



Copyright: © 2025 by the authors.

Original scientific paper / Originalni naučni rad

DOI: <https://doi.org/10.63356/gsf.2025.008>

This work is licensed under a Creative Commons Attribution
4.0 International License.

REPORT ON SOME INTRIGUING FUNGAL SPECIES FROM SPHAGNUM PEATLANDS IN BOSNIA AND HERZEGOVINA

BILJEŠKE O NEKIM ZANIMLJIVIM VRSTAMA GLJIVA SA SPHAGNUMSKI IH
TRESETIŠTA U BOSNI I HERCEGOVINI

Nedim Jukić^{1*}, Nihad Omerović¹, Amar Hršumović¹, Jasmin Jukić¹, Smiljan Tomić¹, Faris Mušija¹

¹ Mycological Society MycoBH, Trg Zlatnih Ljiljana 34, 71000 Sarajevo, Bosnia and Herzegovina

*email: nedim@mycobh.com

Abstract

From October 2022 to October 2024, a series of mycological field studies were conducted in peatlands in Bosnia and Herzegovina, focusing on two bogs - Đilda's bog and Bijambare bog. As a result, several interesting and characteristic fungal species were recorded. This paper presents *Phaeonematoloma myosotis*, *Arrhenia leucotricha*, *Arrhenia philonotis*, *Cortinarius flexipes*, *Geoglossum sphagnophilum*, *Monilinia baccarum*, *Elliottinia kernerii*, and *Sarcoleotia cinnamomea*. The ecology, morphology and key microcharacteristics of each species are reported herein.

Key words: bryophilous fungi, endangered habitat, mycobiota, wetlands

1. INTRODUCTION / UVOD

Raised bogs or ombrotrophic bogs and the transitional forms of these habitats represent some of the most fascinating fungal environments in the world. They are characterized by waterlogged, acidic, nutrient-poor conditions and dominated by peat mosses and cyperaceous vegetation. In addition to their great importance for mitigating the effects of the various climatic challenges today, these relict oases significantly enrich the overall species diversity. Raised bog ecosystems are unique and at the same time highly endangered, hosting some of the rarest and most important indicator fungi. Most of these fungi occur nowhere else and are exclusively adapted to the conditions in raised bogs, where they most of-

ten interact with peat mosses through various types of symbiosis.

The great significance of these specific ecosystems has been recognized by numerous mycologists in the past (Thormann, 2006; Thormann & Rice, 2007; Tkalčec et al., 2008; Filippova, 2012; Filippova & Bulyonkova, 2013; Juan-Ovejero et al., 2020; Četković et al., 2021; Eckstein, 2021; Filippova et al., 2023). On the other hand, until recently (Jukić et al., 2024), there had been no published data on the mycobiota of raised bogs in Bosnia and Herzegovina. The reasons for this lie in the fact that raised bogs in Bosnia and Herzegovina are extremely rare and fragmented, occupying only a negligible

percentage of the total bog area, and there is a lack of biologists specialized in mycology. In addition to their small area and geographical dispersion, raised bogs in Bosnia and Herzegovina are also extremely endangered (Barudanović et al., 2017). It is therefore of great importance to explore the diversity of fungi in *Sphagnum* peatlands as much as possible and to recognize and understand the crucial role these organisms play in such sensitive ecosystems.

This work should be regarded as a continuation of the mycological research of the raised

bogs in Bosnia and Herzegovina, which was primarily conducted within the framework of the scientific project *Mires of Bosnia and Herzegovina - Important and fragile habitat types and refugium for boreal and circumboreal fungal species*, funded by the Rufford Foundation. Among the fungal species taxonomically presented in this paper, the records of *Phaeonematozyma myosotis* and *Arrhenia philonotis* are the first official findings for the mycobiota of Bosnia and Herzegovina. All species presented in this paper constitute a valuable contribution to the mycobiota of Bosnia and Herzegovina.

2. MATERIAL AND METHODS / MATERIJAL I METOD RADA

Five records presented here were documented during a mycological workshop held on 12–13 October 2024, while the rest of the records were collected earlier: *Geoglossum sphagnophilum* and *Sarcoleotia cinnamomea* in October 2022, *Arrhenia leucotricha* in October 2023, *Monilinia baccarum* in April 2023, and *Elliottinia kernerii* in March 2024. Field research was conducted in two geographically close and biologically very important ombrotrophic bogs in Bosnia and Herzegovina: the Đilda's bog, located 7 km east of Vareš, and the Bijambare bogs (Duga, Slana, and Okrugla bara) located in the western part of the Bijambare Protected Landscape, 35 km northeast of Sarajevo, on the Nišići Plateau, both part of the Zvijezda Mountain Massif in the northeastern part of Central Bosnia and Herzegovina.

GPS coordinates are given for each find, with a maximum deviation of 50 meters. The vital characteristics of the freshly collected fungi were preserved to allow the application of the laboratory methods proposed by Baral (1992) for material treatment.

The ascomata and basidiomata of the collected fungal samples were photographed both *in situ* and *ex situ* using a variety of photographic equipment. The macrophotographs were taken with: Canon 700D and 800D DSLR cameras,

various lenses (Canon 100mm f/2.8L Macro IS USM; Canon EFS 18-55 mm + second lens Marumi DHG Achromat Macro-200 (+5); Helios-44M 2/58 + Helios-44-2 2/58 mounted as a double lens reversed macro), a tripod, NiSi Macro Focusing Rail NM-180 and a Canon Macro Ring Lite MR-14EX II.

Nikon SE Type 102 light microscope and Bresser Science Infinity microscope were used for laboratory analysis and observation of micro-morphological features. Photomicrographs were captured using a Canon EOS M100 and a Bresser MicroCam SP 5.0 camera. The free-ware software Piximètre (Henriot & Cheype, 2025) was used to measure all relevant micro-features.

Focus stacking was occasionally employed to generate composite images of observed species with extended depth of field. This image processing was performed using Zerene Stacker version 1.04 and Adobe Photoshop 20.0.0 release.

Samples for microscopy were prepared by manually cutting fresh ascomata or basidiomata with a razor blade. All measurements were performed in a tap water mount and by measuring the vital characters of the species. All vital elements observed (micro measurements and micromorphological descriptions

under the figures) are marked with *, whereas dead elements are unmarked. For each species studied, spores or other microscopical elements were measured to determine their average length and width. The number of measurements (N) is indicated in each individual case. The extreme values of the measured spores and other structures are given in parentheses.

