Acta Mycologica

Article ID: 213278
DOI: 10.5586/am/213278

Publication History
Received: 2025-02-21
Accepted: 2025-10-16
Published: 2025-12-31

Handling Editor
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Funding
The research did not receive any external funding.

Competing Interests
No competing interests have been declared.

ORIGINAL RESEARCH

A summary of the distribution and ecology of *Entoloma conferendum* (Basidiomycota, Agaricales) in Poland

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Abstract

The article presents updated information on the occurrence of *Entoloma conferendum* in Poland. The species has been confirmed at no fewer than 132 sites across the country, spanning a wide range of habitats, including approximately 26 forested environments (accounting for 73.5% of classified records) and 11 non-forested ones (21% of classified records). New localities are reported from the Śnieżnik Massif in southwestern Poland, discovered during mycological research conducted in semi-natural montane grasslands maintained through traditional agricultural practices such as extensive mowing and grazing. The article includes descriptions and illustrations of the morphological features of the collected basidiomata. Additionally, the delimitation of *E. conferendum* is briefly discussed, along with insights into the species' ecology and distribution in Poland. Particular attention is given to the historical misapplication of the name *Hyporrhodius pascuus* (Pers.: Fr.) J. Schröt. and its synonyms in Polish mycological literature. Based on a detailed analysis of Schröter's original description and the examination of specimens he identified, it is concluded that *H. pascuus* is a misapplied name, now correctly attributed to *Entoloma conferendum* (Britzelm.) Noordel.

Keywords

Nolanea conferenda; *Entoloma staurosporum*; *Rhodophyllus staurosporus*; *Hyporrhodius pascuus*; the Eastern Sudetes; Lower Silesia

1. Introduction

Worldwide, more than 1500 species belonging to the genus *Entoloma* (Fr.) P. Kumm. are known (Co-David et al., 2009; Kirk et al., 2008). However, it is presumed that the global diversity of these fungi is significantly greater, exceeding 2500 species (Noordeloos et al., 2022). In Europe, this genus is represented by more than 350 species (e.g., Noordeloos, 1992, 2004; Noordeloos et al., 2018; Noordeloos et al., 2022), while in Poland it includes at least 160 species (Kujawa, 2024; unpublished materials; Wojewoda, 2003).

Entoloma fungi produce cap-shaped, gymnocarpous fruiting bodies, equipped with a lamellar type of hymenophore. One of the basic distinguishing features of these fungi is the presence of pink or pinkish brown (in print) basidiospores with an angular or angularly tuberculate outline (Singer, 1986). Most *Entoloma* species are saprotrophic, but some form biotrophic relationships with *Sphagnum* mosses or engage in mycorrhizal associations with higher plants (e.g., members of the families Betulaceae, Pinaceae, Salicaceae, and Rosaceae) or parasitize the fruiting bodies of other fungi (Largent, 1994; Noordeloos, 1992).

Entoloma conferendum (Britzelm.) Noordel. (syn. *Entoloma staurosporum* (Bres.) E. Horak) is one of the easiest to identify and the most frequently recorded *Entoloma* species in Poland. This fungus is documented in the literature from at least 132 sites located in the northern, southern, eastern, western, and central parts of the country (Adamczyk, 2011; Adamczyk & Kucharski, 2005; Bujakiewicz, 1979, 2004, 2018; Bujakiewicz & Kujawa, 2010; Bujakiewicz & Lisiewska, 1983; Domański et al., 1960, 1963, 1967; Domański, 1965, 1999; Flisińska, 2004; Frejlak, 1973; Friedrich & Orzechowska, 2002; Gierczyk et al., 2009; Gierczyk et al., 2018; Grzesiak et al., 2017; Gumińska, 1972; Kałucka, 2009; Karasiński et al., 2015; Kryza & Puciata, 2009; Kujawa & Gierczyk, 2016; Kujawa et al., 2023; refer to Figure 1A–C; Kujawa et al., 2019; Lisiewska, 1978, 1979, 2004; Lisiewska & Nowicka, 1979; Ławrynowicz, 1973; Łuszczyński, 2008; Łuszczyński et al., 2022; Nespiak, 1960, 1962; Pietras et al., 2016; Ronikier, 2012; Rudnicka-Jezierska, 1969; Stasińska,

2011; Stasińska & Sotek, 2017; Szkodzik, 2005; Ślusarczyk, 2007, 2019; Wojewoda, 1974, 2003; Wojewoda et al., 2004; Wojewoda et al., 2016). In the Sudetes, *E. conferendum* has so far been recorded from the western part of this mountain range, i.e. the Karkonosze Mts, Izera Mts, Kaczawskie Mts, Bardzkie Mts, the Upper Nysa Depression, and the Śnieżnik Massif (Mt. Śnieżnik) (Gierczyk et al., 2018; Kujawa et al., 2023; Schröter, 1885–1889). The main goal of this study is to present new records of this species found by the author in 2011 in the Śnieżnik Massif (near Biała Woda), provide a morphological characterisation, and summarise the knowledge on the ecology and distribution of *E. conferendum* in Poland. Achieving the main objective of the paper also required targeted studies on the contemporary interpretation of taxonomic nomenclature used in older mycological literature, particularly from the 19th and 20th centuries, with special attention to selected data presented in Schröter's monumental work "Die Pilze Schlesiens".

