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FIRST RECORD OF THE RARE SPECIES *PHOLIOTA SQUARROSOIDES* (AGARICALES, STROPHARIACEAE) IN SOUTHWESTERN POLAND

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Abstract. *Pholiota squarrosoides* (Peck) Sacc., one of Poland's rarest *Pholiota* species, is reported for the first time from southwest Poland. It was found in a new locality in the Łężczok Reserve (Kotlina Raciborska basin). The current distribution of *P. squarrosoides* in Poland is summarized, based on a literature review and field observations. The paper presents details of the morphology of the collected specimens, and the general distribution and ecology of *P. squarrosoides*.

Key words: *Pholiota squarrosoides*, morphology, distribution, habitat, Upper Silesia, Poland

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INTRODUCTION

The section *Adiposae* Konr. & Maubl. *ex* Holec of the genus *Pholiota* comprises five species in Europe (Noordeloos 2011). So far, three of them have been reported from Poland: *Pholiota adiposa* (Batsch: Fr.) P. Kumm., *Pholiota limonella* (Peck) Sacc., and *Pholiota squarrosoides* (Peck) Sacc. (Wojewoda 2003; Gierczyk *et al*. 2011). During a mycological excursion to the Łężczok Nature Reserve near the town of Racibórz (SW Poland) in the autumn of 2010, a pholiotoid agaric growing on a rotten oak stump, characterized by distinct echinate squamules on the pileus, was found. It was identified as *Pholiota squarrosoides*, a fungus very rare in Poland and the whole of Europe. This species has been described from dead trunks and old stumps of maple in the Adirondack Mts and Catskill Mts (New York State, U.S.A.) (Peck 1879). Although the first specimens of *P. squarrosoides* in a European area (Sweden) were collected in the first half of the 19th and in the first half of the 20th century, the literature data indicate that it has not been distinguished and reported in Europe for a long time, apparently due to its very rare occurrence (cf. Jacobsson 1987; Holec 2001). The first one to note this taxon on the continent was Romagnesi. He found it in 1947 in the Fontainebleu forest, a few dozen kilometers southeast of Paris (France), and described it as a new species, *Dryophila ochropallida* Romagn. (Kühner & Romagnesi 1953; invalid name). Subsequently the name was validly published by Bon (1986; *Pholiota ochropallida* Bon). Later the conspecificity of the North American specimens of *P. squarrosoides* and the European specimens of *P. ochropallida* were confirmed on the basis of research by Jacobsson (1987) and Holec (2001).

The basidiocarps of *P. squarrosoides* grow more or less caespitose and appear in the summer and autumn. This fungus is considered a saprophyte, rarely a parasite occurring at the base of living trees, which can cause intense degradation of the infected wood (Smith & Hesler 1968; Holec 2001). It is associated with many kinds of dead deciduous wood. In the European mycological literature there are records on roots, buried wood, logs, trunks or stumps of *Alnus*, *Betula*, *Carpinus*, *Fagus*, *Populus*, *Quercus*, *Sorbus* and *Salix* (Holec 2001; Wojewoda 2003; Jacobsson 2008). In the Great Lakes states of the United States *P. squarrosoides* is one of the major causes of intense decay in logs of *Acer saccharum* and *Tilia glabra* (Smith & Hesler 1968). This species is apparently favored by continental climate (Jacobsson 1990). It is reported to be rather common in North America (Smith & Hesler 1968)

and probably is also widespread in temperate parts of Asia (Imai 1938; Jacobsson 1987), but in Europe only scattered records are known (Jacobsson 1987, 1990), including those in Great Britain, France, Germany, Austria, Poland, the Czech Republic, Slovakia, Romania, Ukraine, Denmark, Sweden and Finland (Kühner & Romagnesi 1953; Jacobsson 1987; Holec 2001; Spooner 2007; Jacobsson 2008). Noordeloos (2011) maintains that *P. squarrosoides* probably is much rarer in western than in central and northern parts of the continent, where it seems to prefer old-growth forests. Previously, *Pholiota squarrosoides* was known from only a few eastern localities in Poland. Here I present the first record of the species in the western part of the country and provide a full description of the collected material to facilitate identification of this rare agaric from additional localities in Poland.

