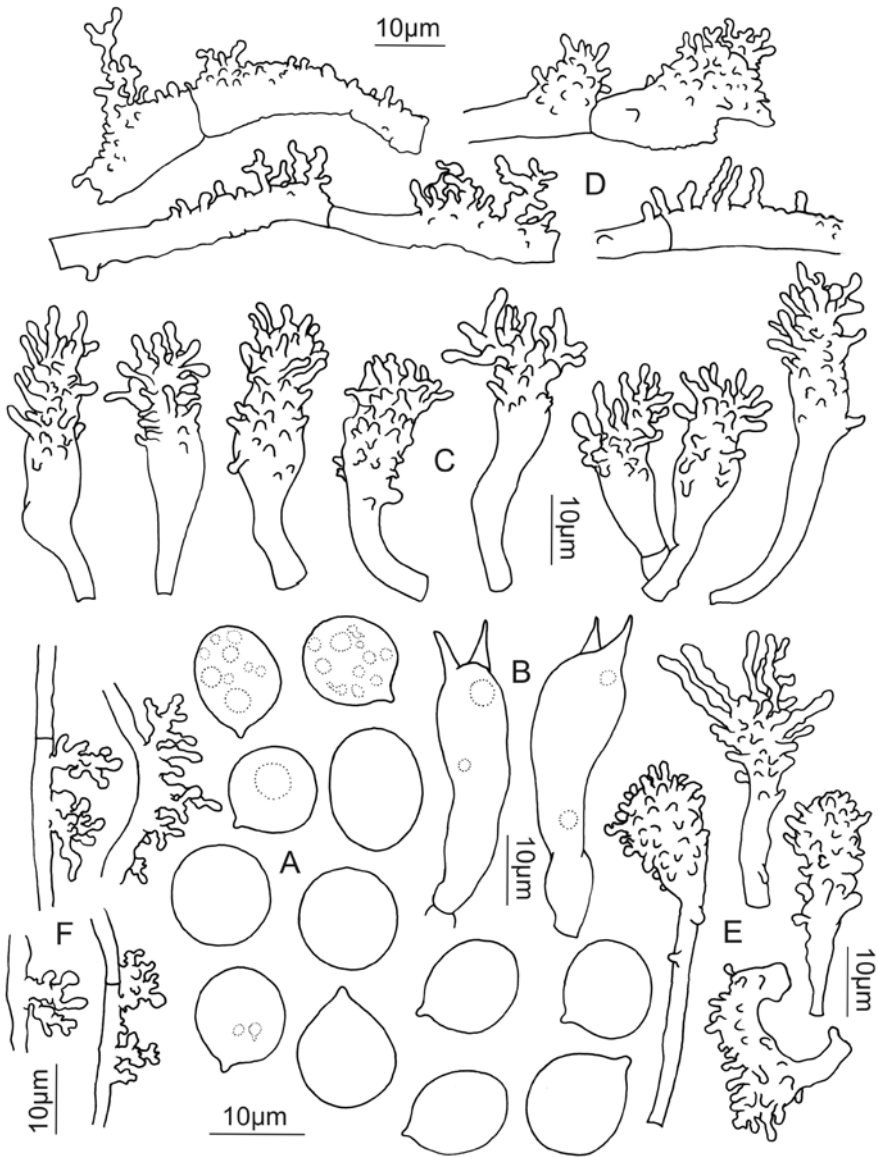


Fig. 3. Microcharacters of *Mycena juniperina* Aronsen: A – basidiospores, B – basidia, C – cheilocystidia, D – hyphae of pileipellis, E – caulocystidia, F – hyphae of cortical layer of stipe (WRS-10032013; drawn by M. Halama).

(1.3)–(9.2) × (0.7)–(2.0) µm, 1.6–7.2 × 1.0–1.5 µm ($n = 46$). Caulocystidia (terminal elements of stipitipellis) abundant, (12.5) 24.0 ± 6.4 (46.6) × (4.7) 8.4 ± 1.5 (11.3) µm, 14.3–35.6 × 5.9–10.7 µm ($n = 66$), clavate, sometimes irregularly shaped, densely diverticulate (Fig. 3).

NOTES ON MORPHOLOGY

Although the holotype of *M. juniperina* from Norway was not observed in this study, we consider the macro- and microcharacters exhibited by a number of Polish specimens to be consistent

with those described by Aronsen (1996), as supplemented by others (e.g., Robich 2003). Our *M. juniperina* basidiomata were collected after a period of dry weather and night frosts. They were slightly dried, so their water content was lower than in a completely fresh state. In such conditions, most fungi have darker carpophores due to the higher concentration of pigments in their (partly drained) cells (cf. Fig. 2).

