

DOI: 10.5586/am.1098

**Publication history**

Received: 2017-05-08

Accepted: 2017-10-22

Published: 2017-11-20

**Handling editor**

Tomasz Leski, Institute of Dendrology, Polish Academy of Sciences, Poland

**Authors' contributions**

AS: identification of the specimens, writing of the manuscript, preparation of the map; TO: field research, correction of the manuscript

**Funding**

Publishing of the manuscript was covered by the statutory funds of the Faculty of Forestry, Warsaw University of Life Sciences – SGGW.

**Competing interests**AS is a member of the Editorial Council of the *Acta Mycologica*; TO: no competing interests**Copyright notice**© The Author(s) 2017. This is an Open Access article distributed under the terms of the [Creative Commons Attribution License](#), which permits redistribution, commercial and non-commercial, provided that the article is properly cited.**Citation**Szczepkowski A, Olenderek T. *Suillus lakei* (Murrill) A. H. Sm. & Thiers (Boletales, Basidiomycota) in Poland: new data. *Acta Mycol.* 2017;52(2):1098. <https://doi.org/10.5586/am.1098>**Digital signature**

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## SHORT COMMUNICATION

# *Suillus lakei* (Murrill) A. H. Sm. & Thiers (Boletales, Basidiomycota) in Poland: new data

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This study presents up-to-date data on the distribution of the Western Painted *Suillus lakei* in Poland. This alien species of fungus was first recorded in Poland in 2012, followed by a second recording in 2013. The third site, presented in this article, was discovered in 2016. A description of the newly discovered site and the basidiomata is given. All three sites of *S. lakei* are located on private properties overgrown with young Douglas fir. Two of the three recorded sites are located within the boundaries of the Wielkopolskie Province, and one in the Kujawsko-Pomorskie Province. Further expansion of this fungus in Poland is expected.

**Keywords**alien species; Western Painted *Suillus*; macrofungi; ectomycorrhizal fungi; Douglas fir; *Pseudotsuga menziesii*; distribution in Poland**Introduction**

*Suillus lakei* (Murrill) A. H. Sm. & Thiers is an example of an additional alien species of mycobiota – besides *Agaricus subrufescens* Peck [1,2] and *Aureoboletus projectellus* (Murrill) Halling [3] – recorded in Poland in recent years. This fungus is known under a number of synonymous names: *Boletus lakei* Murrill, *Boletinus lakei* (Murrill) Singer, *Ixocomus lakei* (Murrill) Singer, and *Suillus amabilis* (Peck) Singer [4]. The epithet *lakei* was added in recognition of a mycologist from the University of Oregon, E. R. Lake [5]. In Northwestern North America – where this *Suillus* originates – it is one of the common species of bolete fungi. *Suillus lakei* is well known as ectomycorrhizal with the Douglas fir, and its basidiomata can be found on the ground in summer and fall amidst the grass of young coniferous forests as well as in parks and gardens with Douglas fir. Basidiomata of *S. lakei* appear in large numbers especially after the first abundant fall rainfalls [5,6]. In North America, basidiomata of *S. lakei* are commonly observed in direct vicinity of spike-cap *Gomphidius subroseus* Kauffman, which is probably a parasite on the mycorrhizal mycelium of the Western Painted *Suillus* [7].

Together with its partner-tree (Douglas fir, *Pseudotsuga menziesii*), *S. lakei* was introduced to South America [8], New Zealand [9], and Europe, where it was recorded in Bosnia and Herzegovina, Bulgaria, the Czech Republic, Denmark, Germany, Slovakia, Hungary, Great Britain, and Italy [10–12]. Since 2012, *S. lakei* is known also from Poland [13,14], where it has also been identified from ectomycorrhizas by Pietras et al. [15].

*Suillus lakei* is relatively easy to recognize by its appearance in the vicinity of the Douglas fir and on the basis of its pileus with a diameter ranging from 3 to 15(18) cm (usually dry, but in older specimens sticky during moist weather), covered with clearly

visible and usually rust-colored, reddish-brown bundles of fibers or scales (sometimes absent in older specimens) (e.g., [16–19]). Within this species, four varieties are distinguished. According to Klofac [20], the dimensions of the spores of the nominate variety *S. lakei* var. *lakei* reach  $11 \times 3.7(-4) \mu\text{m}$ . The variety *S. lakei* var. *pseudopictus*, recorded in North America (and in Europe known only from Italy), differs from the nominate variety only in its smaller (up to 10 cm wide), darker, more brick-red, rougher pileus and its – according to some authors – somewhat smaller ( $9 \times 4 \mu\text{m}$ ) spores [16,20–22]. In Italy, the variety *S. lakei* var. *calabrus*, which is characterized by its brighter, yellowish cap covered by rusty red scales, was recorded under Douglas firs growing in acidic soils [10]. On the other hand, *S. lakei* var. *landkammeri* is characterized by the olive hue of its pores, its hymenophore tubes that visibly descend onto the stipe, and its spores of up to  $4.8 \mu\text{m}$  in width.