Ascospore ornamentation was visualized using lactophenol cotton blue (LCB); the type of amyloid reaction of the ascus apical apparatus was tested with Lugol's solution (IKI) and classified according to Baral (1987): type RR –

solely red, type BB – *solely blue*, and type RB – *red at high blue at low iodine concentrations*. Aceto-carmine (AC) staining was employed to highlight the nucleus and nucleolus in species belonging to the family *Sclerotiniaceae*.

To define the simple spore shape according to the Q value (length:width ratio of ascospores), the geometric delimitation criteria presented in Kušan et al. (2014) were used.

The abbreviation “FAMU,” along with the corresponding database codes and exsiccata numbers, is provided if the material has been deposited in the Fungarium of the Mycological Society MycoBH.

3. RESULTS AND DISCUSSION / REZULTATI I DISKUSIJA

Phaeonematoloma myosotis (Fr.) Bon
Figure 1–A), B) & 5–a), e)

Basidioma: *pileus* initially convex, later flattening, slightly inrolled at the margin, with a characteristic central umbo. **Margin** usually slightly radially striated, 1–3 cm in diam., smooth, viscid, and mucilaginous during humid weather, hygrophanous, brownish-ochre to light brown with pronounced olive tints, often with conspicuous velum remnants at the margin. **Lamellae** adnate, intermixed with lamellulae, irregularly spotted, light ochre to olive-ochre initially, becoming ochre-brown to brown in maturity; edge usually somewhat paler. **Stipe** cylindrical, filamentous or with fine white fibrils from the velum remnants, more scaly in the upper part, 5–8 (10) cm in height and 3–4 mm in width, usually of constant width throughout its length or slightly broader at the gill attachment, light yellow, ochre-yellow to ochre-brown.

Basidiospores: ovoid to parabolic, initially hyaline, later light brown to brown, containing numerous small cytoplasmic granules, *(13) 13.3–14.7–16.1 (17.7) × (6.9) 7.3–7.9–8.6 (9.6) μm (N=20); cell walls are quite thickened, *0.6–0.8–0.9 μm (N=10), germinative pore is fairly pronounced.

Cheilocystidia: irregularly cylindrical, hyaline, *36.7–38.7–40.7 × 6.3–7.2–8.6 μm (N=5).

Material examined: Đilda's bog, 12 October 2024, 1,086 m asl, N 44.16914°, E 18.41946°, among *Sphagnum* spp., sharing habitat with *Hypholoma elongatum*. – exsiccata N.J./12102024-Y2, assigned database code FAMU-1432.

Distribution: Likely a rare species, listed as endangered (EN) on the Red List of Fungi in Austria (Krisai-Greilhuber, I. & Dämon, W., 2017), strictly associated with raised bog habitats.

Notes: The finding of *P. myosotis* from Đilda's bog represents the first and only known official record for Bosnia and Herzegovina. It is quite possible that this species also lives in other large peatlands in Bosnia and Herzegovina; however, further investigation and field research are required.

Arrhenia leucotricha P.-A. Moreau & Corriol
Figure 1–C) & 5–d), f), g)

Basidioma: *pileus* spatulate to flabelliform, with lateral pseudostipe; upper part of the *pileus* striated and with very fine, short, silky fibrils, 1–2 (2.5) cm in diam., white to white-grey, pale brownish towards the pseudostipe and along the striated lines. **Lamellae** not

crowded, intermixed with lamellulae, occasionally in the peripheral part of the hymenophore with straight series of 3–5 lamellulae, forking not observed, most often white to white-grey in mature specimens.

Basidiospores: pyriform or irregularly cylindrical, usually broader at one end, hyaline, *(6.6) 6.7–7.8–8.9 (9.6) × 3.8–4.3–4.8 (4.9) μm (N=20).

Material examined: Đilda's bog, 23 October 2023, 1,086 m asl, N 44.17219°, E 18.42170°, on dead stems of *Filipendula ulmaria*. – exsiccata N.J./28102023-Y5, assigned database code FAMU-1429.

Distribution: Registered in several European countries – Austria, France, Norway, usually associated with peatlands and remnants of various hygrophilic plants.

Notes: Đilda's bog is the only known locality with living population of *A. leucotricha* in Bosnia and Herzegovina so far. Although it is not strictly associated with peat mosses, it prefers wetlands and it can be usually found on or near peatlands.

Arrhenia philonotis (Lasch) Redhead, Lutzoni, Moncalvo & Vilgalys
Figure 1–D), F) & 5–b), c)

Basidioma: **pileus** deeply funnel-shaped, often with an inrolled margin, translucently striate, radially fibrillose, scales quite thin and more pronounced in the central umbilical part, hygrophalous, 1–3.5 (4) cm in diam., grey-brown or pale grey when drying. **Lamellae** strongly decurrent, moderately spaced and with smooth edges, quite thick and rarely forked, at first white later becoming pale brownish. **Stipe** cylindrical, hollow and smooth, usually concolorous with the cap or somewhat darker especially in the upper part, 2–4 (5) cm in height and 2–5 mm in width.

Basidiospores: oblong-ellipsoid to amygdaliform, hyaline to pale yellow due to the refractive content of the spores, *(5.9) 6.1–6.6–7 (8.4) × (3.9) 4.3–4.8–5.4 (5.6) μm (N=10), germinative pore fairly pronounced.

Material examined: Duga bara bog (Protected landscape Bijambare), 13 October 2024, 953 m asl, N 44.08405°, E 18.50294°, among *Sphagnum* sp.

Distribution: Associated with raised *Sphagnum* bogs, quite rare but widespread, found in North America and Europe. More common in Northern Europe, whereas in the south its occurrence is limited by habitat fragmentation.

Notes: The finding of *A. philonotis* from Duga bara bog in Protected Landscape Bijambare represents the first record of this species for Bosnia and Herzegovina. Further investigation of other raised bogs is required to improve knowledge of the presence of this species.

