

New records of rare wood-inhabiting fungi from the Ukrainian Carpathians

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The Ukrainian Carpathians provide an important refuge for rare lignicolous fungi due to one of the largest areas of old-growth forests in Europe. During 2019–2022, new localities of 13 noteworthy species of lignicolous fungi were revealed on the northeastern macroslope of the Ukrainian Carpathians (Gorgany Nature Reserve, vicinities of the towns of Nadvirna and Yavoriv). Of these, *Sistotrema alboluteum* is a new species for Ukraine. In addition, we report two rare species restricted to natural forests, *Amylocystis lapponica* and *Crustoderma dryinum*, which had not been recorded in the country for over 80 years. Locality data and habitat types for all reported species as well as detailed descriptions and illustrations of the most interesting finds are provided. Ecology and distribution of some species are briefly summarised.

Key words: *Amylocystis lapponica*, biodiversity, *Crustoderma dryinum*, indicator species, primeval forests, *Sistotrema alboluteum*.

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Ukrajinské Karpaty představují významné refugium pro vzácné dřevožijné houby, neboť se jedná o jednu z nejrozsáhlejších pralesních oblastí v Evropě. V průběhu let 2019 až 2022 byly na severovýchodní straně karpatského pásma (přírodní rezervace Horhany, okolí města Nadvirna a vsi Javoriv) objeveny nové lokality 13 druhů, které zasluhují bližší pozornost. Je mezi nimi *Sistotrema alboluteum*, nový druh pro Ukrajinu, a dále dva vzácné druhy přirozených lesů, *Amylocystis lapponica* a *Crustoderma dryinum*, které nebyly v této zemi zaznamenány přes 80 let. Článek přináší údaje o lokalitách a stanovištích všech uvedených druhů, u nejzajímavějších nálezů doplněné o podrobný popis a ilustrace; u některých druhů jsou též stručně shrnuty poznatky o jejich ekologii a rozšíření.

INTRODUCTION

The Ukrainian Carpathians have one of the highest percentages of old-growth forest cover in Europe, making them an important refuge for rare lignicolous fungi (Dudka et al. 2019). A basic study of wood-inhabiting funga of Ukrainian Carpathians was conducted by Albert Pilát between 1928 and 1938 (Pilát 1940, Holec 2002). His records of fungi restricted to undisturbed habitats remained the only reports of these species in Ukraine for a long time.

Our study is an attempt to rediscover such species after decades of intensive forest management in this region and to survey the present fungal diversity of the remaining natural forests. We focused our attention on the forests of the north-eastern macroslope¹ of the Ukrainian Carpathians. This part of the region slightly differs in terms of climate and altitudinal zonation (Stoyko 2003), and its wood-inhabiting funga is studied relatively badly (Dudka et al. 2019). Studies on the opposite macroslope (Küffer et al. 2004, Lovas et Küffer 2006, Holec 2008, Ordynets et Nadeyina 2013, Gleb et al. 2019) have revealed a wide array of rare wood-inhabiting fungi, both new to Ukraine and rediscovered after Pilát, which motivated us to continue research on the northeastern macroslope.

The northeastern macroslope of the Ukrainian Carpathians is influenced by the cold continental climatic conditions of the East European Plain. As a result, vegetation belts in this part of the region are shifted down significantly, as compared to the warmer southwestern part. The lower part of the forest belt (up to 900 m a.s.l.) in the study region is mostly covered with beech and fir forests which at higher elevations are substituted with stands composed primarily of spruce (800–1600 m a.s.l.) which, in turn, are alternated by subalpine shrubs and meadows (1400–1860 m a.s.l.) and alpine meadows (1860–2061 m a.s.l.). The vegetation cover of the southwestern macroslope mainly differs in a higher representation of oak- and beech-dominated forests, with the latter occasionally reaching the treeline (Stoyko 2003).