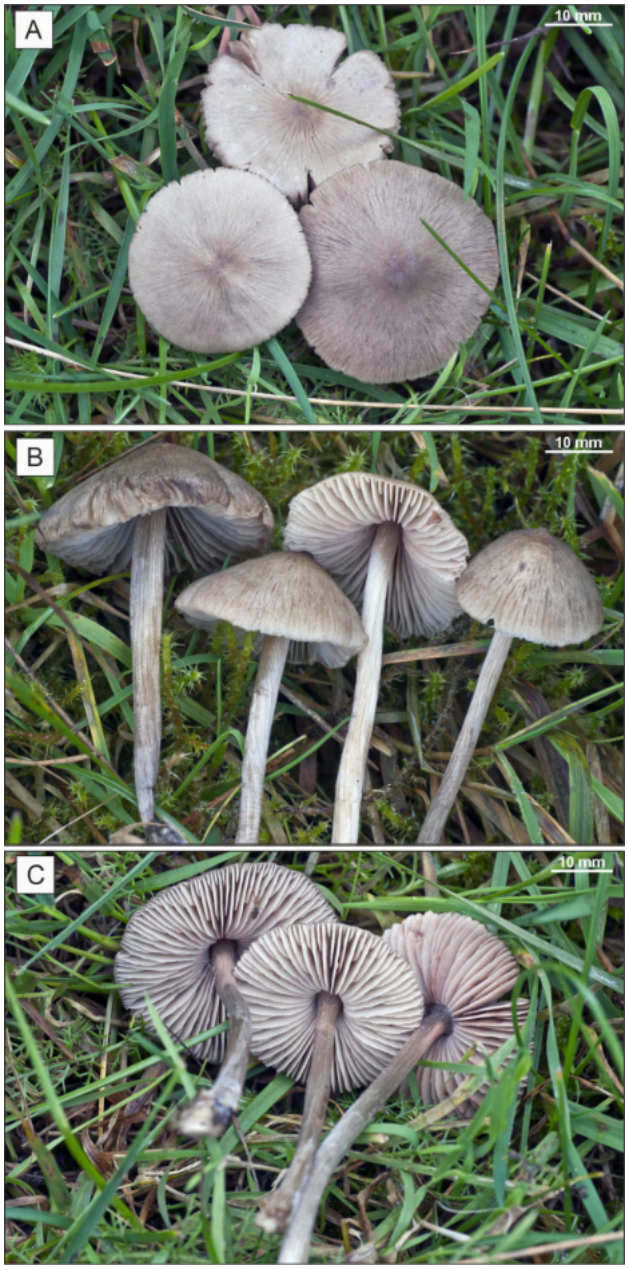

Figure 1A–C Basidiocarps of *Entoloma conferendum* in the extensively grazed semi-natural montane grassland near the village of Biała Woda (the Śnieżnik Massif, alt. ca. 860 m a.s.l.), 16.09.2011 (photo by M. Halama).

2. Material and methods

Fieldwork was conducted in September 2011. Mycological data was collected using a transect method (cf. Jongman et al., 1995), with the aid of a GPS device and dedicated database software. Field photographs of fresh basidiomata were taken with the aid of a Pentax K10D camera equipped with a F2.8 Tamron SP 90mm macro lens. The basidiomata were collected, transported to the laboratory, and dried for further study. Characteristics that change over time (colour of basidiomata, smell, texture) were noted in the field.

Taxonomic analysis of the collected material was carried out using classical methods of mycological taxonomy, utilising a light microscope and specific chemical reagents and stains (Clémençon, 2009; Noordeloos, 1992). The macroscopic description is based both on the study of fresh material and on the analysis of photos. All microscopic structures were observed from dried material with a Nikon Eclipse E–400 light microscope equipped with a Nikon digital camera (DS-Fi1). Freehand sections of rehydrated basidiomata pieces were examined in squash preparations in 5% $NH_3 \bullet H_2O$ and 1% aqueous solution of Fuchsin B in 5% $NH_3 \bullet H_2O$. Image capture and biometric analyses were performed with NIS-Elements D 3.1 imaging software. The dimensions of the microcharacters are given as follows: (minimum) 10^{th}–90^{th} percentile values (maximum), mean ± standard deviation. For basidiospores, randomly selected mature spores were measured without the hilar appendix. The length of the basidia was measured excluding sterigmata. Statistical computations were carried out using Statistica software (StatSoft). The following abbreviations are used: L = number of lamellae reaching the stipe, l = number of lamellulae between each pair of lamellae, Q = the length-width ratio of basidiospores (mean value). The number of analyzed elements is indicated in parentheses (n =), sequentially providing the number of measurements taken, the number of specimens analyzed, and the number of collections examined. The fungal nomenclature is united according to the Index Fungorum database (www.indexfungorum.org), while the plant nomenclature is based on Mirek et al. (2002) and Ochyra et al. (2003). Syntaxon names of plant communities are given according to Matuszkiewicz (2001, 2007). The collections studied are deposited at the Museum of Natural History of Wrocław University, Poland (WRSL).

