

NEW INLAND LOCALITIES OF A RARE GASTEROID BASIDIOMYCETE, *SCLERODERMA SEPTENTRIONALE*, IN NATURAL AND ANTHROPOGENIC HABITATS IN CENTRAL EUROPE

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Abstract. *Scleroderma septentrionale* Jeppson was first discovered in Central Europe in the Puszcza Kampinoska primeval forest (Central Poland) over 40 years ago. We found two new inland localities of this rare species in southern Poland: on natural inland sand dunes of post-glacial origin (Pustynia Błędowska) and at an anthropogenic site on sandy soil polluted by heavy metals (Olkusz, in the vicinity of the Bolesław Mine and Smelter). The basidiocarps occurred under willow and birch or pine and birch. The new localities are approximately midway between two previously known inland stands in Central Europe (Puszcza Kampinoska forest and the Záhorie region in Slovakia).

Key words: *Scleroderma*, Boletales, fungi, sand dunes, industrial areas, ecology, distribution, Poland, Europe

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INTRODUCTION

Scleroderma septentrionale Jeppson was originally described in the late 1990s from material from Finland (Jeppson 1998). Together with the European species *Scleroderma bovista* Fr., *S. citrinum* Pers. and *S. meridionale* Demoulin & Malençon it belongs to the section *Scleroderma*, which is characterized by the presence of clamp connections and reticulated ornamentation of basidiospores (Guzmán 1970; Jeppson 1998). The long rooting rhizomorphic stipe and distinct brownish scales present all over the peridium surface (including the lower part of the basidiocarp) are the most characteristic features of *S. septentrionale*. *S. septentrionale* is compared with other European members of the section *Scleroderma* in Jeppson (1998), and with other European species forming a pseudostipe in Jeppson and Piątek (2005). Jeppson (2008) recently published a description of the basidiocarps, with color illustrations and notes on the species distribution.

The species has a northern distribution, with most localities in coastal sand dunes of Finland,

Sweden and Denmark, and one locality in Iceland. In Finland and Sweden it was also recorded inland (Jeppson 1998, 2008). The first Central European localities of *S. septentrionale* (from Poland and Slovakia) were published by Jeppson and Piątek (2005). The Polish localities they mentioned were previously reported by Rudnicka-Jeziarska (1991) in her monograph of epigeous gasteroid basidiomycetes of Poland. In 1961–1968, Rudnicka-Jeziarska found specimens of a *Scleroderma* species which she left unidentified, in the Puszcza Kampinoska primeval forest (central Poland). She suggested *S. macrorrhizon* Wallr. as a possible identification that needed to be confirmed by further studies. Jeppson and Piątek's (2005) revision of specimens collected by Rudnicka-Jeziarska assigned the specimens to *S. septentrionale*; they also published the southernmost known European locality of *S. septentrionale* from Slovakia (Záhorie region, Moravský Svätý Ján, Borová). Apart from Europe, *S. septentrionale* has also been reported from the northern United States and Canada

(Guzmán & Overbo 2000; Kuo 2004; Jeppson 2008). Recently we discovered two new inland localities of this rare fungus in Poland.

MATERIAL AND METHODS

The description of morphological characters was based on two already dried specimens from the Pustynia Błędowska dunes and three fresh specimens collected in Bolesław. For LM and measurements the spores were mounted in 5% KOH and examined with a NIKON E80i microscope with Nomarski interference contrast. The spore diameter measurements exclude ornamentation, which was measured separately. Measurements are based on 70 spores. Spores were also examined with a Hitachi S-4700 scanning electron microscope after coating with gold. The SEM observations were carried out in the Laboratory of Field Emission Scanning Electron Microscopy and Microanalysis at the Institute of Geological Sciences, Jagiellonian University in Kraków.

RESULTS AND DISCUSSION

Scleroderma septentrionale Jeppson

Karstenia 38: 37. 1998.

Basidiocarps (Figs 1–3) immersed in sandy soil up to 3/4 of height, globose or slightly flattened, 2.7–5.5 cm in diameter, old specimens usually lacking upper part of peridium and with lower part remaining intact, giving the basidiocarps a goblet shape. Peridium yellowish to yellowish brown, entirely covered with small brownish scales, ca 1 mm thick in upper part, thicker and tough in lower part of basidiocarp, fragile and easily breaking into large patches in dried or old specimens. Gleba brown to grayish-brown. Pseudostipe prominent, consisting of thick, branched and interconnected whitish rhizomorphs densely covered by sand particles. Basidiospores (Figs 4–10) globose, 6.5–15.0 (mean 10.3) μm in diameter, covered by ornamentation in the form of a complete net up to 3 μm high, with irregular, frayed outer part.