Cortinarius flexipes (Pers.) Fr.
Figure 1–E) & 5–i), j), k), l), n);

Basidioma: **pileus** initially convex, usually hygrophalous, bell-shaped with pointed, centered and darker umbo, rarely more flattened, 1–4 (5) cm in diam., brown-violet when moist and brown-grey during the dry periods, surface regularly covered with very conspicuous and prominent white to white-grey scales. **Lamellae** adnate, intermixed with lamellulae, cinnamon-brown at first, becoming rusty-brown to violet-brown in mature specimens, edge slightly paler. **Stipe** cylindrical, usually bent, with an inconsistent ring in the middle part and fibrillose velum remnants denser toward the base, pale brown to violet-brown, 3–6 (8) cm in height and up to 6 mm in width.

Basidiospores: irregularly ellipsoid, amygdaliform, moderately warty, pale yellow to pale brown, *(7.1) 7.3–8–8.7 (9.6) × (4.6) 4.8–5.1–5.4 (5.7) μm (N=30).

Material examined: Đilda's bog, 12 October 2024, 1,084 m asl, N 44.16990°, E 18.42007°, among *Sphagnum* sp., close to *Picea abies* trees.

Distribution: Widespread throughout Europe, especially in mainland. Usually found in coniferous or mixed forests (*Picea*, *Fagus*, *Pinus*, *Betula*), on moist soil often covered in mosses. Mycorrhizal.



Figure 1. Fungi (phylum *Basidiomycota*, class *Agaricomycetes*) recorded in Đilda's bog in Central Bosnia and Herzegovina: **A, B**) – *Phaeonematoloma myosotis*, **C**) – *Arrhenia leucotricha*, **D, F**) – *Arrhenia philonotis*, **E**) – *Cortinarius flexipes*. / **Slika 1.** Gljive (odjeljak *Basidiomycota*, razred *Agaricomycetes*) registrovane na Đildinom tresetištu u centralnoj Bosni i Hercegovini: **A, B**) – *Phaeonematoloma myosotis*, **C**) – *Arrhenia leucotricha*, **D, F**) – *Arrhenia philonotis*, **E**) – *Cortinarius flexipes*.

Notes: Previously recorded in coniferous forests in central parts of Bosnia and Herzegovina.

Geoglossum sphagnophilum Ehrenb.

Figure 2–A), C) & 4–a), b), c), d), e), f), g), k), l);

Ascoma: filiform to more or less clavate, usually spatulate and occasionally irregularly tapered at the top. The fertile part (capitulum) is usually shorter than the sterile one (stipe), 3–5 (6) cm in height, black, glossy and slightly rugose. The stipe measures 2–3 (4) cm in height, is black, narrower than capitulum, fairly uniform and even, often bent, glabrous or very rarely finely squamulose.

Asci: 8-spored, biseriate to multiseriate, clavate-lanceolate, most often curved, rounded at the apex, *143.3–163.2–184.7 × 17–20–23.2 μm (N=5), *pars sporifera* *89.8–109.7–124.6 (137.3) μm (N=5), IKI⁺ (type RB).

Ascospores: cylindrical, clavate, slightly curved, dark fuliginous, light brown to dark brown, most often 7-septate and rarely with 8–9 septa, *(66.6) 68.2–75.2–81.6 (92) × (3.7) 4.7–5.1–5.8 (6.1) μm (N=20). Large lipid bodies (LBs) are present and conspicuous, though not as prominent as in some other species of this genus.

Paraphyses: filiform, with a specific rounded enlarged apex, *(6.6) 7.2–9–10.4 (10.7) μm wide (N=20), pale brown, septate, and often in clusters.

Stipe cortical layer: composed of cells organized in a *textura porrecta*, *(4.9) 6.1–8.2–9.7 (9.8) μm (N=10) in width.

Material examined: Đilda's bog, 30 October 2022 & 12 October 2024, 1,086 m asl, N 44.16935°, E 18.41952°, among *Sphagnum* sp. – exsiccatae N.J./30102022-Y2 & N.J./12102024-Y5, assigned database code FAMU-1431.

Distribution: A very rare, yet widespread species, strictly limited to raised bog ecosystems.

Notes: Đilda's bog is the only known locality with living population of *G. sphagnophilum* in

Bosnia and Herzegovina so far. Further investigation is required to determine whether this species inhabits other peatland sites in Bosnia and Herzegovina.

Monilinia baccarum (J. Schröt.) Whetzel

Figure 2–B) & 3;

Ascoma: apothecial, stipitate, cupulate, cinnamon brown to dark brown, up to 0.7 (0.9) cm in diam., with a smooth hymenium. The margin is quite distinctive, sometimes pronounced and membranaceous, especially in overmature specimens. The outer side of the apothecia is usually darker, finely fibrillose from the margin down to the central part of the stipe. The stipe is very often eccentric or slightly lateral, darker towards the base, most often completely black at the very bottom, 1–4 (5) cm in height and up to 2 mm in width.

Asci: 8-spored, uniseriate, cylindrical and curved, hyaline, *(224) 233–270–309 (320) × (13.1) 13.3–14.5–16 (16.6) μm (N=20), occasionally with four large and four smaller ascospores and with an inconsistent sequence (smaller abortive ascospores located above or beneath the larger ones, less frequently intermixed), *pars sporifera* *(82) 87.5–94.4–102.2 (102.3) μm (N=20), IKI⁺ (type BB).

Ascospores: ellipsoid, narrowly ellipsoid to irregularly ellipsoid, rarely somewhat pyriform, hyaline, frequently inequilateral, *(19.4) 20.4–21.3–22 (22.9) × (9.4) 9.9–10.5–11.1 (11.3) μm (N=20), containing two polar groups of asymmetrically aggregated refractive vacuoles; single group *(2.9) 3.2–3.4–3.6 (3.9) μm in diam. (N=20). When observed in IKI, the spores retain slightly more dispersed groups of polar granules in the sporoplasm, measuring *(16.5) 16.7–17.6–18.6 (18.7) × (7.0) 7.6–7.9–8.1 (8.8) μm (N=10); in AC, they are distinctly binucleate and with a more prominent perispore layer, measuring (15.0) 15.6–16.9–18.2 (18.4) × (5.5) 6.2–6.8–7.4 (8.3) μm (N=10); finally, in LCB, the dimensions are (10.5) 14.3–15.7–17.1 (18.0) × (6.9) 7.3–7.7–8.1 (8.5) μm (N=10).