When Aronsen (1996, 2008) published his accounts of *M. juniperina* he described it as having four-spored basidia. Clamp connections were said to be present in all tissues. The Polish material of *M. juniperina* is almost lacking in four-spored basidia. The dominant two-spored basidia are smaller in our material, consistent with the four-spored ones described in the protologue. Two-spored (together with four-spored) basidia of *M. juniperina* were also reported by Robich (2003), Doğan and Karadelev (2006) and Pérez-De-Gregorio i Capella *et al.* (2009), and the occurrence of two- and four-spored forms in this species seems not to be an unusual phenomenon in *Mycena* (cf. Maas Geesteranus 1992). One would expect the two-spored condition to be accompanied by a corresponding difference in basidiospore dimensions (cf. Smith 1934). However, there is little if any difference in spore size between the Polish material and the available literature data. Since the analyzed basidia are somewhat smaller, it appears that the slight difference in spore size in our collections may be explained by the small amount of material available for spore formation. In the Polish specimens we saw no clamps in the pileipellis or the cortical layer of the stipe; at the base of basidia and cheilocystidia we observed them exceptionally. The literature devoted little attention to the presence and distribution of clamp connections in the species. According to Aronsen (2008) the common situation in the genus *Mycena* is that taxa with four-spored basidia possess clamps at the septa of the hyphae and at the base of basidia and cystidia, whereas two-spored forms are lacking in clamps (e.g., *M. meliigena*, *M. pseudocorticola*). There are exceptions: some species are known to produce clamps in both four-spored and two-spored forms (e.g., *M. filopes*, *M. metata*), and some constantly

four-spored species (e.g., *M. clavularis*) consistently lack clamps. Furthermore, some species generally forming clamps (e.g., *M. leptcephala*) are sometimes devoid of clamp connections (cf. Maas Geesteranus 1992). These few examples suggest that there may be reasons not to overestimate the taxonomical value of clamps in the case of *M. juniperina*. The close similarity in all of the characters except for those mentioned indicates that the specimens we studied are evidently segregates from the typical (four-spored) forms of *M. juniperina*. Whether the discrepancy between the Polish material and the typical forms of the species is due to a genetic alteration or to the influence of a less favorable environment must remain unanswered for the present.

NOTES ON ECOLOGY, PERIODICITY AND DISTRIBUTION

Mycena juniperina is a saprotroph, producing basidiocarps on the bark of living *J. communis* (Aronsen 1996; Robich 2003; Læssøe 2005; Emmett *et al.* 2008; Krikorev 2008, Pérez-De-Gregorio i Capella *et al.* 2009; this study). The first finds of *M. juniperina* in Poland were from the same substrate type. We observed several dozen basidiocarps growing on the bark of three separate living trunks (diam. 3–5 cm) of *J. communis*, always at the base of these trees (partially moss covered) up to ca 0.6 m above the ground. No other fungi shared the same substrate with this species except for some leprose and foliose lichen species. However, in recent years it has been shown that *M. juniperina* is able to inhabit other *Juniperus* species. It also grows on the bark of *J. excelsa* (Doğan & Karadelev 2006; Doğan *et al.* 2011), *J. oxycedrus* (Pérez-De-Gregorio i Capella *et al.* 2009; Fridlender & Louis 2010), *J. foetidissima* (Doğan *et al.* 2011) and *J. phoenicea* (Moreau *et al.* 2007; Konstantinidis 2012). There are also exceptional records from other hosts besides those within *Juniperus*, including *Cedrus* sp. (Malençon & Bertault 1975), *Cupressus sempervirens* (Antonín & Maas Geesteranus 1998 as *M. cupressina*), and the angiosperm *Arbutus unedo* (Antonín & Maas Geesteranus 1998 as *M. cupressina*, Roux 2006 as

M. cupressina, Moreno & Esteve-Raventós 2008, Pérez-De-Gregorio i Capella *et al.* 2009, and Wilhelm 2012 as *M. cupressina*).