Material and methods

The study is based on specimens I collected during field studies in the Łężczok Reserve in 2010. The description of macroscopic features is based on fresh material, of one collection comprising six basidiomata in different stages of development. Microscopic features of three mature, dried basidiomata were observed with a Nikon Eclipse E-400 light microscope equipped with a Nikon digital camera (DS-Fi1). For microscopy, dried pieces of basidiomata were rehydrated in 95% ethanol and then mounted in 5% NH_4OH for *ca* 5 minutes. Free-hand sections of basidiomata were observed in Melzer's reagent. Image-grabbing and biometric analyses of micromorphological characters were done with NIS-Elements D 3.1 imaging software. Microphotographs were taken at 600×, except for basidiospores, which were taken at 1500×. Morphological measurements were made and are presented according to Breitenbach and Kränzlin (1991). The dimensions of micromorphological features given in the description are based on 10 measurements of randomly selected characters per specimen, except for basidiospores, for which 30 measurements per specimen were made. The 95% population limits for the mean were calculated, and the lower and upper limits are presented. Minimum and maximum dimensions are given in parentheses additionally. The range ratio of basidiospores is given as the Q value, and the mean of the length/width ratio (Q_m) also is reported. None of the measurements were taken from a spore print. The length of basidia was measured excluding sterigmata. Statistical computations employed Statistica software (StatSoft). Drawings were made on the basis of microphotographs taken with a digital camera. Macro- and micromorphological terminology used for descriptions follows Vellinga (1988) and Vellinga and Noordeloos (1999).

The distribution of *P. squarrosoides* in Poland is presented on map based on the ATPOL grid square system (Zając 1978; Wojewoda 2000). Voucher specimens have been deposited in WRSL (Museum of Natural History, Wrocław University, Wrocław, Poland).

Results and discussion

Pholiota squarrosoides (Peck) Sacc. Figs 1–3

Syll. fung. **5**: 750. 1887.

Agaricus squarrosoides Peck, Annual Rep. New York State Mus. **31**: 33. 1879.

Dryophila ochropallida Romagn., Fl. anal. champ. sup.: 328. 1953, *nom. nud.*

Pholiota ochropallida Bon, Doc. Mycol. **16**(62): 66. 1986.

Basidiocarps growing caespitose. Pileus 42–65 mm, hemispherical with involute margin when young, convex at maturity, fleshy, not hygrophanous, not translucently striate, cuticle dry (in dry weather), almost white to pale white-yellow at margin, towards the center gradually more yellow to yellow-ochre, covered sparsely to densely and ± regularly with white-yellow to ochre-brown, conical to triangular scales, 1.0–3.3 mm high, 1.0–4.2 mm broad, with less erect to almost appressed scales at margin. Lamellae rather crowded ($L > 50$), segmentiform to subventricose, adnate to emarginate, dirty pale yellow then ochre-brown. Stipe 30–100 × 9–15 mm, cylindrical or slightly and gradually attenuated towards the base, flexuose, dry, with fibrillose annuliform zone, above the zone smooth, pale yellow to sordid yellow-ochre, sparsely to densely fibrillose-squamulose below the zone, with distinct fibrillose and erect scales (0.6–5.0 mm long) with downwards-pointed apex, pale white-yellow, in the uppermost part to rusty ochre at base. Context rather firm in pileus and below surface of stipe, soft and cottony in central part of stipe, pale yellow-white. Taste mild, smell pleasant-aromatic. Spore print rusty-brown.

Basidiospores (5.1–)5.6–5.7(–6.7) × (3.0–)3.3–3.4(–4.0) µm, Q = (1.4–)1.6–1.7(–1.9), Q_m = 1.7, ellipsoid to ovoid-ellipsoid in front view, slightly phaseoliform in side view, smooth, pale ochre in ammonia, germ pore absent. Basidia (18.0–)22.1–23.5(–26.3) × (4.4–)5.1–5.3(–6.0) µm, cylindrical to narrowly clavate, 4-spored. Cheilocystidia (23.9–)31.9–37.4(–56.6) × (7.5–)9.4–10.3(–12.5) µm, variable in shape: mostly clavate, rarely fusiform, utriform subcylindrical and sublageniform, thin-walled, mucronate or with cylindrical outgrowth, colorless. Pleurocystidia (leptocystidia) (34.1–)47.2–52.6(–64.2) × (8.0–)10.8–12.0(–15.4) µm, in shape similar to cheilocystidia, mostly clavate, mucronate or with cylindrical outgrowth, colourless. Chrysocystidia (30.6–)42.9–48.3(–59.2) × (7.8–)10.3–11.4 (–14.3) µm, not frequent, present almost solely on lamellae surface, mostly clavate, rarely narrowly utriform and infrequently legeniform-fusiform, usually mucronate or with a projecting outgrowth, thin-walled, partly or completely filled with a refractive inclusion coloring yellow in ammonia. Caulocystidia not observed. Clamp-connections present – clamped basidia observed.