Paraphyses: filiform, cylindrical, septate, becoming less hyaline and containing darker content near the apex; similar in length as the asci, only rarely surpassing them, *2.5–3.4–4.6 μm (N=10) in width at the apex.

Excipulum: ectal excipulum composed of *textura globulosa-angularis*, cells *(17.3) 22.9–37.8–47.2 (51) \times (8.7) 14.3–23.8–30.6 (32.2) μm (N=10), while the medullary excipulum is composed of *textura prismatica* to *textura intricata*, cells *(27.3) 30.7–36.4–52.2 (54.8) \times (4.9) 5.3–7.3–8.6 (10.2) μm (N=10).

Material examined: Đilda's bog, 29 April 2023, 1,086 m asl, N 44.17030°, E 18.42039°, on mummified dead fruits of *Vaccinium myrtillus*. – exsiccata N.J./29042023-Y5, assigned database code FAMU-1430.

Distribution: This is a widespread yet quite rare species. This species is probably not strictly associated with raised bog ecosystems or *Sphagnum* moss. However, high humidity, acidic soil and very harsh winters all favor this species, so it can often be found within the ecosystem of raised bogs.

Notes: Đilda's bog is the only known locality with *Monilinia baccarum* in Bosnia and Herzegovina so far.

***Elliottinia kernerii* (Wettst.) L.M. Kohn** Figure 2–D) & 5–h), m), o), p);

Ascoma: apothecial, shortly stipitate, deeply cupulate, expanding up to 5 mm in diam. with age; the hymenium is sienna brown, hazel brown, or honey-colored, becoming lighter. The margin is well-pronounced, villose, concolorous with the outer surface. The stipe is cylindrical and arises from a conspicuous, blackish, tire- or donut-shaped sclerotium embedded in the substrate. The entire outer surface, from the stipe to the margin, is villose and beige-colored.

Asci: 8-spored, uniseriate to overlapping uniseriate, cylindrical with short narrowed base, aporhynchous, *184.9–201–222.3 \times 20–21.5–22.8 μm (N=5), IKI⁺ (type RR).

Ascospores: often irregularly shaped, elliptical, ovate, amygdaliform, hyaline, smooth, without lipid bodies, with granular contents, *(24.9) 25.5–27.5–30 (31.8) \times (14.2) 15.3–16.5–17.6 (18.2) μm (N=30).

Paraphyses: septate, inflated at the apices and immersed in a gelatinous matrix, *(7.7) 7.9–9.1–11.1 (11.6) μm (N=13) in diam., with yellowish-brown contents, and are clavate or snake-head shaped.

Terminal cells on the margin ("hairs") have enlarged apices, up to 12.5 μm in diam.

Excipulum: ectal excipulum composed of *textura prismatica*.

Material examined: Đilda's bog, 10 March, 2024, 1,086 m asl, N 44.16916°, E 18.41938°, on wind-broken, still green fir (*Abies alba* Mill.) twigs, fallen onto a peat bog, among male flowers.

Distribution: In Bosnia and Herzegovina reported recently and all findings are from the same region; globally rare or rarely reported.

Notes: This unusual species, with unique ecological niche, is not specifically associated with bogs.

***Sarcoleotia cinnamomea* (Maas Geest.) Baral** Figure 2–E) & 4–h), i), j), m), n), o), p), q), r);

Ascoma: consists of two conspicuous parts: a fertile head, 0.3–1 cm in diam., clearly separated from the stipe, irregularly rounded, spatulate to mitrate, usually glabrous, smooth, pale cinnamon at first, turning cinnamon brown to dark brown with age, especially in overmature specimens. The stipe is sterile, cylindrical or slightly flexuous, slender, 1–2.5 (2.8) cm long and 1–3 mm broad, most often equally thick along its entire length, finely squamulose, similarly colored to the head, becoming paler towards the base.

Asci: 8-spored, usually biseriate, cylindrical, slightly curved, *(109.5) 127.2–145.5–158.1 (189.6) \times (9.5) 10.5–11.8–12.8 (15.2) μm (N=20), with ascospores usually packed in the upper part of the asci, *pars sporifera* *(77.2) 80.7–88.0–96.1 (104.0) μm , IKI⁺ (type BB).