The majority of the locations mentioned in this paper belong to the Gorgany Nature Reserve. This protected area is named after the Gorgany mountain range, the least populated part of the Ukrainian Carpathians. This region is characterised by medium elevations (up to 1836 m a.s.l.), steep slopes and the presence of large stone fields covering the upper parts of the ridges. The reserve is located near the villages of Bystrytsia and Zelena (Ivano-Frankivsk Region) at elevations

1 A macroslope is a part of a mountain system situated on any side of its main water divide. We use this rather unusual concept from the East European scientific tradition for three reasons. Firstly, the concept of a macroslope indicates precisely the nature of division used. Secondly, this division is traditionally used in studies of mountain landscapes and ecosystems in Ukraine. Finally, the Main Carpathian Ridge has been a political border for a long time, shaping study areas of biodiversity research. For instance, Pilát's study of the fungal diversity of the Eastern Carpathians was delimited by the border between Czechoslovakia and Poland.

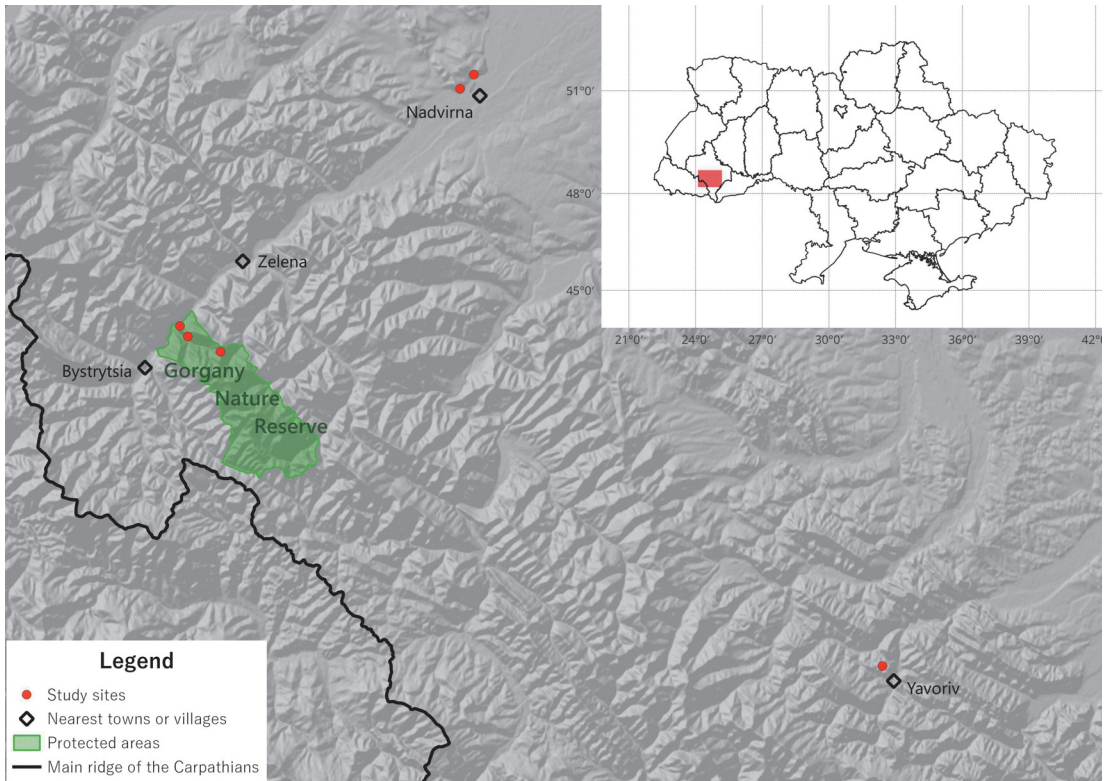


Fig. 1. Position of the studied localities on the northeastern macroslope of the Ukrainian Carpathians. The map was created using QGIS 3.28.0 software. The background relief map is an edited version of the “Esri Shaded Relief” basemap, a free layer provided through the QMS plugin.

