

First records of *Galerina paludosa* (Basidiomycota) in North Macedonia

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Abstract

This study documents the first occurrence of *Galerina paludosa*, a species of agaric fungus, in North Macedonia. The identification of this species was confirmed through a combination of macroscopic and microscopic morphological analysis. The discovery of this species in North Macedonia enriches the knowledge on fungal biodiversity of the country and expands the knowledge on the distribution of this species globally.

Key words: fungal biodiversity, morphology, bogs.

INTRODUCTION

The genus *Galerina* Earle consists of ca. 300 species of small brown-spored agarics predominately found in the Northern Hemisphere. Most of the species are associated with bryophytes, while others are living on other wood or plant remains and their ecology is important for identification of the species. Also, different macroscopic features are important for identification of *Galerina* species, as basidiocarp size, surface features on the pileus, type of lamellae connection to the stipe, color, flavor and odor. The basidiocarps are usually mycenoid, although some species are larger in size and occasionally an annulus on the stipe is present. In most species, the spore surface is usually weakly verrucose, however in some species near the apex, a smooth area called "plage" with callus is present. The spores which have this plage structure have an inner wall layer forming an endospore which inflates after exposure to diluted base or acid solution (Gulden et al., 2005).

Galerina paludosa (Fr.) Kühner is a sphagnicolous species that is fairly common throughout most of Europe and North America where it grows in association with *Sphagnum* mosses in bogs and wet mossy woodlands (Redhead, 1981; Kirk et al., 2008). This type of habitats is present in the zone immediately around Lake Lokuv, the glacial lake that covers an area of

4000 m² where waters from the surrounding slopes converge. It is one of the five glacial lakes located on Mount Deshat near the village of Trebishte. Situated at an altitude of 1565 m.a.s.l. it is the lowest glacial lake in North Macedonia (Vasilevski, 2008). Summer temperatures of the water in the lake reach 25°C, while in winter the lake completely freezes over (Micevski et al., 2008). The area around the lake is mostly covered by *Sphagnum* mosses after which a transition zone of grassy forest edge is present followed by beech forest. This habitat is suitable for sphagnicolous species of genus *Galerina*, such as *G. paludosa*.

METHODOLOGY

The material was collected on a student fieldtrip organized by BSRS (Biological Students' Research Society) in the summer season of 2023 on Mount Deshat near the glacial lake Lokuv. Photographs of the fresh specimens were made on site using a Samsung A52. The samples were dried in an air dehydrator at a temperature of 50°C. Identification of the basidiocarps was done on dried samples in the Mycological laboratory, Institute of Biology, Faculty of Natural Sciences and Mathematics in Skopje. Preparations were made from the hymenium and pileipellis in Meltzer's reagent and water. The slides were observed with "ZEISS Primostar 3" microscope while the photos were

taken using “ZEISS Axiocam 208 color” camera with the software “ZEN 3.0 blue edition”. Multiple photos were taken from the spores, hyphae and cheilocystidia on which measurements were conducted. Measurements were taken from 30 randomly selected basidiospores, as well as from hyphae and cheilocystidia. Length and width of the spores were measured, average values and quotient were calculated. The presented photos were edited in “Photoshop CC 2018”.

RESULTS AND DISCUSSION

A morphological analysis of basidiocarps collected along the edge of Lake Lokuv among *Sphagnum* mosses revealed new species for the mycobiota of North Macedonia. The species *G. paludosa* was for the first time identified in its typical type of habitat.

Taxonomy

Galerina paludosa (Fr.) Kühner, *Encyclop. Mycol.* 7: 184 (1935).

Basionym: *Agaricus paludosus* Fr., *Epicr. syst. mycol. (Upsaliae)*: 209 (1838). *Synonym*: *Agaricus paludosus* var. *stygius* Fr., *Epicr. syst. mycol. (Upsaliae)*: 209 (1838); *Galera paludosa* (Fr.) P. Kumm., *Führ. Pilzk. (Zerbst)*: 75 (1871); *Galerula paludosa* (Fr.) A.H. Sm., *Pap. Mich. Acad. Sci.* 20: 175 (1935); *Hydrocybe paludosa* (Fr.) M.M. Moser, in *Gams, Kl. Krypt.-Fl. Mitteleuropa - Die Blätter- und Bauchpilze (Agaricales und Gastromycetes) (Stuttgart)* 2: 181 (1953); *Naucoria paludosa* (Fr.) Henn., in *Engler & Prantl, Nat. Pflanzenfam., Teil. I (Leipzig)* 1(1**): 250 (1898); *Pholiota paludosa* (Fr.) Pat., *Hyménomyc. Eur. (Paris)*: 116 (1887); *Tubaria paludosa* (Fr.) P. Karst., *Bidr. Känn. Finl. Nat. Folk* 32: 445 (1879); *Tubaria paludosa* f. *limosa* Sacc., *Syll. fung. (Abellini)* 5: 873 (1887).

Morphology

Macroscopic features (Fig. 1). Pileus is 10-20 mm across, conical, campanulate when young, convex to bell-shaped when mature, a distinct umbo present, cap finely felty to scruffy, non-striate, hygrophanous with white border from velar remains. Flesh color is brownish with a faintly farinaceous to mild taste and odor. Gills are rusty brown, brighter brown towards the edges, adnate or with a small decurrent tooth. Stipe is 40-80 mm long and 2-3 mm wide, cylindrical, solid when young, fragile and hollow when old, rusty brown, paler than the cap, white pruinose, white veil fibrils on the entire length of the stipe.