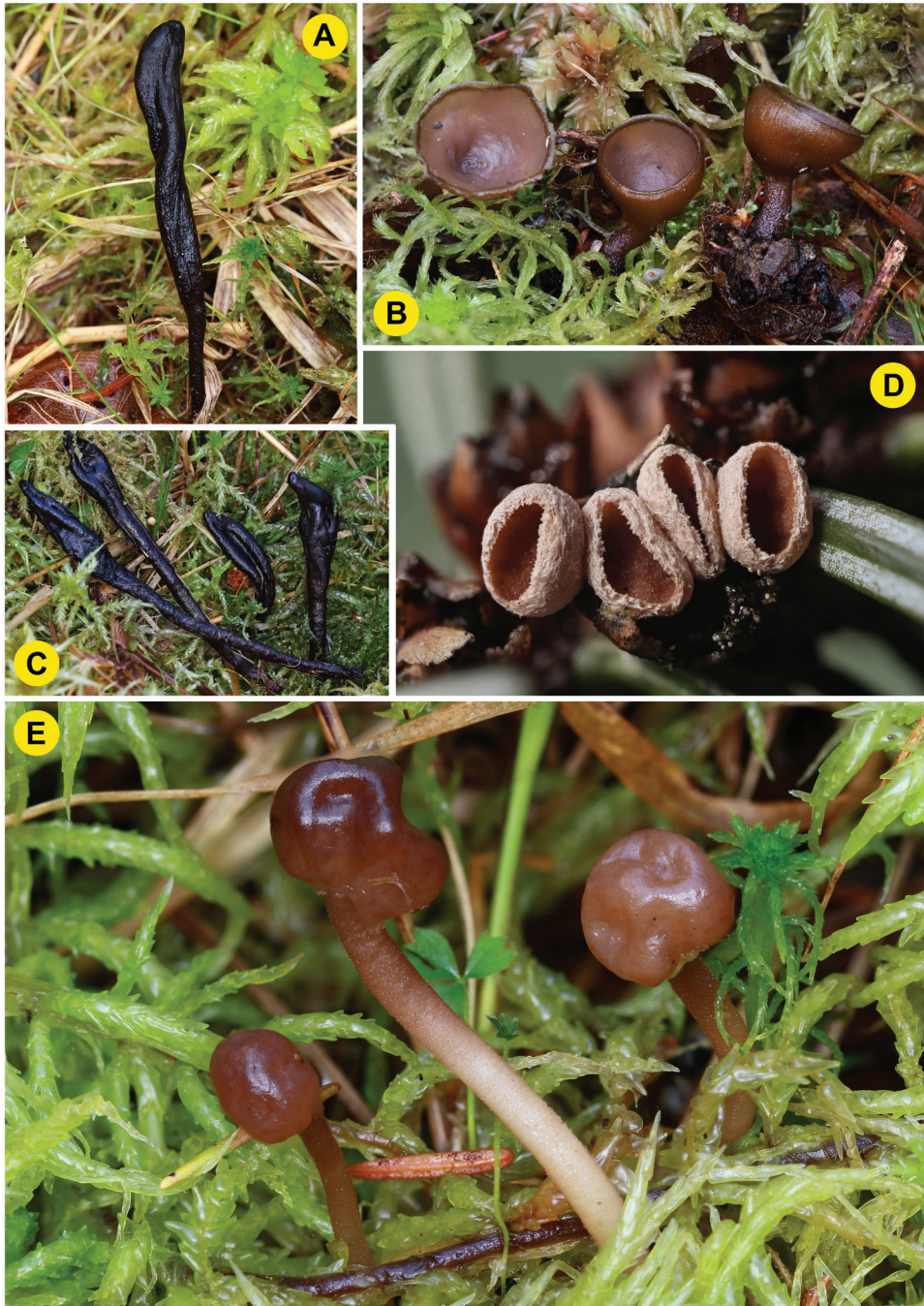


Figure 2. Fungi (phylum Ascomycota) recorded in Đilda's bog in Central Bosnia and Herzegovina: **A, C** – *Geoglossum sphagnophilum*, **B** – *Monilinia baccarum*, **D** – *Elliottinia kernerii*, **E** - *Sarcoleotia cinnamomea*. / **Slika 2.** Gljive (odjeljak Ascomycota) registrovane na Đildinom tresetištu u centralnoj Bosni i Hercegovini: **A, C** – *Geoglossum sphagnophilum*, **B** – *Monilinia baccarum*, **D** – *Elliottinia kernerii*, **E** - *Sarcoleotia cinnamomea*.