In compiling data on the ecology, habitat requirements, and national distribution patterns of the studied species, a variety of information sources were utilized. This included data from available literature (cf. Kujawa, 2024; Wojewoda, 2003), a revision of materials deposited in the WRSL-F herbarium, as well as additional data and spatial information layers of a natural-geographical nature (e.g., resources of the Forest Data Bank and the geoportal website www.geoportal.gov.pl). Spatial data management and

analysis were performed using the QGIS geoinformation software. A list of national localities of *E. conferendum* included in the study is provided in Appendix A.

3. Results and discussion

Distinguishing features and morphological characteristics

Although *E. conferendum* exhibits considerable morphological variability, it is distinguished by its clearly hygrophanous, shiny, grey brown cap, which, upon drying, often appears wrinkled in the central part and is covered with short fibrils. Furthermore, it is characterised by its silvery, fibrously striated, typically twisted stipe, and, most notably, its characteristic basidiospores. These spores, though diverse in shape, are predominantly cross-star-shaped in outline and feature 4 (rarely 5 or 6) corners when viewed in profile. Additionally, the species lacks clamp connections (Noordeloos et al., 2022). The morphological characteristics of the basidiocarps of *E. conferendum* found in new localities within the Śnieżnik Massif align with the contemporary concept of this species and descriptions available in the literature (e.g., Ćetković et al., 2020; Kaygusuz & Battistin, 2020; Noordeloos, 1980, 1992, 2004).

The colouration and general habit of the fruiting bodies of *E. conferendum* are illustrated in the accompanying photographs Figure 1A–C). Context pale brown grey or yellow grey in cortex of pileus and stipe, whitish or greyish in inner parts. Smell weak farinaceous. Taste not verified. The most important features of the micromorphological structure are as follows:

Basidiospores: (8.4) 9–11.9 (13), 10.4±1.1 × (7) 7.9–10.6 (11.6), 9.2±1.1 µm, Qw = (1) 1–1.3 (1.4), 1.1±0.1 (n=60/5/3), varied in outline and complex in shape, predominantly cross-star-shaped with 4 corners (less frequently 5 or 6); thin-walled and colourless in ammonia water (Figure 2). Basidia: (24.7) 25.7–31.5 (32.1), 28.8±2.4 × (10) 10.3–12 (13.2), 11.1±0.9 µm (n=13/5/3), 4-sterigmate, from ventricose-cylindrical to clavate. Cystidia: hymenial cystidia were not observed. Pileipellis: of the "cutis" type, transitioning to a "trichoderm" structure in the central region of the cap; it consists of an upper layer of cylindrical hyphae, 6.2–14 µm wide, with an intracellular beige-brown pigment (rarely also incrustatory-parietal) and a subpellis layer composed of inflated hyphae measuring 40–100 × 20–35 µm. Clamps not observed.

Examined collections: Poland, Śnieżnik Massif: 1. extensively managed mountain meadow, in humus composed of