of 750–1754 m a.s.l. and occupies an area of 53.442 km² (Fig. 1). The climate is continental with a mean temperature of 13.0–16.5 °C in July (with a vertical gradient of –0,7 °C per 100 m) and –7.6 °C in January (with a vertical gradient of –0,4 °C per 100 m), and an annual precipitation of 800–1000 mm. Approximately 86% of the total area is covered by spruce-dominated forests, nearly 11% is covered by stone fields, while meadows cover less than 2%. Spruce stands admixed with arolla pine are scattered throughout the upper part of the forest belt (965–1580 m a.s.l.). These relict ecosystems represent one of the rarest forest types in the Carpathians (Klimuk et al. 2006, Cherniavskiy 2021).

Natural and primeval stands occupy nearly 46% of the total area (Cherniavskiy 2021). Since 2017, some primeval forests of Gorgany Nature Reserve (7.53 km²), mostly concentrated in the Dzhurdzhynets stream valley, have become a component of the Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe UNESCO Natural World Heritage Site (Anonymus 2017).

The funga of Gorgany Nature Reserve is considered to be the most original in the Ukrainian Carpathians for its relatively high number of species (19%) found there, unknown to any other Reserve or National Nature Park of the Ukrainian Carpathians (Dudka et al. 2019). Mycological research in this area has revealed the presence of ten species listed in the Red Data Book of Ukraine as well as numerous rare species, such as *Camarops tubulina* (Alb. et Schwein.) Shear, a bioindicator of natural forest ecosystems (Holec 2005, Hayova 2012, Dudka et al. 2019, Anonymus 2021).

The forest area occupying the slopes of the Horodyshche (598 m a.s.l.) and Potoky (584 m a.s.l.) mountains north of the town of Nadvirna represents remnants of natural beech forests, once covering low-mountain flysch ranges of the Pre-Carpathian Upland. These ranges run parallel to the nearest ridges of the Gorgany and Pokuttia-Bukovyna Carpathians and have a similar origin, but are separated from them by broad depressions (Herenchuk 1973, Melnyk 1999). The climate of the region is continental with a mean temperature of 15.0–17.2 °C in July and 2.0–6.0 °C in January, and an annual precipitation of 500–800 mm (Andrianov 1957). Haydukevych (2012) notes that the vegetation cover in the studied forest area is typical of the lower part of the forest belt in the Ukrainian Carpathians, but with a high representation of thermophilic species in the underbrush and grass cover as a distinct regional feature.

There are five protected areas of local significance in this small (approximately 8 km²) forest, all with different protection regimes (Bohoslavets et al. 2020). For instance, management in the Potoky protected area (1.54 km²) involves salvage logging and does not limit recreational activities. This territory bears traces of logging, campfire sites and a set of tracks for downhill biking and motorcycling. On the other hand, the adjacent territory of the Bukove protected area (0.52 km²) represents an almost intact natural forest (Haydukevych 2012, Smaliychuk et Gräbener 2018).

Our preliminary survey (Bohoslavets et al. 2020) of the forest area on the slopes of the Potoky and the Horodyshche mountains revealed the presence of four fungal species listed in the Red Data Book of Ukraine, as well as two wood-inhabiting species [*Hericium coralloides* (Scop.) Pers. and *Ischnoderma resinosum* (Schrad.) P. Karst.] suggested as indicators of high nature value of European beech forests (Christensen et al. 2004). The studied forest area therefore deserves a stricter protection regime within the continuous protected area (Bohoslavets et al. 2020).

In this paper, we also provide one locality from a small forest patch in the territory of the village of Yavoriv (Ivano-Frankivsk Region). This area belongs to the Pokuttia-Bukovyna Carpathians, mountains of low to medium elevation with gentle slopes, densely settled and deforested (Herenchuk 1973). The biodiversity of the least disturbed ecosystems of the region is protected in Hutsulshchyna and

Vyzhnytskyi National Nature Parks. The results of mycological research in these protected territories are summarised in the latest monography dedicated to fungal diversity in the protected areas of the Ukrainian Carpathians (Dudka et al. 2019), as well as in some more recent papers (Fokshei 2022, Fokshei et Derzhypilskyi 2022).