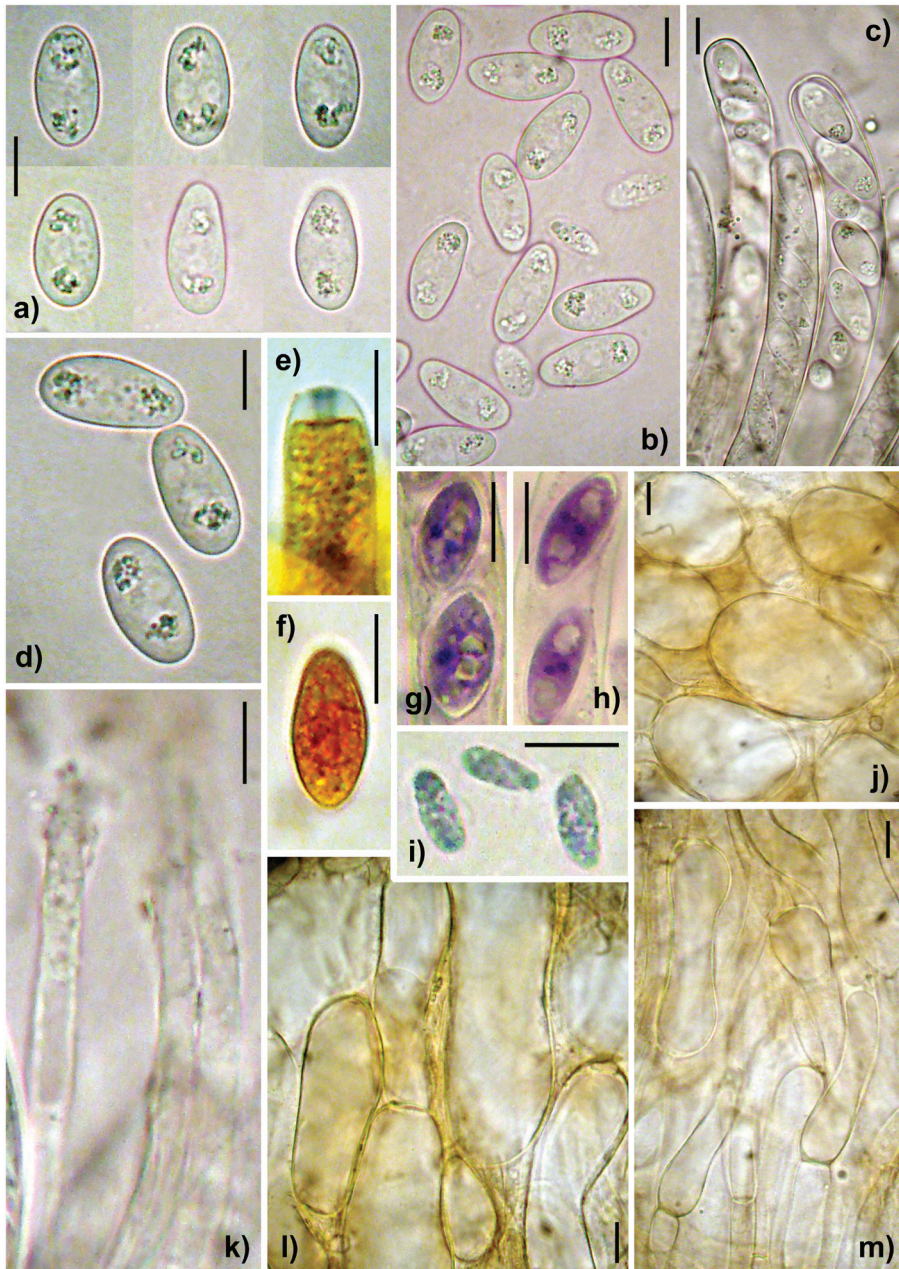


Figure 3. *Monilinia baccharum* (FAMU-1430, N.J./29042023-Y5). Microscopical characters: **a), b), d)** *mature ascospores, **c)** *upper part of asci with ascospores, **e)** *apical apparatus of the asci in IKI mount, **f)** *mature ascospore in IKI mount, **g), h)** binucleate ascospores in AC mount, **i)** ascospores in LCB mount, **j)** *ectal excipulum cells, **k)** *tips of the paraphyses, **l), m)** *medullary excipulum cells. Bars: 10 μm . / **Slika 3.** *Monilinia baccharum* (FAMU-1430, N.J./29042023-Y5). Mikroskopske karakteristike: **a), b), d)** *zrele askospore, **c)** *vršni dio askusa s askosporama, **e)** *apikalni aparat askusa u IKI, **f)** *zrela askospora u IKI, **g), h)** dvojedarne askospore u AC, **i)** askospore u LCB, **j)** *ćelije vanjskog dijela ekscipuluma, **k)** *vršni dijelovi parafiza, **l), m)** *ćelije središnjeg dijela ekscipuluma. Mjerne skale: 10 μm .

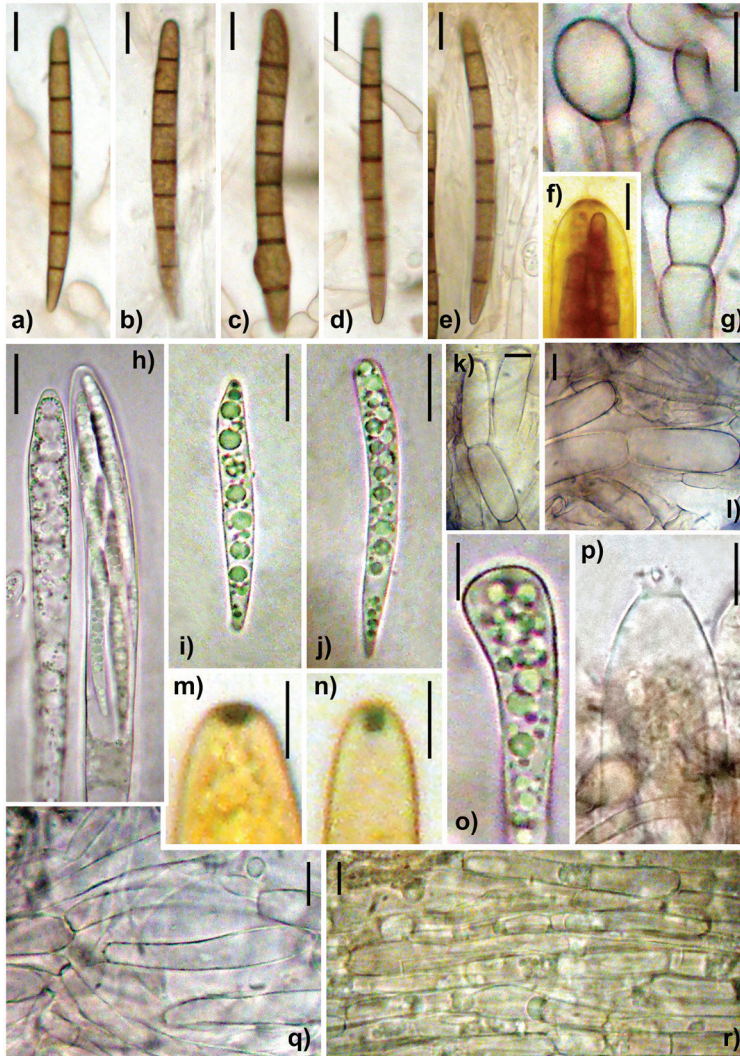


Figure 4. *Geoglossum sphagnophilum* (FAMU-1431, N.J./30102022-Y2), *Sarcoleotia cinnamomea* (FAMU-1433, N.J./30102022-Y4). Microscopical characters: **a), b), c), d), e)** *mature ascospores (*G. sphagnophilum*), **f)** *upper part of asci in IKI mount (*G. sphagnophilum*), **g)** *apical part of the paraphyses with globular cells (*G. sphagnophilum*), **k), l)** *cells in the cortical layer of the stipe (*G. sphagnophilum*), **h)** *pars sporifera part of the ascus (*S. cinnamomea*), **i, j)** *mature ascospores (*S. cinnamomea*), **m), n)** *apical apparatus of the ascus in IKI mount (*S. cinnamomea*), **o)** *tips of the paraphyses with refractive vacuoles (*S. cinnamomea*), **p)** *apical part of the discharged asci, **q), r)** *cells in the cortical layer of the stipe (*S. cinnamomea*). Bars: a), b), c), d), e), f), g), h), i), j), k), l), q), r) – 10 µm; m), n), o), p) – 5 µm. / **Slika 4.** *Geoglossum sphagnophilum* (FAMU-1431, N.J./30102022-Y2), *Sarcoleotia cinnamomea* (FAMU-1433, N.J./30102022-Y4). Mikroskopske karakteristike: **a), b), c), d), e)** *zrele askospore (*G. sphagnophilum*), **f)** *vršni dio askusa u IKI (*G. sphagnophilum*), **g)** *vršni dio parafiza sa okruglastim završecima (*G. sphagnophilum*), **k), l)** *čelije u kortikalnom sloju stručka (*G. sphagnophilum*), **h)** *vršni dio askusa (*S. cinnamomea*), **i, j)** *zrele askospore (*S. cinnamomea*), **m), n)** *apikalni aparat askusa u IKI (*S. cinnamomea*), **o)** *vršni dio parafiza sa refraktivnim vakuolama (*S. cinnamomea*), **p)** *vršni dio ispražnjenog askusa (*S. cinnamomea*), **q), r)** *čelije u kortikalnom sloju stručka (*S. cinnamomea*). Mjerne skale: a), b), c), d), e), f), g), h), i), j), k), l), q), r) - 10 µm; m), n), o), p) - 5 µm.