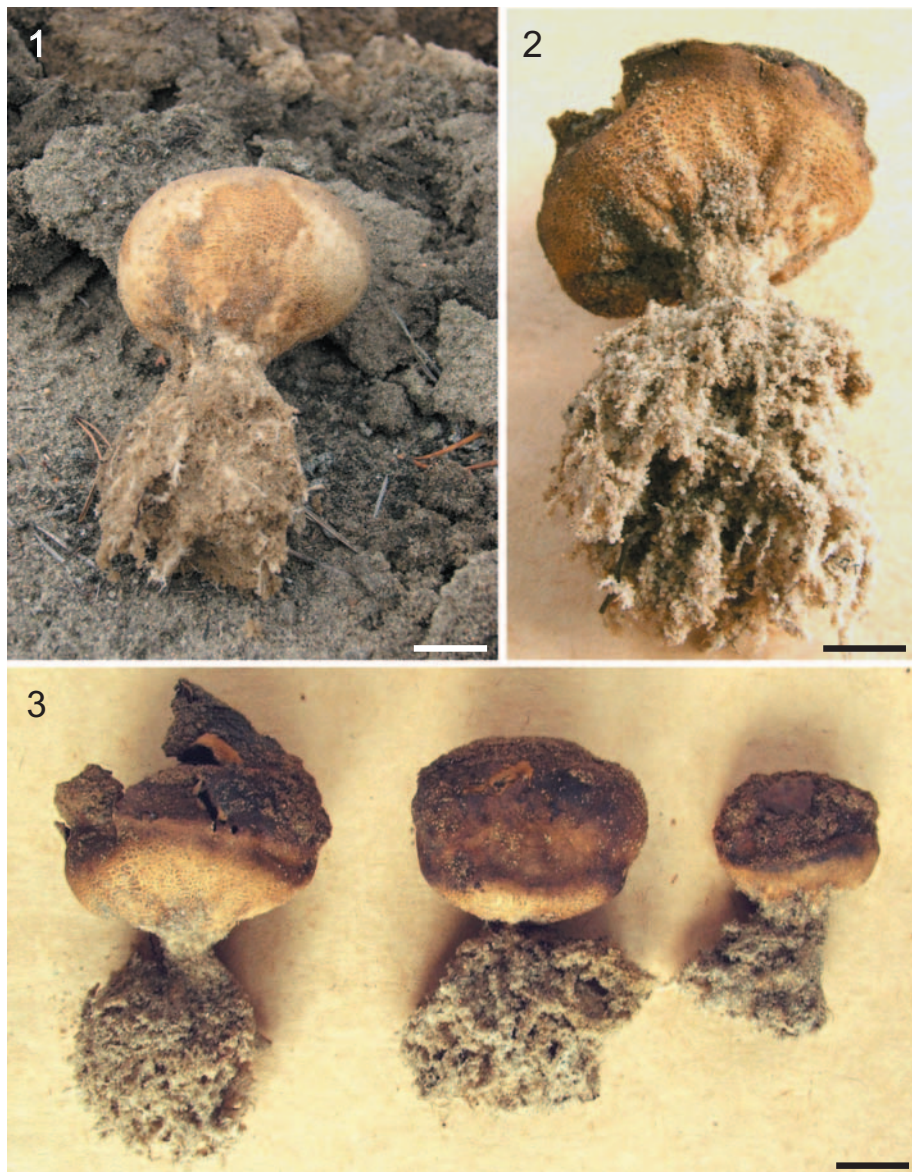
SPECIMENS EXAMINED: POLAND. WYŻYNA ŚLĄSKA UPLAND, GARB TARNOGÓRSKI PLATEAU: Orlich Gniazd Landscape Park, Pustynia Błędowska dunes, on sand with scattered *Salix repens* L. subsp. *arenaria* (L.) Hiitonen

and *Betula pendula* Roth., N 50°21'24", E 19°31'05", 319 m a.s.l., 15 Oct. 2007, leg. S. Gawroński (KRA-F 2007-1); near Olkusz, in vicinity of Bolesław Mine and Smelter, on sand, in open area with scattered pine (*Pinus sylvestris* L.) and birch (*Betula pendula*) trees, between pine plantations, N 50°16'55", E 19°31'18", 330 m a.s.l., 2. Oct. 2008, leg. P. Kapusta (KRA-F 2008-4).