The Western Painted Suillus is considered an edible species, especially young mushrooms, although opinions differ significantly regarding its taste qualities [22]. A significant amount of alkaloids and tannins is found in the basidiomata of *S. lakei*, suggesting also the potential medicinal properties of this fungus [23].

The aim of this work is to summarize the data regarding previous observations and distributions of localities of *S. lakei* in Poland and to present a newly discovered site and a description of the basidiomata discovered there.

## Material and methods

The list of documented sites of *S. lakei* basidiomata occurrence in Poland is presented according to physico-geographical divisions – by subprovince, macroregion, and microregion [24] – and Polish administrative divisions at the level of province and county. The names of fungi are cited according to Mycobank [4], and plants after Mirek et al. [25]. Observations and measurements of 30 spores were conducted in water using a Nikon Eclipse E400 microscope.

## Results

Previously, only two localities of *S. lakei* in Poland have been reported. The locality presented in this work is the third site in Poland. All localities are found on private properties situated within the boundaries of three mesoregions: Lower Vistula Valley (Polish: Dolina Dolnej Wisły), Great Poland Lakeland (Polish: Pojezierze Wielkopolskie), and Southern Great Poland Lowland (Polish: Nizina Południowowielkopolska) and two provinces: Kujawy-Pomerania and Great Poland.



**Fig. 1** Distribution of *Suillus lakei* (Murrill) A. H. Sm. & Thiers in Poland (white circle: new locality; black circles: localities known from the literature).

### List of localities of *Suillus lakei* in Poland (Fig. 1)

**New locality.** Central Polish Lowlands (Polish: Niziny Środkowopolskie), Southern Great Poland Lowland, Kalisz Upland (Polish: Wysoczyzna Kaliska): Brudzew (Kalisz County, Great Poland Province), on private property, in grass in the vicinity of young Douglas firs, on November 5, 2016, leg. Irena & Józef Bażant, det. Andrzej Szczepkowski.

**Localities known from the literature.** South Baltic Lakeland (Polish: Pojezierze Południowobałtyckie), Lower Vistula Valley, Fordon Valley (Polish: Dolina Fordońska): Pruszcz Pomorski (Świecie County, Kujawy-Pomerania Province), October 8, 2012 [13]; South Baltic Lakeland,

Great Poland Lakeland, Września Plain (Polish: Równina Wrzesińska): Poznań-Szcze-pankowo (Poznań County, Great Poland Province), September 28 and October 10, 2013 [14] (and personal communication, 2017).

#### Description of the new locality and basidiomata in Brudzew

On November 5, 2016, a site of *S. lakei* was found within the locality of Brudzew (Blizanów municipality, Kalisz County, Great Poland Province). The site is located on private property (N 51°55'35"; E 17°59'10") encompassing approximately 0.7 hectares. Apart from a residential building and utility buildings, the greater part of the property's terrain is occupied by an orchard with fruit trees and shrubs (apples, plums, raspberries, blackberries, and grapes), English oaks *Quercus robur* and several species of coniferous trees: Douglas fir *Pseudotsuga menziesii* subs. *menziesii*, European larch *Larix decidua* var. *polonica*, Scots pine *Pinus sylvestris* and ponderosa pine *P. ponderosa*, Norway spruce *Picea abies* and blue spruce *P. pungens*, and northern white cedar *Thuja occidentalis*. Currently, more than 30 trees of Douglas fir are growing on the property. The oldest tree is about 20 years old and the youngest about 4–5 years old. According to the owners of the property, the seedlings of the Douglas firs originate from the Beskid Mountains (Wisła Forest District). Basidiomata of *S. lakei* were observed in the direct vicinity of the apple trees, northern white cedar, pines, spruces, and two young Douglas firs (70 cm height). Among nine basidiomata of *S. lakei*; seven were characterized by fused stipes and two were growing individually in grass, at a distance of 3–4 meters from the Douglas firs. The diameter of the pilei ranged from 3 to 12 cm and a thickness reached 2.5 cm (the tube layer was up to 0.9 cm). The surface of the pileus was covered with dry, rough, rusty reddish-brown fibrils. The tubes and pores were olive-yellow. The pores were angular and elongated, up to 2.5 mm wide, partially descending onto the stipe. When pressed, the pores got darken. The stipes were full, cylindrical, ochre in color, and from 3 to 9 cm in height and 0.8 to about 3 cm in width. On the stipes and at the edge of the younger pilei, the remnants of the whitish partial veil were visible. The tissue of the pileus and stipe was yellowish with a subtle orange hue; without changing a color when exposed to the air. There was no perceptible smell; the taste was somewhat acidic. The spores were smooth, elongated ellipsoids with dimensions (9–)10–11(–12) × 3.5–4.5 μm, with one or a few drops. The spore print was olive-brown. Apart from the *S. lakei*, basidiomata of Greville's bolete *S. grevillei* were also growing on the property, in the vicinity of larches. Dried basidiomata of *S. lakei* were preserved in the fungarium of the Division of Mycology and Forest Phytopathology of the Warsaw University of Life Sciences – SGGW (WAML).