MATERIAL AND METHODS

During the years 2019–2022, we conducted a series of expeditions to the Ukrainian Carpathians, focusing mainly on forests in the basin of the Bystritsia Nadvirnianska river. Samples were collected during both casual field surveys and an examination of permanent forest monitoring plots in Gorgany Nature Reserve.

At collecting specimens, we recorded information on substrate (tree species, size, wood decay stage and type), habitat (forest type, management status) and location (coordinates, elevation). Wood decay stages are given according to the classifications by Heilmann-Clausen (2001) and Renvall (1995) (for beech and conifer trunks, respectively). The categories of forest naturalness as proposed by Holec et al. (2015) were used. Types of habitats are given according to the National Habitat Catalogue of Ukraine (Kuzemko et al. 2018). We used GPS coordinates obtained from a mobile phone and cross-referenced them with elevation data available at open access resources such as Google Maps. In cases when we worked in the permanent forest monitoring plots at Gorgany Nature Reserve, we used location data provided by the Reserve's administration. Collections are deposited in the Fungarium of the National Herbarium of Ukraine (KW-M) at the M.G. Kholodny Institute of Botany, NAS of Ukraine, Kyiv.

Microscopic structures were studied in a 5% solution of KOH. Spore sizes are given based on at least 20 measurements per sample. Sizes of basidia and cystidia are based on 10 measurements per sample. In the descriptions of the microscopic features the following abbreviations are used: av. W = average width of basidiospores; av. L = average length of basidiospores; Q = length/width ratio of basidiospores; av. Q = average Q.

Species were identified according to Bernicchia et Gorjón (2010), Knudsen et Vesterholt (2012), Ryvarden et Melo (2014). In cases when reliable species identification was possible in the field and the value of the find was relatively small, we did not collect specimens, but recorded the observation with a description of its features in situ. Such species are referred to as “not.” according to Kotlaba (1999) in Specimens examined. The scientific names of the species are provided according to Index Fungorum database (www.indexfungorum.org).

RESULTS AND DISCUSSION

New occurrences of 13 interesting and rare wood-inhabiting fungi were recorded in the study area. Of these, *Sistotrema alboluteum* (Bourdot et Galzin) Bondartsev et Singer is a new species for Ukraine. In addition, we report two rare species restricted to natural forests, *Amylocystis lapponica* (Romell) Bondartsev et Singer and *Crustoderma dryinum* (Berk. et M.A. Curtis) Parmasto, which had not been recorded in the country for over 80 years. We provide detailed descriptions and illustrations of these three finds, based on the examination of collected

specimens, completed with an overview of their habitats and distribution, and supply the remaining species with a brief note on their distribution in Ukraine and conservation significance. The species are listed below in alphabetical order, regardless of their systematic position.

Amylocystis lapponica (Romell) Bondartsev et Singer, in Singer, *Mycologia* 36(1): 67, 1944 Fig. 2

Macroscopic and microscopic features. Fruitbody annual, effused-reflexed; fleshy when fresh, but becoming brittle with drying. Pilei imbricate, with rounded edges, 5–10 cm in diameter, up to 2 cm thick; upper surface hirsute, light pinkish to crimson red, without distinct zoning, tending to darken when bruised or dried. Hymenophore poroid, pores angular, 1–4 per mm with thin, lacerate dissepiments; surface pinkish, becoming darker when bruised. Tube layer slightly darker than context, up to 5 mm thick.