ECOLOGICAL OBSERVATIONS AND NOTES ON MORPHOLOGY

In the Pustynia Błędowska sand dunes the basidiocarps were found on bare sand of post-glacial quaternary origin, ca 1 m from the nearest *Salix repens* subsp. *arenaria* dwarf shrubs and one specimen of dwarf form of *Betula pendula* (Fig. 11). In the vicinity of willows and a birch, single specimens of *Corynephorus canescens* (L.) P. Beauv., *Koeleria glauca* (Spreng.) DC. and *Thymus serpyllum* L. emend. Fr. were growing together with small tufts of the lichen species *Stereocaulon condensatum* Hoffm. and *Cladonia fimbriata* (L.) Fr., and the bryophytes *Polytrichum piliferum* Hedw., *Niphotrichum canescens* (Hedw.) Bednarek-Ochyra & Ochyra and *Ceratodon purpureus* (Hedw.) Brid. This plant assembly can be classified as the first stage of plant succession on the Pustynia Błędowska sand dunes (Rahmonov 2007).

In Olkusz the basidiocarps were also growing on bare sand of post-glacial origin, in an open area between pine plantations (Fig. 12). The site was sparsely colonized by pine and birch trees and the ground was partly and loosely covered with lichens (*Diploschistes muscorum* (Scop.) R. Sant., *Stereocaulon incrustatum* Flörke as well as a few species of *Cladonia* dominated there), *Thymus* sp. and grasses. The basidiocarps were found 3–4 m away from the nearest pine trees growing at the edge of a 50-year-old pine plantation. The presence of stunted trees and poor vegetation in this place results from the high deposition of heavy metals (Zn, Pb) and sulphur in the soil, the main sources of which are post-flotation tailings ponds and smelters. The *Scleroderma septentrionale* basidiocarps found at this locality were normally