#### Discussion

Douglas firs began to be introduced into Europe (and into Poland) in the first half of the nineteenth century [26]. The first record of *S. lakei* was reported after nearly 100 years from the first introduction of the Douglas firs to Europe and originate from Denmark from 1920. The second and the last (so far) record of this fungus has been reported from that country in 1980 [27,28]. In 1949, *S. lakei* was found in Czechoslovakia and was described as *Boletinus tridentinus* (Bres.) subsp. *Landkammeri* by Pilát and Svrček [29]. Few years later, Chinková and Pouzar [30] demonstrated that the described taxon is in fact the North American species *Boletinus lakei* (Murr.) Sing. It has also been found in the Czech Republic in recent years [31]. In England, *S. lakei* was found once, in 1952 [32]. In other countries such as Germany, *S. lakei* was noted for the first time in 1971 and also in recent years [33–36]. In 1989, it was found in Hungary [37]. In Italy, *S. lakei* was encountered since the end of the twentieth century [10,38,39]. In 2004, *S. lakei* was reported in Bulgaria (currently known from a few stands) [11,40,41].

The first documented record of *S. lakei* in Poland originates from 2012 and, because this fungus was earlier known in the neighboring countries (Czech Republic, Slovakia, northeastern Germany), we presume that *S. lakei* could also arrive to Poland much earlier. In 1960, in her monograph on boletoid fungi of Poland, Skirgiełło included

a description of *Boletinus Lakei* (Murr.) Sing. (there with the Polish name “borowiec Lakego”) and information that the mushroom was not yet confirmed in Poland but might possibly be found [42]. If we assume that *S. lakei* indeed arrived prior to 2012, then this brings up the question why this fungus had not been noticed before from the area of Poland. The most probable explanation is that the basidiomata of *S. lakei* were rarely encountered by mushroom pickers. Additionally, basidiomata were probably not distinguished from those of *Suillus cavipes* = *Boletinus cavipes* (whose basidiomata are characterized by a hollow stipe and mycorrhizal symbiosis with the larch *Larix*) or even from some boletes *Xerocomus* spp. However, we may also not exclude that the findings of *S. lakei* in Poland in recent years roughly reflect the time of its arrival to Poland. This assumption is supported by the fact that the fungus was only recently discovered in Bulgaria and Hungary. It is also possible that in Poland *S. lakei* mycelium existed for a long time only in mycorrhizal form and from the unknown reason did not expressed in the form of basidiomata. Mycorrhizas of *S. lakei* were recently reported by Pietras et al. from young forest plantations of Douglas fir [15]. The new questions concern factors influencing the appearance of basidiomata of *S. lakei* in recent years and potential further spreading of this fungus on the area of Poland. Therefore, more research is required on the occurrence of basidiomata of *S. lakei* on new plantings of Douglas fir in gardens, parks, and forest plantations to better understand the biology of this alien fungus species and its expansion dynamics in Poland.

### Acknowledgments

The authors express their sincere thanks to Irena and Józef Bażant for conveying the basidiomata and information regarding the site of *Suillus lakei* in Brudzew and to Prof. Tadeusz Tylkowski from the Institute of Dendrology, Polish Academy of Sciences in Kórnik for additional information regarding the locality in Poznań-Szczepankowo. The text was translated by Bogna J. Gladden-Obidzińska and proofread by Matthew E. Gladden.

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