SPECIMENS EXAMINED. POLAND. SILESIAN LOWLANDS, Kotlina Raciborska basin: Łężczok Reserve, on forest road verge, on decayed stump of *Quercus* sp., 10 Oct. 2010, *leg. M. Halama* (WRSL).

Macroscopically and microscopically, the recorded specimens of *P. squarrosoides* agree well with the descriptions of Holec (2001) and Smith and Hesler (1968). However, basidiospore length was somewhat greater than the measurements they presented: (5.1–)5.6–5.7(–6.7) × (3.0–)3.3–3.4(–4.0) µm versus (4.0–)4.5–6.0(–6.5) × (2.5–)2.7–3.5(–4.0) µm versus 4.0–5.5(–6.0) × (2.5–)3.0–3.5 µm. This discrepancy probably is attributable to difference in sample size. Nevertheless, the cheilo-, pleuro- and chrysocystidia, although differing in appearance, were mostly clavate in shape, confirming the observations of other mycologists (Jacobsson 1990; Holec 2001; Spooner 2007).

Pholiota squarrosoides is known from only four localities in Poland and is considered an endangered species here (Wojewoda 2003; Wojewoda & Ławrynowicz 2006). The oldest known locality is from Białowieża National Park, where the well-known mycologist M. M. Moser recorded specimens of *P. squarrosoides* on the dead trunk of a deciduous tree in the second half of the 1960s (Holec 2001). The next two localities were found in the late 1960s in the Lasy Łochowskie forests (in the vicinity of Łazy, on wood of *Alnus*) (Domański 1997) and in the second half of the 1970s in the Bieszczady Mts (in the vicinity of Wetlina, on the slopes of Jawornik Mt. on *Fagus*) (Holec 2001). For a long time the species was not recorded again in Poland until Romański found it in 2008 on dead wood of *Betula* in Wigierski National Park (Halama & Romański 2010). After that, Szczepkowski and colleagues recorded the species in 2010 in Białowieża National Park (Szczepkowski *et al.* 2010), confirming its persistence in this area. Recently a fifth locality of *P. squarrosoides* was found in Poland (Fig. 3). In Poland, excluding records from unidentified deciduous substrates (Holec 2001; Szczepkowski *et al.* 2010), the fungus has

Fig. 1. *Pholiota squarrosoides* (Peck) Sacc. Basidiocarps recorded in the Łężczok Reserve. Scale bar = 20 mm.