Hyphal system monomitic, hyphae clamped, thick-walled, 4–6 μm in diameter, slightly amyloid. Cystidia variable in shape, cylindrical to somewhat clavate, abundant, amyloid, smooth, thick-walled especially in the apical part, 20–42 \times 5.5–9 μm . Basidia 19–23 \times 7–8 μm , clavate, 4-spored. Basidiospores (7)8–9.5(10.2) \times 2.9–3.5(4) μm , Q = 2–3.2, av. L = 8.6 μm , av. W = 3.4 μm , av. Q = 2.57; cylindrical, thin-walled, hyaline, smooth, non-amyloid.

Habitat and distribution. Saprobic on dead wood of spruce or fir; brown-rotter. Known mainly from boreal or montane spruce-dominated forests of Eurasia and North America. Generally, *A. lapponica* is a rare species, reported only from locations of high conservation significance (Dahlberg et Croneborg 2003, Ryvarden et Melo 2014, Bernicchia et Gorjón 2020). In Europe, this species is known from Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Finland, Italy, Norway, Poland, Slovakia, Sweden and Ukraine (Holec et Kučera 2007, Ryvarden et Melo 2014, Rivoire 2020, Kunca et al. 2022, Dahlberg et Ainsworth on-line).

Notes. This species was first reported from Ukrainian territory by Pilát [as *Leptoporus lapponicus* (Romell) Pilát] in the Berlebash and Lishchynka stream valleys (Pilát 1940, Holec 2002) situated in the Marmarosy protected massif of the Carpathian Biosphere Reserve more than 80 years ago, and had not been found since then. In 2021, *A. lapponica* was included (as Regionally Extinct) in the updated edition of the Red Data Book of Ukraine (Anonymus 2021, Heluta et al. 2022). Thus, further observations of the occurrence of this fungus in the country are required to reassess its nature conservation status.

Amylocystis lapponica is included in the IUCN Red List of Threatened Species (LC category) due to its decline in the area and the quality of its habitat in

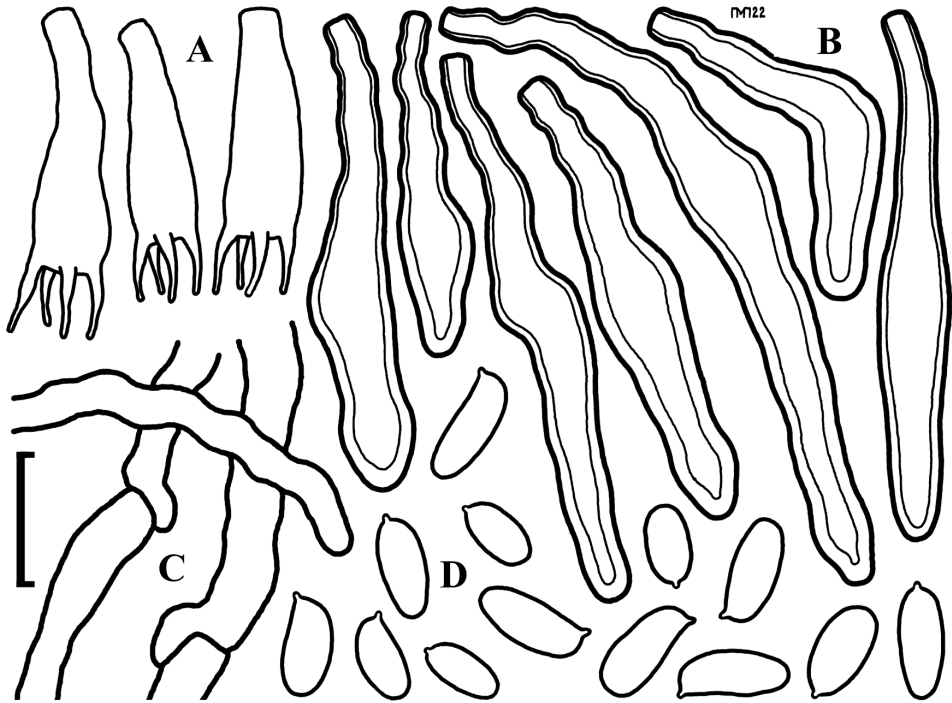


Fig. 2. *Amylocystis lapponica* (KW-M71507): A – basidia, B – cystidia, C – hyphae, D – spores. Bar = 10 μ m. Photos by O. Bohoslavets, drawings by M. Prydiuk.