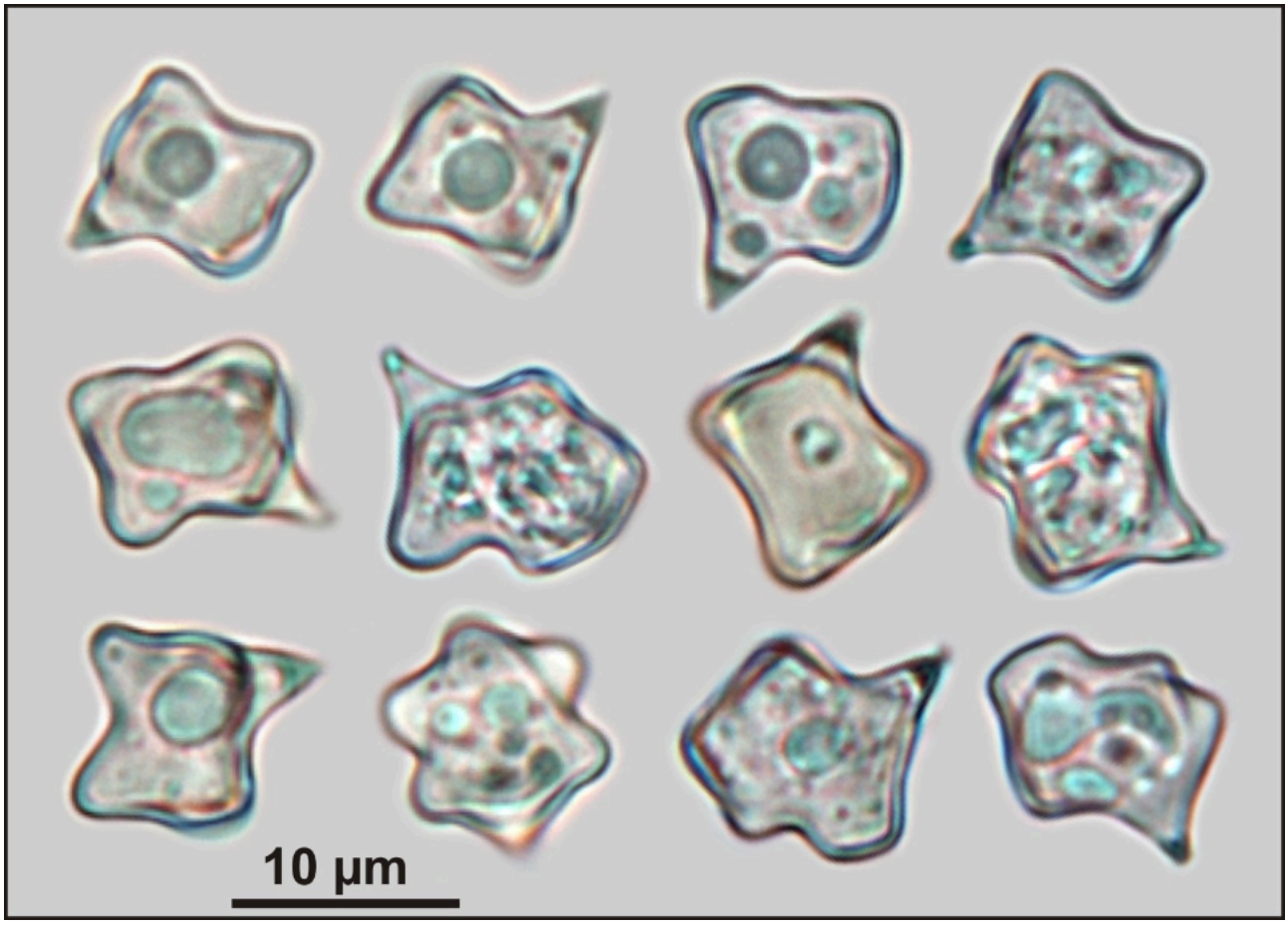

Figure 2 Basidiospores of *Entoloma conferendum* observed under a compound microscope (HM-2011-0022; photo by M. Halama).

herbaceous and moss remains, near *Achillea millefolium*, *Deschampsia caespitosa*, *Festuca* sp., and *Rhytidiadelphus squarrosus*, 855 m a.s.l., 50°15'60"N, 16°47'53"E, 16.09.2011, leg. M. Halama (HM-2011-1034); 2. *Ibidem*, habitat as described above, 856 m a.s.l., 50°15'59"N, 16°47'51"E, 16.09.2011, leg. M. Halama (HM-2011-1034); 3. Poland, Ślęża Mountain (Zobtenberg), 10.1872, leg. L. Becker, det. J. Schröter as *Nolanea pascua* (WRSL-F 002073).

Taxonomic diversity and similar species

Noordeloos et al. (2022) assigned *E. conferendum* to the subgenus *Nolanea* (Fr.) Noordel. and the section *Staurospora* (Largent & Thiers) Noordel. Among the European representatives of *Staurospora*, only *E. conferendum* and *Entoloma milthalerae* M. Kamke & Lüderitz are known to exhibit cross-star-shaped spores. The latter species was recently described from oligotrophic, moist crowberry (*Empetrum*) heaths in Schleswig-Holstein, Germany (Lüderitz et al., 2016) and has also been recorded in Austria (Reschke et al., 2022). *Entoloma milthalerae* has not yet been confirmed in Poland, although some earlier records of *E. conferendum* in the country may in fact pertain to this species (cf. Noordeloos et al., 2022). Unfortunately, *E. milthalerae* remains a poorly known species. Its current interpretation (Noordeloos et al., 2022; Reschke et al., 2022) differs significantly from the original description. Initially, the species was reported as having a non-striate, non-hygrophanous pileus with a tomentose surface, the presence of cheilocystidia, significantly larger spores, and occasional clamp connections on the hyphae of the stipe (Lüderitz et al., 2016). According to Noordeloos et al. (2022), most of the holotype of *E. milthalerae* has been lost; however, a study of the remaining fragment revealed smaller spores and aberrant basidia, which correspond well with the previously reported so-called cheilocystidia. Despite its similarity to *E. conferendum, E. milthalerae* seems to be not its sister species according to phylogenetic analyses (Reschke et al., 2022). It should be noted, however, that the minor genetic differences have been observed between these taxa (with a p-distance not exceeding 2.0% based on ITS sequences data), which until recently, has not been considered sufficient grounds for distinguishing separate species within the genus *Entoloma* (e.g. Morozova et al., 2014). The smaller size of the fruit bodies (pileus ≤ 20 mm in diameter vs. 20–60 mm; stipe 30–50 × 1–1.5 mm vs. 25–80 × 2–6.5 mm), together with differences in spore size and shape (9–12 × 7.5–9 µm, Q = 1.1–1.5 – often irregularly cruciform-stellate with sharp angles, vs. 7.5–9.5 × 6–8 µm, Q = 1.1–1.3 – relatively regular and cruciform), seem to have key diagnostic value, allowing for the differentiation of *E. milthalerae* from *E. conferendum* (Noordeloos et al., 2022). However, the current study suggests that such morphological differentiation may not be entirely reliable. Although the analyzed specimens more closely match *E. milthalerae* in terms of spore size, the spore shape and the relatively large dimensions of the fruit bodies support their identification as *E. conferendum*. These findings, in agreement with those of other authors (e.g. Ćetković et al., 2020), indicate that the morphological delimitation of *E. conferendum* proposed in the most recent monograph of the genus *Entoloma* (Noordeloos et al., 2022) may be overly simplistic.