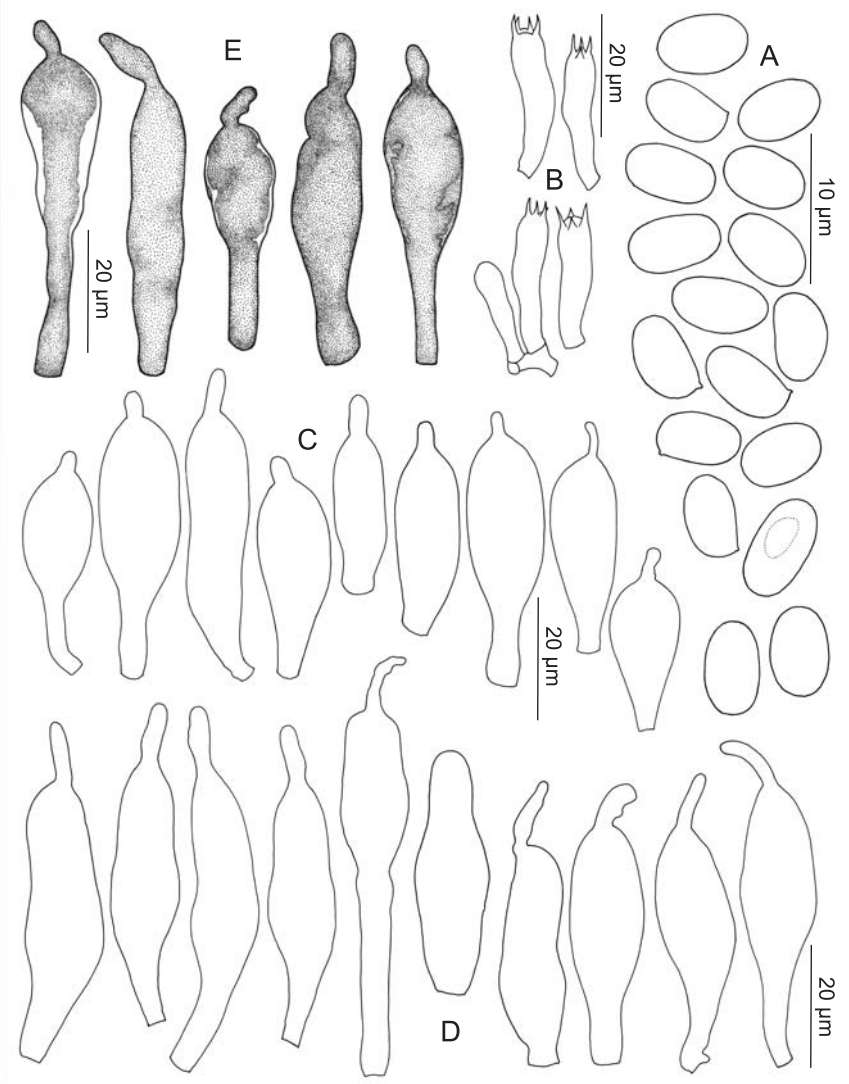

Fig. 2. Basidiospores (A), basidia (B), cheilocystidia (C), pleurocystidia – leptocystidia (D) and chrysocystidia (E) of *Pholiota squarrosoides* (Peck) Sacc. recorded in the Łężczok Reserve (only the most common shapes of cystidia were depicted; drawn from *M. Halama s.n.*, WRSL).

been noted from wood of *Alnus glutinosa*, *Betula* sp. and *Fagus sylvatica* so far (Domański 1997; Wojewoda 2003; Halama & Romański 2010). This record is probably the first case of finding *P. squarrosoides* on wood of *Quercus* in the country. In Europe this fungus is more frequent only in areas with near-natural to virgin deciduous and mixed forests or in old wooded parks (Holec 2001; Jacobsson 2008; Noordeloos 2010). Recognized as a rare species, *P. squarrosoides* has been red-listed in several European countries. It is considered an endangered species in the Czech Republic, Denmark and in Poland (Vesterholt *et al.* 1998; Antonín *et al.* 2006; Wojewoda & Ławrynowicz 2006), and near-threatened in Finland and Sweden (Bonsdorff *et al.* 2010; Dahlberg *et al.* 2010).

The new record of *P. squarrosoides* probably does not reflect expansion of the fungus in Poland,

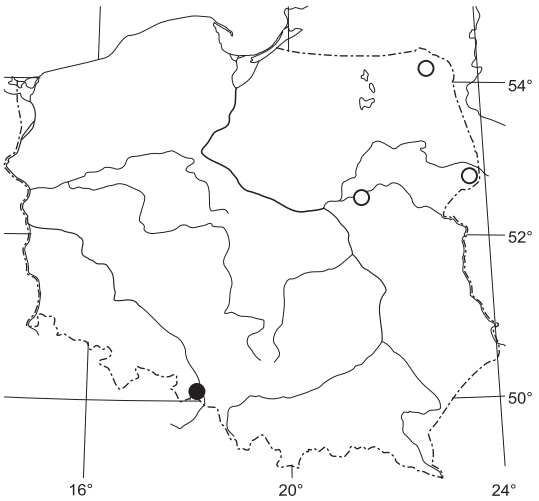

Fig. 3. Distribution of *Pholiota squarrosoides* (Peck) Sacc. in Poland. ● – new locality, ○ – known localities.

but only more intensive mycological exploration of southwestern Poland. As mentioned above, this species is known to occur in well-preserved wooded ecosystems. The Łężczok Reserve is a unique nature area, founded to protect a diverse bog forest and Cistercian fish ponds of high natural value within the significantly altered landscape of the upper Oder Valley. An exceptional biota, including many rare species of fungi (Wojewoda 1981; Szczepka 1985; Sokół *et al.* 1986; Trząski 1994; Halama & Panek 2001), slime molds (Stojanowska 1974; Stojanowska & Panek 2002), plants (Kuczyńska & Fabiszewski 1962; Krawiecowa & Kuczyńska 1964; Sendek 1986; Wika 1994) and animals (Harmata 1963; Mysłajek *et al*. 2002) thrives in the Łężczok Reserve thanks to its favorable biogeographical factors. The Łężczok Reserve is covered by many very old deciduous trees, including oaks and beeches hundreds of years old, favoring the occurrence of several wood-inhabiting fungal rarities (cf. Halama & Panek 2001). The presence of *P. squarrosoides* and other threatened and rare macrofungi confirms the remarkable diversity and richness of the reserve's environment.

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