Europe. Populations in North America are considered to be less affected by these threats (Dahlberg et Ainsworth on-line).

Basidiospores of our specimen, rarely reaching a length of 10 µm, tend to be shorter than in the descriptions given by Romell (1911) and Ryvarden et Melo (2014). This results in a significantly decreased length/width ratio, compared to measurements given by Kotiranta et al. (2005). We also could not find any cystidia with apical encrustation in our specimen. However, we regard these features as manifestations of intraspecific variability.

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the village of Zelena, Gorgany Nature Reserve, Dzhurdzhynets stream valley, Ancient and Primeval Beech Forests UNESCO Site, 48°28'36" N, 24°18'11" E, 1020 m a.s.l., primeval mountain spruce forest on poor soil, on lying decorticated trunk of *Picea abies* 23 cm in diameter, brown rot, decay stage 3, 6 October 2021, leg. O. Bohoslavets (KW-M71507).

Crustoderma dryinum (Berk. et M.A. Curtis) Parmasto, Consp. System. Corticiac. (Tartu): 88, 1968 Fig. 3

Macroscopic and microscopic features. Fruitbody annual, resupinate, forming thin irregular patches on the underside of dead lying logs, up to 50 cm long. Hymenophore corticioid, smooth, light yellow to ochre, with yellowish guttation droplets. Margin thin, reddish, darker than the rest of the fruitbody.

Hyphal system monomitic, hyphae clamped, 3–5 µm in diameter, thick-walled, hyaline. Cystidia tubular, smooth, thick-walled, especially in the apical part, 45–80 × 4.5–7 µm. Basidia 20–25 × 5–6.5 µm, clavate, 4-spored. Basidiospores 6.8–9.4(10) × (2.5)3–4.3 µm, Q = 1.9–2.5, av. L = 7.7 µm, av. W = 3.5 µm, av. Q = 2.22; cylindrical, thick-walled, hyaline, smooth, non-amyloid.

Habitat and distribution. Saprobic on dead wood of conifers, causing brown rot. Rare species, known from forest regions around the world (Gilbertson 1981, Greslebin et Rajchenberg 2003, Dai et al. 2004, Bernicchia et Gorjón 2010, Dhingra 2011). In Europe, it seems to be more common in regions with a continental climate (Larsson et Ryvarden 2021).

Notes. This is the only record of *C. dryinum* on spruce wood in Ukraine. The species had not been found in the country since Pilát reported it [as *Coniophorella crocea* (Karsten)] from the Berlebash and Lishchynka stream valleys in the Marmarosy protected massif of the Carpathian Biosphere Reserve on wood of *Abies alba* (Pilát 1940, Holec 2002).

Kotiranta et Niemelä (1993) listed *C. dryinum* among indicator fungi of old spruce-dominated forests in Finland.