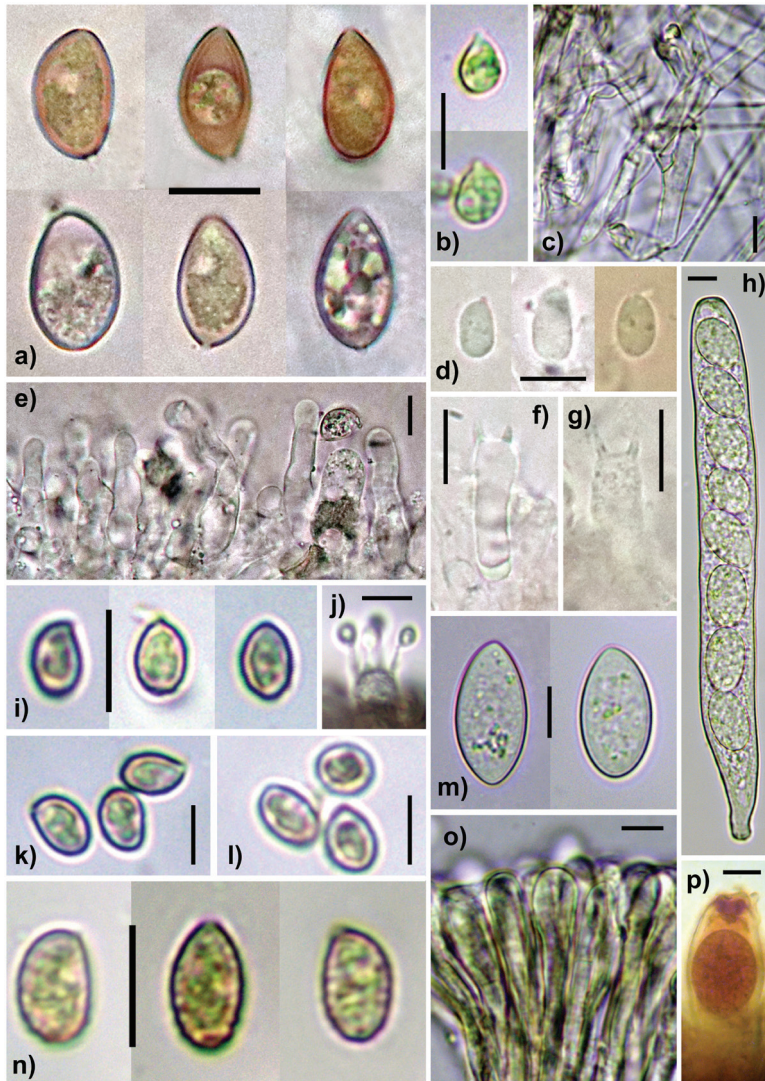


Figure 5. *Phaeonematoloma myosotis* (FAMU-1432, N.J./12102024-Y2), *Arrhenia leucotricha* (FAMU-1429, N.J./28102023-Y5), *Arrhenia philonotis*, *Cortinarius flexipes*, *Elliottinia kernerii*. Microscopical characters: **a)** *basidiospores in different stages of maturity (*P. myosotis*), **e)** *cheilocystidia (*P. myosotis*), **b)** *basidiospores (*A. philonotis*), **c)** *cheilocystidia (*A. philonotis*), **d)** *basidiospores (*A. leucotricha*), **f)**, **g)** *two-spored basidia (*A. leucotricha*), **h)** *asci with ascospores (*E. kernerii*), **m)** *ascospores (*E. kernerii*), **o)** *tips of the paraphyses (*E. kernerii*), **p)** *apical apparatus of the asci in IKI mount (*E. kernerii*), **i)**, **k)**, **l)**, **n)** *ascospores (*C. flexipes*), **j)** *four-spored basidia (*C. flexipes*). Bars: a), b), c), d), e), f), g), h), i), j), m), n), o), p) - 10 μ m; k), l) - 5 μ m. / **Slika 5.** *Phaeonematoloma myosotis* (FAMU-1432, N.J./12102024-Y2), *Arrhenia leucotricha* (FAMU-1429, N.J./28102023-Y5), *Arrhenia philonotis*, *Cortinarius flexipes*, *Elliottinia kernerii*. Mikroskopske karakteristike: **a)** *bazidiospore u različitim fazama sazrijevanja (*P. myosotis*), **e)** *heilocistidije (*P. myosotis*), **b)** *bazidiospore (*A. philonotis*), **c)** *heilocistidija (*A. philonotis*), **d)** *bazidiospore (*A. leucotricha*), **f)**, **g)** *dvosporne bazidije (*A. leucotricha*), **h)** *askus s askosporama (*E. kernerii*), **m)** *askospore (*E. kernerii*), **o)** *vršni dio parafiza (*E. kernerii*), **p)** *apikalni aparat askusa u IKI (*E. kernerii*), **i)**, **k)**, **l)**, **n)** *bazidiospore (*C. flexipes*), **j)** *četverosporne bazidije (*C. flexipes*). Mjerne skale: a), b), c), d), e), f), g), h), i), j), m), n), o), p) - 10 μ m; k), l) - 5 μ m.

Ascospores: subcutuliform, oblong-clavate or irregularly fusiform, hyaline, inequilateral, rounded at apex and acute at the base, *(36.1) 38.1–40.9–42.4 (48.1) × (3.7) 4.1–4.7–5.5 (5.6) μm (N=20), containing 7–12 larger refractive vacuoles (guttules) and numerous smaller ones, often 1–5 septate when mature.

Paraphyses: filiform, hyaline, septate, approximately the same length as the asci, rarely branched, containing brownish guttules or brownish pigment, expanding at the apex up to 3.5 (4.5) μm, slightly bent.

Stipe cortical layer: composed of very loosely woven vertical hyphae, organized in a *textura porrecta*, cells *(5.1) 5.7–6.8–8.6 (8.7) μm in width (N=10).

Material examined: Đilda's bog, 30 October 2022 & 12 October 2024, 1,085 m asl, N 44.16914°, E

18.41946°, among *Sphagnum* sp., sharing habitat with *Geoglossum sphagnophilum*. – exsiccatae N.J./30102022-Y4 & N.J./12102024-Y3, assigned database code FAMU-1433.

Distribution: Extremely rare, strictly limited to preserved *Sphagnum* peatlands. Previously recorded in just a few European countries (Austria, France).

Notes: Đilda's bog is the only known locality with living population of *S. cinnamomea* in Bosnia and Herzegovina so far. The fact that this bog represents exclusive sites and refugium for numerous rare and endangered species of fungi which have been registered during this project is definitely a strong argument for the protection of this peatland in its current state. In any case, this site should be considered an important research plot at the national and regional level.