Entoloma conferendum exhibits a broad distribution and ecological amplitude (see below), as well as considerable morphological variability. This is reflected in the numerous synonyms of the species (Ludwig, 2007; Noordeloos, 1980, 1992). Among the several varieties and forms of *E. conferendum* (e.g., Bon & Courtecuisse, 1987; Courtecuisse, 2008; Jamoni & Bon, 1991; Largent, 1994; Noordeloos, 1980; Noordeloos & Hausknecht, 1998), two taxa deserve a brief discussion here, as their presence has been previously reported from Poland.

Entoloma conferendum var. *pusillum* (Velen.) Noordel. (syn. *Rhodophyllus xylophilus* J.E. Lange), is characterised by smaller and slenderer basidiomata (cap up to 15 mm in diameter, stipe 1–1.5 mm wide) (Noordeloos, 1980; Noordeloos et al., 2022). This taxon is now regarded as an occasional, aberrant form of *E. conferendum* fruiting on (very rotten) woody substrates (Noordeloos et al., 2022). In Poland, *E. conferendum* var. *pusillum* has been recorded several times to date (Domański et al., 1967; Gierczyk et al., 2018; Lisiewska, 1978, 1979; Łuszczyński, 2008). Noordeloos et al. (2022) point out that some reports of the presence of the wood-inhabiting variety on other substrates, particularly in swampy and *Sphagnum* dominated environments, may in fact represent *E. milthalerae*.

Entoloma conferendum var. *incrustatum* (Largent & Thiers) Noordel. & Hauskn. (syn. *Nolanea staurospora* var. *incrustata* Largent & Thiers) – taxon described from western USA (Largent & Thiers, 1972), was recently reported in Poland by Gierczyk et al. (2018). It differs morphologically from the typical variety in having a minutely incrusting pigment present on some of the slender hyphae in the pileal trama (Largent, 1994). However, this incrustation may occasionally be present in both *E. conferendum* and *E. milthalerae*, especially in narrow hyphae beneath the subpellis layer (Noordeloos et al., 2022). In the case of European collections, the aforementioned taxa lack incrusting pigment organised in ring-like patterns, as observed and described by Largent & Thiers (1972). Therefore, for European collections, the taxonomic status of *E. conferendum* var. *incrustatum* remains unclear, and it is currently not recommended to apply this name to European materials (Noordeloos et al., 2022).

A strong morphological resemblance to *E. conferendum* is also exhibited by *Entoloma nothofagi* G. Stev. and *Entoloma botanicum* by G. Stev., which occur in forest communities dominated by *Nothofagus*, *Weinmannia*, *Metrosideros*, and *Dacrydium* in New Zealand (Horak, 2008; Stevenson, 1962). Similarly, though possessing noticeably smaller spores, *Entoloma brevispermum* G.M. Gates & Noordel. is recognized as a species widespread in the moist sclerophyll forests of Australia and Tasmania (Gates & Noordeloos, 2007; Noordeloos & Gates, 2012). Subsequent morphological analyses of the holotypes of *E. nothofagi* and *E. botanicum* revealed no significant distinguishing features, and the differences observed in comparison to *E. conferendum* were deemed negligible (Noordeloos & Gates, 2012). Both taxa are now

considered conspecific (Horak, 2008) and likely synonymous with *E. conferendum* (Horak, 1980; Noordeloos, 1980; Noordeloos & Gates, 2012). Molecular phylogenetic studies are needed to conclusively resolve the taxonomic status of *E. nothofagi* and *E. botanicum* within the *Staurospora* section and to better define the global distribution of *E. conferendum*.