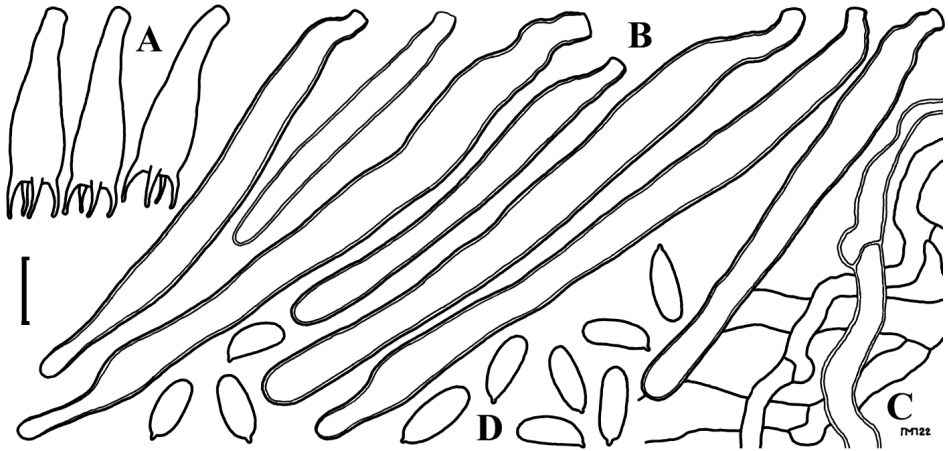


Fig. 3. *Crustoderma dryinum* (KW-M71518): **A** – basidia, **B** – cystidia, **C** – hyphae, **D** – spores. Bar = 10 μ m. Photo by O. Bohoslavets, drawings by M. Prydiuk.

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the village of Zelena, Gorgany Nature Reserve, Dzhurdzhynets stream valley, Ancient and Primeval Beech Forests UNESCO Site, 48°28'36" N, 24°18'11" E, 1020 m a.s.l., primeval mountain spruce forest on poor soil, on lying decorticated trunk of *Picea abies* 23 cm in diameter, brown rot, decay stage 3, 8 September 2022, leg. O. Bohoslavets (KW-M71518).

Cystostereum murrayi (Berk. et M.A. Curtis) Pouzar, *Česká Mykol.* 13(1): 18, 1959 Fig. 4

Notes. The species is new for Gorgany Nature Reserve. In Ukraine *C. murrayi* [as *Stereum murrayi* (B. et C.) Burt. var. *tuberculosum* (Fr.) Pilát] was first discovered by Pilát (1940). His records were made on the territories now belonging



Fig. 4. *Cystostereum murrayi* (KW-M71519).
Photo by O. Bohoslavets.



Fig. 5. *Dentipellis fragilis* (KW-M71520).
Photo by A. Atamanchuk.

to Svydovets and Marmarosy protected massifs of the Carpathian Biosphere Reserve. The species was also recorded on the slopes of mount Menchul in Chornohora massif by Holec (2008). The only Ukrainian specimen of *C. murrayi* (TAAM053929) collected outside of the Carpathian Biosphere Reserve is preserved in the Mycological Herbarium of the Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences (Pärtel on-line). The species was recorded near the town of Truskavets (Lviv Region).

According to Kotiranta et Niemelä (1993) and Holec (2008), *C. murrayi* is suitable for bioindication of natural spruce-dominated forests.

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the village of Zelena, Gorgany Nature Reserve, Dzhurdzhynets stream valley, Ancient and Primeval Beech Forests UNESCO Site, 48°27'59" N, 24°18'54" E, 1290 m a.s.l., primeval spruce forest in upper part of the forest belt on rich soil, on saw cut surface of a naturally fallen trunk of *Picea abies* 25 cm in diameter, white rot, decay stage 2, 21 October 2020, leg. O. Bohoslavets (KW-M71519).

Dentipellis fragilis (Pers.) Donk, Persoonia 2(2): 233, 1962

Fig. 5

Notes. The species is new for Gorgany Nature Reserve. In Ukraine, *D. fragilis* is known from the forests of Crimea, the Western Forest-Steppe, Roztochchya

and the Ukrainian Carpathians (Akulov et al. 2002). Pilát (1940) was the first to discover the species [as *Dryodon nodulosum* (Fr.) Cejp] in the Ukrainian Carpathians in the territories of Svydovets and Marmarosy protected massifs of the Carpathian Biosphere Reserve and their vicinities. Later, the species was reported from Hutsulshchyna, Uzhanskyi and Synevyr National Nature Parks (Dudka et al. 2019).

Christensen et al. (2004) consider *D. fragilis* to be an indicator species of conservation value of beech forests in Europe. According to Dvořák et al. (2017), the species has significant preference for natural forests, but may also occur in managed stands.