With a few exceptions there is little background information about the habitat availability and habitat use of *M. juniperina* in the known areas of its occurrence. In the Pieniny Mts (Wielki Cisowiec Mt., Głębokki Potok stream, Podskalnia Góra Mt.) we noted *M. juniperina* in xerothermic swards (*Origano-Brachypodietum*) from 530 to 700 m a.s.l. This association develops on south-facing, warm and dry slopes on soil rich in calcium carbonate (Pancer-Kotejowa & Zarzycki 1976). From the literature it seems that *M. juniperina* is widespread in coastal localities in the northern and southern parts of its distribution range. This interpretation cannot stand for all of Europe, however, since the species is also reported from inland regions (cf. Fig. 1). Habitats with the occurrence of *M. juniperina* appear to be quite heterogeneous. In Northern Europe (e.g., Norway, Sweden, Denmark), *J. communis* is the only host, and *M. juniperina*'s affinity for various (coastal) plant communities dominated by common juniper is clearly pronounced (Aronsen 1996, 2008; Læssøe 2005). At lower latitudes, for example in the south of France (Languedoc-Roussillon region), *M. juniperina* was observed in a scientific garden on the slope of a very sunny hill where plants from different Mediterranean climates grow, including numerous specimens of *J. oxycedrus* (Fridlender & Louis 2010), while in Corsica it was recorded in a maquis shrubland biome with *J. phoenicea* in the *Clematido-Lentiscetum juniperetosum* association (Moreau *et al.* 2007). In Turkey, Doğan *et al.* (2011) gave records of *M. juniperina* from different environments at 900–1200 m a.s.l. in pure and open stands of *Juniperus foetidissima* and *J. excelsa*, *J. foetidissima* stands mixed with *J. excelsa* and *Pinus nigra*, various forest formations dominated by *J. foetidissima* and mixed with *J. excelsa*, *J. oxycedrus*, *Abies cilicica*, *Acer* sp., *Pinus nigra*, *P. latifolia*, *Quercus cerris* and *Q. coccifer*, and (cf. Doğan & Karadelev 2006) from forest consisting mainly of *Cedrus libani* mixed with *A. cilicica*, *Q. coccifer*, *J. excelsa* and *Phillyrea media*.

It is known that fungi generally have more extensive ecological ranges than vascular plants do. In turn, fungal species have wider distribution areas than higher plants (Schröter 1880; Kalamees 1978). The nature of the distribution of fungal species is determined principally by the presence of suitable substrates and/or phorophytes with which fungi are trophically related; climatic conditions are mostly of secondary importance (Bisby 1933). Temperature, precipitation, humidity, length of season and other climatic factors affect the distribution of fungi, but it is not always easy to assess their exact influence (Bisby 1943). It is apparent that *M. juniperina* is not restricted to a specific set of seaside environmental conditions. The vast distance between recorded finds of *M. juniperina* shows that it has a wide distribution; it seems to be limited by moderate temperature but humidity may be equally or more important. The fungus appears to favor habitats with damp and cold but relatively mild climate of coastal regions at higher latitudes, as well as those with a bimodal regime of Mediterranean climate. Both at higher latitudes and in Mediterranean regions, *M. juniperina* can also occupy habitats far from the coast. The climate in the Pieniny Mts is milder than in other adjacent mountain ranges in Poland. Precipitation is relatively low. The south-facing hillsides where *M. juniperina* occurs are markedly warmer and more arid than the colder and more humid north-facing slopes and valley bottoms. During the growing season, rainfall is highest on northern slopes, but in winter the southern exposures also have abundant precipitation (cf. <http://www.pieniny.pl>). The occurrence and local distribution of the species may also be (favorably) affected by the close proximity of the Czorsztyn-Niedzica and Sromowce Wyzne Reservoir Complex, as it is thought that these reservoirs alter the local mesoclimate within a 5 km range (e.g., Wróbel & Zarzycki 2010). This suggestion is preliminary and needs to be verified.

Emmett *et al.* (2008) state that *M. juniperina* produces basidiocarps from late summer to autumn, while Aronsen (2008) mentions late autumn and early winter. Our observations are not consistent with this pattern but we note that most of the litera-

ture data confirm that *M. juniperina* appears generally in the final quarter, with maximum incidence in November and December (ca 50% records; Aronsen 1996; Robich 2003; Moreau *et al.* 2007; Krikorev 2008; Pérez-De-Gregorio i Capella *et al.* 2009; Doğan *et al.* 2011; Anonymous 2013). The rest of the finds are unequally distributed over the remaining months of the growing season: October (ca 10% records; Aronsen 1996; Robich 2003; Pérez-De-Gregorio i Capella *et al.* 2009), May (ca 10% records; Pérez-De-Gregorio i Capella *et al.* 2009; Fridlender & Louis 2010; Doğan *et al.* 2011), March (ca 10% records; Pérez-De-Gregorio i Capella *et al.* 2009; this study), and to a small extent also over September, August, April, February and January (Aronsen 1996; Kummer & Miersch 2001; Doğan & Karadelev 2006; Pérez-De-Gregorio i Capella *et al.* 2009; Konstantinidis 2012; Anonymous 2013). Since *M. juniperina* is so characteristic in the color and size of basidiomata, and also substrate specificity, it probably has not been much overlooked, but an occurrence early in the season or on a different phorophyte may draw less attention from macromycologists. Nor can we rule out the possibility that this species has spread only in recent years due to the unexpected development of favorable mesoclimatic conditions. In the Pieniny Mts *M. juniperina* does not seem to be extremely rare, but in Poland it should be classified at least as vulnerable and red-listed. Future collections should extend the present sparse observations so that this interesting species can be assigned its correct threat status in Poland.

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