At this point, it is also necessary to briefly address the name *Agaricus pascuus* Pers.: Fr., which frequently appears in older mycological literature (e.g., Schröter, 1885–1889). Noordeloos (1980) concluded that this name, along with its later homotypic synonyms (e.g., *Nolanea pascua* (Pers.: Fr.) P. Kumm., *Rhodophyllus pascuus* (Pers.: Fr.) Quél., *Hyporrhodius pascuus* (Pers.: Fr.) J. Schröt., *Entoloma pascuum* (Pers.: Fr.) Donk), represents a case of doubtful application. In the literature, it has been used to refer to a taxonomically complex group comprising at least three grassland species: *E. conferendum*, *Entoloma sericeum* (Bull. ex) Quél., and *Entoloma vernum* Lundell. Recently, however, the name *Agaricus pascuus* Pers.: Fr. has been recognised as an earlier homotypic synonym of *Entoloma sericeum* Quél. (Reschke & Noordeloos, 2022). In the "Checklist of Polish larger Basidiomycetes" (Wojewoda, 2003), *E. pascuum* is listed among the representatives of the genus *Entoloma*, categorized as a "doubtful taxon". This publication does not provide a detailed interpretation of *A. pascuus* sensu J. Schröt., and only two (out of a total of 26) Polish localities of *E. pascuum*, originally reported in "Die Pilze Schlesiens" by Schröter (1885–1889) under the name *Hyporhodius pascuus*, are mentioned in a simplified manner. Additionally, data from two other authors, Chełchowski (1898) and Eichler (1900), are also included. Schröter's (1885–1889: page 614) description of the taxon – particularly the spore dimensions and shape, clearly points to *E. conferendum* as the modern equivalent of *A. pascuus* ss. J. Schröt. This identification is further supported by micromorphological analysis of selected collections housed in the WRSL fungarium (e.g., WRSL-F 002073). Unfortunately, due to the overly general nature of the available information, an unambiguous taxonomic interpretation of the data published by other 19th-century authors regarding *A. pascuus* remains unattainable (cf. Chełchowski, 1888: page 81, 1898: page 155; Eichler, 1900: page 191; Zawadzki, 1835: page 168).

Distribution, phenology, and ecology

The natural range of *E. conferendum* is likely very broad, encompassing areas in both the Northern and Southern Hemispheres (Krieglsteiner, 2003; Noordeloos & Gates, 2012). This fungus is a widely distributed taxon in Poland. Its most numerous sites (4–11) are in the following mesoregions: Drawsko Lakeland, Warsaw Basin, Karkonosze Mts, Bieszczady Mts, Olkusz Upland, Częstochowa Upland, and Żywiec Beskid Mts (Figure 3). *Entoloma conferendum* seems to demonstrate a very wide ecological amplitude, both in

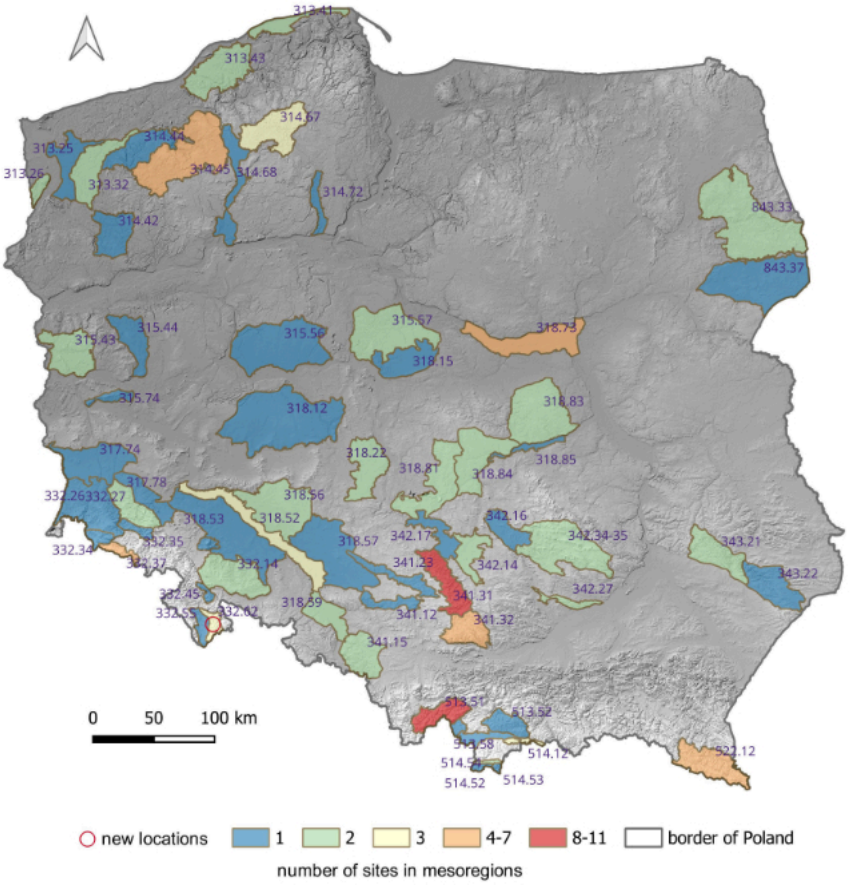

Figure 3 Distribution of sites of *Entoloma conferendum* in Poland against the background of mesoregions (codes of mesoregions after Solon et al., 2018; see Appendix A for additional information).