Fig. 1. *Galerina paludosa* fruitbody (MCF19622) . a. stipe with white veil fibrils. b. brown cap with velar remains. c. ochre brown gills with decurrent tooth. Scale bar: a-c. 5 mm.

Microscopic features (Fig. 2). Spores are ovoid to amygdaliform, tapering at apex, weakly verrucose, plage just above the apiculus with callus is present and color is yellow-brown to tawny. Size of spores is 7.6–10.6 × 5.3–6.8 μm and Q = 1.4–1.8, spore print is red-brown. Cheilocystidia is lageniform to lageniform capitate 23,3–26,5 × 6.6–9.5 μm. Pileipellis is composed of periclinal hyphae 5 – 9.5 μm wide, light yellow to brown and encrusted, septa is present with clamp.

Specimen examined

North Macedonia, Mount Deshat, Lokuv, 41° 38'7.008"N, 20°33'38.088"E (Fig. 3), in association with *Sphagnum* moss, at an altitude of 1580 m.a.s.l., leg. Kristijan Jakimovski, , MCF19622 (24.7.2023).

G. paludosa is easily distinguished from other sphagnicolous *Galerina* species. From the similar *G. sphagnorum* (Pers.) Kühner and *G. tibiicystis* (G.F. Atk.) Kühner is separated by the white velar remnants on the stipe. Concerning the odor and taste of *G. paludosa* it is farinaceous which is the same in *G. sphagnorum* while *G. tibiicystis* lacks any specific odor or taste (Breitenbach et al., 2000). *G. tibiicystis* has a tybiiform cheilocystidia with a narrow neck and often capitate

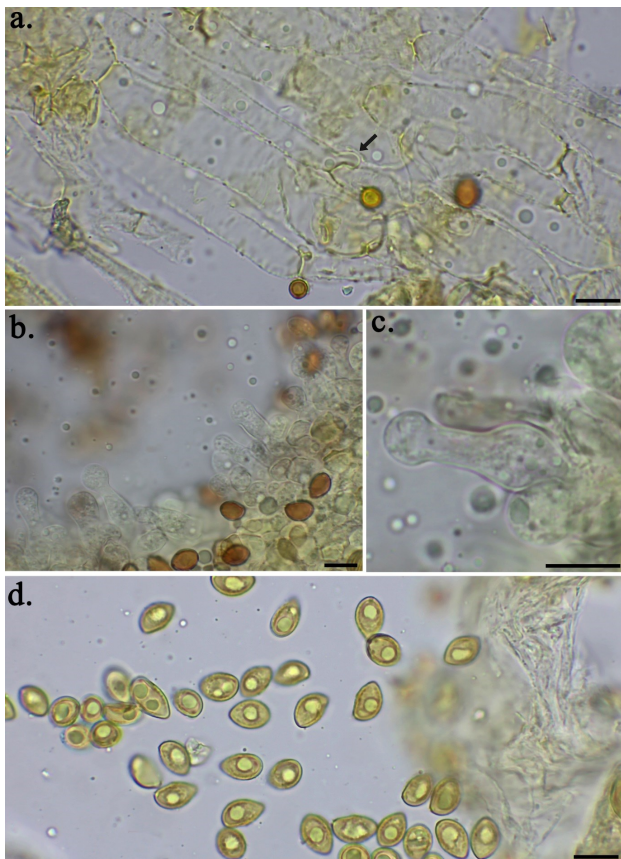


Fig. 2. *Galerina paludosa* microscopic characteristics. a. hyphae with clamp connections. b. lageniform cheilocystidia and dextrinoid spores in Meltzer reagent. c. close up of cheilocystidia. d. spores prepared in water. Scale bar: a-d. 10 μ m.

apex, while the other two species have cheilocystidia with a broader neck (Pegler et al., 1972).

This species is distributed in both Europe and North America. In Europe it is quite common in bogs, fen and wet parts of the forest overgrown with mosses. It is reported in many different countries such as Poland (Grzesiak & Wolski, 2015), Bulgaria (Gyosheva & Dimitrova, 2011), Ukraine (Prylutsky, 2014), Romania (Chinan, 2010), Hungary (Pál-Fám & Benedek, 2017), Turkey (Acar et al., 2021), Faroe Islands (Gulden & Vesterholt, 1999), Russia (Filippova, 2008), Canada (Noordeloos & Gulden, 1992), with 4521 occurrences on GBIF (GBIF, 2023).

The frequency of finds of this species increases the further on the north which correlates with the increase in the abundance of bogs and other wet habitats with *Sphagnum* mosses. This type of habitats is not as common in southern countries like North Macedonia. Peat bogs are among the priority habitats for conservation listed in Annex I of the Habitats Directive in the EC

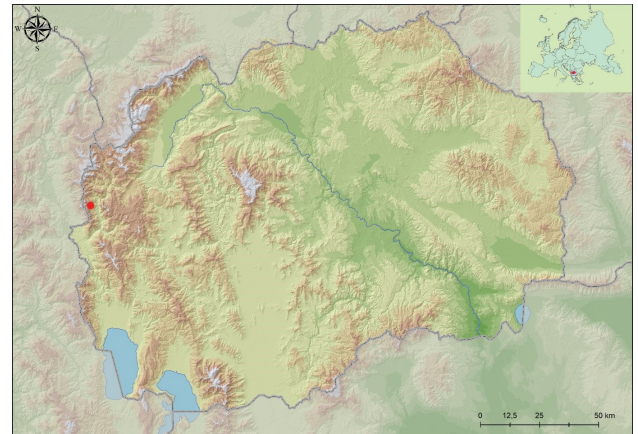


Fig. 3. Distribution map of *Galerina paludosa*.

project Natura2000 (Eur-lex, 2013).

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