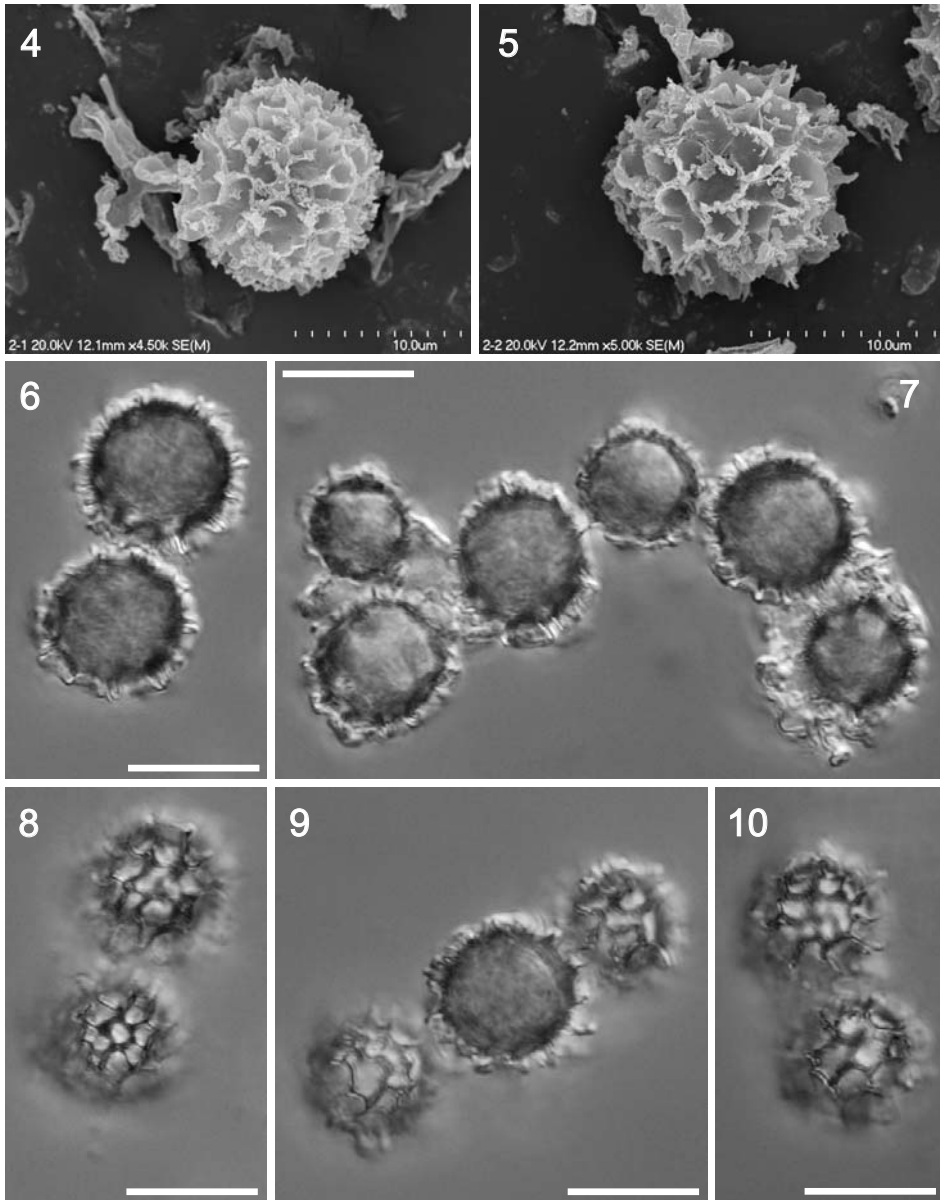


Figs 1–3. *Scleroderma septentrionale* Jeppson from southern Poland. 1 – fresh basidiocarp from Olkusz, 2 – dry basidiocarp from Olkusz, with well-visible pseudostipe and brownish scales covering peridium surface, 3 – three dried specimens from Olkusz, with upper parts of peridia disintegrating. Scale bars = 1 cm.

developed, however, and bore no macro- or micromorphological signs of deformation.

Scleroderma septentrionale is associated almost exclusively with sandy habitats of coastal and inland sand dunes. In the Puszcza Kampinoska forest (central Poland) it was found growing on

inland mobile sand dunes (Rudnicka-Jeziarska 1991; Jeppson & Piątek 2005). The new localities in the Wyżyna Śląska upland are approximately midway between two previously known inland stations in Central Europe (Puszcza Kampinoska forest and Záhorie region in Slovakia). In Slovakia,



Figs 4–10. Spores of *Scleroderma septentrionale* Jeppson from Pustynia Błędowska. 4 & 5 – spores by SEM, 6 & 7 – spores by LM in optical section (NIC), 8–10 – spores by LM in surface view (NIC). Scale bars for Figs 6–10 = 10 µm.

S. septentrionale was found growing in Scots pine (*Pinus sylvestris*) forest covering inland dunes close to a river. In the Puszcza Kampinoska forest it probably was also associated with pine, which, however, was sparse and rather far from the basidiocarps. At least once the fungus was found

by Rudnicka-Jezińska (1991) growing close to a cluster of birch trees. The basidiocarps found in the Pustynia Błędowska dunes were growing close to *Salix repens* subsp. *arenaria* and one specimen of dwarf *Betula pendula*, and those from Bolesław occurred close to *Pinus sylvestris* and *Betula*



Fig. 11. Locality of *Scleroderma septentrionale* Jeppson in Pustynia Błędowska.



Fig. 12. Locality of *Scleroderma septentrionale* Jeppson in Olkusz.

pendula trees. According to Jeppson (1998), most Scandinavian findings were made in areas with scattered *Pinus sylvestris*, and one among shrubs of *Salix repens*. Thus, *S. septentrionale* probably is associated with both conifers and hardwoods as ectomycorrhizal partners.

The characters of *Scleroderma septentrionale* basidiocarps from the new localities in southern Poland agree with the descriptions given by Jeppson (1998) for Scandinavian specimens and by Jeppson and Piątek (2005) for those from Central Poland and Slovakia. The spore dimensions matched the ones given by those authors, but it should be noted that Guzmán and Overbo (2000), after revision of some Swedish specimens (from Skåne) and investigation of American specimens (spores mounted in KOH, measured without ornamentation), found the dimension range to be shifted: maximum up to 21 and 26 μm , minimum 10 μm , as compared to maximum 15 μm and minimum 7 μm given by Jeppson (1998) and Jeppson and Piątek (2005). The ornamentation height given by Guzmán and Overbo (2000): (1.5–)2–4(–6) μm also exceeds the measurements of Polish specimens: 1–3 μm . Interestingly, the spore dimensions of North American specimens reported by Kuo (2004) are rather similar to those reported from Europe (spore diameter 8–16 μm , ornamentation 2–4 μm high).

Among the Polish members of the genus *Scleroderma*, which form clamp connections, only

S. bovista resembles *S. septentrionale*. This species can be found in various types of forests and on a diverse range of soil types, and usually forms a short pseudostipe which may be more prominent if the basidiocarps develop on sandy soil. *Scleroderma bovista* differs in lacking brownish scales scattered all over the peridium surface, which is rather delicately and irregularly cracked. The spores of the two species are very similar in size and ornamentation type.

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