terms of the habitats it occupies and other environmental parameters, including climatic and geological-soil conditions (see below). The vertical distribution of the Polish sites of the species varies and includes both lowland and mountainous areas (Figure 4). The highest occurrences of this species in Poland are found in the Tatra Mountains and the Babia Góra Massif, occupying habitats at elevations between 1100 and 1900 meters above sea level, including alpine environments (Bujakiewicz, 1979; Frejlak, 1973; Nespiak, 1960, 1962; Ronikier, 2012). Although a significant proportion (over 23%) of *E. conferendum* sites are located at elevations between 751 and 1 000 meters above sea level – including, among others, records from the Śnieżnik Massif – the majority of the species' recorded locations in Poland lie below 500 meters above sea level (approximately 56%).

In general, basidiomata of *E. conferendum* appear singly or in small groups from April to November, although there are also some records of this fungus in January and December (Krieglsteiner, 2003; Ludwig, 2007). A similar phenology is observed in Poland (Figure 5), where *E. conferendum* fruits from spring to late autumn, with the peak period being from August to October (more than 58% of classified records).

In Europe, *E. conferendum* is considered a species of fresh and moist habitats, developing among mosses, grasses, and shrubs, and is found almost exclusively on acidic or at least surface-acidified soils (brown, podzol, peat), characterised by low calcium carbonate and nutrient content. The habitats of the species on the European continent include the interiors and edges of various forest types (coniferous, mixed, and deciduous), parks, clearings, poor meadows and pastures, and raised bogs (Krieglsteiner, 2003; Ludwig, 2007; Noordeloos, 1992; Noordeloos et al., 2022). The sites presented in this study from the Śnieżnik Massif, which include extensively used and unfertilized meadows, confirm the preference of the species for habitats characterised by low nutrient content in the soil. Available data indicate that *E. conferendum* in Poland is most often recorded in forested and shrub habitats. These environments constitute approximately 74% of classified sites for this species (Adamczyk, 2011; Bujakiewicz, 1979; Bujakiewicz & Kujawa, 2010; Bujakiewicz & Lisiewska, 1983; Domański et al., 1960, 1963, 1967; Domański, 1965, 1999; Friedrich & Orzechowska, 2002; Gierczyk et al., 2009; Gierczyk et al., 2018; Grzesiak et al., 2017; Karasiński et al., 2015; Kujawa & Gierczyk, 2016; Lisiewska, 1979; Ławrynowicz, 1973; Nespiak, 1960; Ronikier, 2012; Rudnicka-Jezierska, 1969; Schröter, 1885–1889; Stasińska, 2011; Stasińska & Sotek, 2017; Szkodzik, 2005; Ślusarczyk, 2007, 2019; Wojewoda, 1974; Wojewoda et al., 2004). Non-forest communities represent 21% of the sites of *E. conferendum* in Poland (Adamczyk & Kucharski, 2005; Frejlak, 1973; Gierczyk et al., 2009; Grzesiak et al., 2017; Gumińska, 1972; Karasiński et al., 2015; Kujawa et al., 2019; Łuszczyński et al., 2022, presented data; Schröter, 1885–1889; Stasińska, 2011). The remaining portion (a total of 5%) consists of unclassified habitats and park-garden type habitats (Flisińska, 2004; Gierczyk et al., 2018; Karasiński et al., 2015; Kryza & Puciata, 2009; Lisiewska & Nowicka, 1979; Pietras et al., 2016). Among the forest-shrub habitat categories of *E. conferendum* in Poland, 17 types of phytosociological associations have been distinguished (*Abieti-Piceetum*, *Calamagrostio villosae-Pinetum*, *Dentario glandulosae-Fagetum*, *Fraxino-Alnetum*, *Galio-Abietetum*, *Leucobryo-Pinetum*, *Luzulo luzuloidis-Quercetum*, *Pinetum mughi carpaticum*, *Plagiothecio-Piceetum*, *Potentillo albae-Quercetum*, *Querco roboris-Pinetum*, *Ribeso nigri-Alnetum*, *Serratulo-Pinetum*, *Sorbo-Aceretum*, *Tilio-Carpinetum*, *Vaccinio uliginosi-Betuletum pubescentis*, *Vaccinio uliginosi-Pinetum*) as well as 11 types of more general or simplified defined vegetation communities (e.g., unspecified forest, swamp forest, deciduous forest, mixed forest, pine forest, etc.). The highest proportion of *E. conferendum* sites are found in "unspecified" forest phytocoenoses (15%) and a group of 11 associations and communities, including: upper montane Carpathian spruce forest, mesotrophic fir forest, lower montane spruce-fir forest, dwarf pine thickets, subcontinental oak-hornbeam forest, swamp birch forest, and submontane acidophilous oak forest (35%). The proportion of reported *E. conferendum* sites in Poland representing non-forest habitats is 21%. These include meadow and grassland communities (*Adonido-Brachypodietum*, *Thalictro-Salvietum*), pastures, roadsides, clearings,