4. CONCLUSIONS / ZAKLJUČCI

The aim of the research on peatland mycobiota was to document, for the first time, the presence of specific fungal species in *Sphagnum* peatlands in Bosnia and Herzegovina. The most important findings are: *Phaeonematoloma myosotis*, *Arrhenia leucotricha*, *Arrhenia philonotis*, *Cortinarius flexipes*, *Geoglossum sphagnophilum*, *Monilinia baccarum*, *Elliottinia kernerii*, and *Sarcoleotia cinnamomea*. This work thus makes a significant contribution to the knowledge of the mycobiota of Bosnia and Herzegovina, particularly regarding sensitive habitats.

Most of these species are first records for Bosnia and Herzegovina. The majority of them prefer this type of habitat and are directly associated with peat mosses, and all the species presented are generally considered rare. Col-

lectively, this makes them a valuable addition to the Bosnian-Herzegovinian mycobiota.

The discovery of these species in the studied peatlands (Đilda's bog and Bijambare) highlights the importance of these sites as refugia for specialized fungal species and the need to protect these habitats as effectively as possible.

For all these reasons, further research is needed to expand studies to other peatland localities; to conduct more detailed ecological investigations demonstrating the specific associations of fungal species with peat mosses and the substrate preferences of individual species; to improve species identification by introducing molecular analysis; and to monitor the presence of specialised and protected fungal species in peatlands.

Acknowledgments / Zahvale

This research was financially supported by a grant from Rufford Small Grants for Nature

Conservation. The authors gratefully acknowledge their support and determination which

has made a significant contribution to the study of fungal diversity in peatlands of Bosnia

and Herzegovina.

References / Literatura

- Baral, H.-O. (1987). Lugol's solution/IKI versus Melzer's reagent: Hemiamyloidity, a universal feature of the ascus wall. *Mycotaxon*, 29, 399–450.
- Baral, H.-O. (1992). Vital versus herbarium taxonomy: Morphological differences between living and dead cells of Ascomycetes, and their taxonomic implications. *Mycotaxon*, 44, 333–390.
- Barudanović, S., Mašić, E., & Macanović, A. (2017). *Raised bogs in the Bosnian mountains*. University of Sarajevo, Faculty of Science.
- Četković, I., Tkalčec, Z., Dragičević, S., Alegro, A., Šegota, V., Jadan, M., Matočec, N., Kušan, I., Zgrablić, Ž., & Mešić, A. (2020). *Entoloma conferendum*, *Hygrocybe coccineocrenata*, and *Hypholoma ericaeum* new to Montenegro. *Mycotaxon*, 135, 637–647. <https://doi.org/10.5248/135.637>
- Eckstein, J. (2021). *Trizodia acrobia*, ein mit Cyanobakterien assoziierter Ascomycet auf Torfmoosen. *Boletus*, 42(1), 53–55.
- Filippova, N. V. (2012). Discomycetes from plant, leaf and *Sphagnum* litter in an ombrotrophic bog (West Siberia). *Environmental Dynamics and Global Climate Change*, 3(1), 1–20. <https://doi.org/10.17816/edgcc311-20>
- Filippova, N. V., & Bulyonkova, T. M. (2013). Notes on the ecology of *Ascocoryne turficola* (Ascomycota: Helotiales) in West Siberia. *Environmental Dynamics and Global Climate Change*, 4(2), 1–6. <https://doi.org/10.17816/edgcc421-6>
- Filippova, N., Zvyagina, E., Rudykina, E., Dobrynina, A., & Bolshakov, S. (2023). The diversity of macromycetes in peatlands: Nine years of plot-based monitoring and barcoding in the raised bog "Mukhrino", West Siberia. *Biodiversity Data Journal*, 11, e105111. <https://doi.org/10.3897/BDJ.11.e105111>
- Henriot, A., & Cheype, J.-L. (2025). *Piximètre*. <http://www.piximetre.fr>
- Juan-Ovejero, R., Briones, M. J. I., & Öpik, M. (2020). Fungal diversity in peatlands and its contribution to carbon cycling. *Applied Soil Ecology*, 146, 103393. <https://doi.org/10.1016/j.apsoil.2019.103393>
- Jukić, N., Omerović, N., & Tomić, S. (2024). *Diverzitet gljiva na tresetištima u Bosni i Hercegovini*. Mycological Society MycoBH.
- Krisai-Greilhuber, I., & Dämon, W. (2017). *Die Pilze Österreichs: Verzeichnis und Rote Liste 2016. Teil: Makromyzeten*. Österreichische Mykologische Gesellschaft.
- Kušan, I. (2015). *Contribution of "vital taxonomy" methods to the Ascomycota taxonomy* (Doctoral dissertation). Josip Juraj Strossmayer University of Osijek.
- Thormann, M. N. (2006). Diversity and function of fungi in peatlands: A carbon cycling perspective. *Canadian Journal of Soil Science*, 86, 281–293. <https://doi.org/10.4141/S05-082>
- Thormann, M. N., & Rice, A. V. (2007). Fungi from peatlands. *Fungal Diversity*, 24, 241–299.
- Tkalčec, Z., Mešić, A., Matočec, N., & Kušan, I. (2008). *Red book of Croatian fungi*. Ministry of Culture; State Institute for Nature Protection.

Sažetak

Od oktobra 2022. do oktobra 2024. godine provedena su mikološka terenska istraživanja na tresetištima u Bosni i Hercegovini, s naglaskom na dva lokaliteta: Đildino tresetište na planini Zvijezdi te Duga, Slana i Okrugla bara u okviru Zaštićenog pejzaža Bijambare. Kao rezultat, zabilježeno je nekoliko zanimljivih i specifičnih vrsta gljiva. Ovaj rad predstavlja vrste *Phaeonematoloma myosotis*, *Arrhenia leucotricha*, *Arrhenia philonotis*, *Cortinarius flexipes*, *Geoglossum sphagnophilum*, *Monilinia baccarum*, *Elliottinia kernerii* i *Sarcoleotia cinnamomea*. Ekologija i morfologija navedenih vrsta detaljno su opisane.

Ključne riječi: briofilne gljive, mikrobiota, močvarna staništa, ugroženo stanište