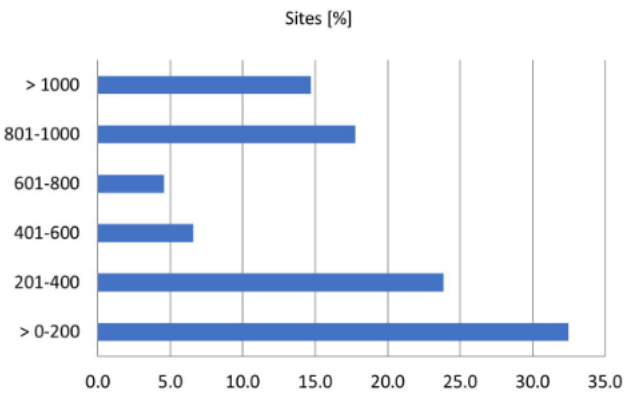

Figure 4 The altitude occurrence of *Entoloma conferendum* in Poland.

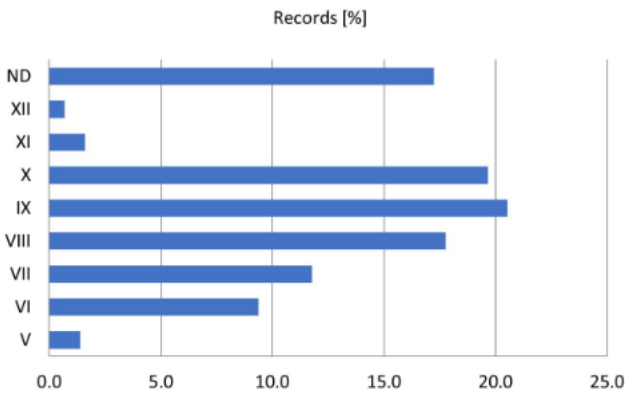

Figure 5 The phenology of *Entoloma conferendum* in Poland (ND – not classified data).

fallow lands, and ombrotrophic moss communities (*Sphagnetum magellanici*). The last category, which accounts for the smallest share of *E. conferendum* sites (>5%), consists of records lacking habitat information and habitats reported as parks and garden environments.

4. Conclusions

Entoloma conferendum has a wide global distribution, including most temperate zones of both hemispheres, and is widespread from the lowlands to the alpine zones. The species seems to be a very common fungus in Poland. Although the taxon exhibits significant morphological variability, it also possesses a distinctive set of characteristics that allow for its unequivocal identification, among which the most important role is played by its unique – regular cruciform-stellate spore form. The known varieties of the species reported from Poland, such as var. *pusillum* and var. *incrustatum* exhibit the following main differences: the first is characterised by woody substrate affinity, while the second is distinguished by the presence of a minutely incrusting pigmentation on some of the slender hyphae of the pileal trama. However, the taxonomic status of the latter taxon in Europe (and in Poland) remains uncertain, and this name is currently advised against using it for European materials. Nomenclaturally, *H. pascuus* sensu J. Schröt., must be considered as a misapplied name of *A. conferendus* Britz., which is consistent with data from the literature and results from morphological characteristics of the collections studied. Within the subgenus *Nolanea* and the Staurospora section, *E. conferendum* stands out alongside *E. milthalerae* due to its unique spore morphology, however, the latter differs from related *E. conferendum,* apart from other habitat preferences, in its larger and more irregular spores.

Entoloma conferendum is very common fungus, which demonstrates an amazing wide ecological amplitude, thriving in diverse habitats across Poland. In this country, the species is predominantly found in forested and shrub habitats, which constitute approximately 74% of its recorded sites. Non-forest habitats account for 21% of the records, while the remaining 5% represent unclassified or park-garden environments. The fungus appears to prefer acid soils and habitats with a low soil nutrient content. It is found across various elevations, from lowlands to mountainous regions (up to 1900 m above sea level). Its fruiting season spans from spring through late autumn, with peak occurrences observed from August to October.

Further research should focus on molecular analyses to clarify the taxonomic relationships within the *Staurospora* section and validate the distinctiveness of the *E. conferendum* variants on a global scale. Additionally, expanding ecological studies can improve understanding of the habitat preferences of the species and its ecological roles within fungal communities.

5. Supplementary material

The following supplementary material is available for this article:

Appendix A. Polish localities of *Entoloma conferendum* documented in the study.

Acknowledgments

The author gratefully acknowledges Mr. Czesław Narkiewicz for the opportunity to discuss the distribution of the studied species in Lower Silesia. This research was funded through private means and co-financed by statutory funds from the Museum of Natural History, University of Wrocław. I also extend sincere thanks to the anonymous reviewers for their constructive comments.

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