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the village of Zelena, Gorgany Nature Reserve, Dzhurdzhynets stream valley, Ancient and Primeval Beech Forests UNESCO Site, 48°28'36" N, 24°18'11" E, 995 m a.s.l., primeval fir and spruce forest in lower part of the forest belt on rich soil, on fragmented lying solitary trunk of *Fagus sylvatica* 48 cm in diameter, white rot, decay stage 4, 2 September 2022, leg. O. Bohoslavets (KW-M71520).

Gloeoporus pannocinctus (Romell) J. Erikss., Symb. bot. upsal. 16 (no. 1): 136, 1958

Notes. This species is new for Gorgany Nature Reserve. The first records of *G. pannocinctus* (as *Leptoporus semisupinus* f. *resupinata* Pilát) from the territory of Ukraine were made by Pilát (1940). Recent studies (Savchenko et al. on-line, Dudka et al. 2019) have revealed new occurrences of this species in the Ukrainian Carpathians from the Synevyr National Nature Park and the Carpathian Biosphere Reserve. Outside the Carpathian region, *G. pannocinctus* is known from Crimea (Akulov et al. 2002) and numerous localities in Eastern Ukraine (Ordynets et al. 2011, Ordynets et al. 2012, Savchenko et al. on-line).

Christensen et al. (2004) listed the species among wood-inhabiting fungi which can be used for indication of the natural value of beech forests in Europe. According to Abrego et al. (2017), *G. pannocinctus* is a reliable indicator of forest connectivity. However, an analysis by Dvořák et al. (2017) shows that although the species has significant preference for natural forests, it may also occur in managed stands. Generally, the species is uncommon but widely distributed, fruiting on the wood of various angiosperms (Rivoire 2020).

Specimens examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the village of Zelena, Gorgany Nature Reserve, 48°29'14" N, 24°16'52" E, 810 m a.s.l., near-natural fir and spruce forest in lower part of the forest belt on rich soil, on underside of fallen trunk of *Abies alba* 28 cm in diameter, white rot, decay stage 2, 8 July 2021, leg. O. Bohoslavets (KW-M71521). – Vicinity of the town of Nadvirna, Bukove protected area of local significance, 48°39'11" N, 24°34'03" E, 540 m a.s.l., natural neutrophilous beech forest, on fallen trunk of *Fagus sylvatica* 35 cm in diameter, white rot, decay stage 3, 6 June 2021, leg. O. Bohoslavets (KW-M71522).

Hermanssonia centrifuga (P. Karst.) Zmitr., Folia Cryptogamica Petropolitana (Sankt-Peterburg) 6: 100, 2018 Fig. 6

Notes. The first records of *H. centrifuga* (as *Phlebia mellea* Overholts) in Ukraine were made by Pilát (1940). The species was reported from a few locations in the Marmarosh Mountains southeast of Rakhiv (Pilát 1940, Holec 2002) on dead logs of *Abies alba* and *Picea abies*. After more than 70 years the species was collected by Ordynets in Uholka-Shyrokyi Luh primeval beech forest (Savchenko et al. on-line). All of these records were made in forests on the southwestern macroslope of the Ukrainian Carpathians, protected within the Carpathian Biosphere Reserve. Our finds are the first records of the species in Ukraine outside of this region.

According to Kotiranta et Niemelä (1993), Nordén et Larsson (2000) and Dvořák et al. (2017), *H. centrifuga* is suitable for bioindication of unmanaged spruce-dominated forests. Besides spruce, the species also occurs on wood of various hosts, both broadleaves and conifers, in forest regions of Eurasia and North America (Hallenberg 1981, 1984, Holec et al. 2015, Tejklová et Zibarová 2020).

Specimens examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the village of Zelena, Gorgany Nature Reserve, Dzhurdzhynets stream valley, Ancient and Primeval Beech Forests UNESCO Site, 48°28'27" N, 24°18'31" E, 1020 m a.s.l., primeval fir and spruce forest in lower part of the forest belt on rich soil, on saw cut surface of naturally fallen trunk of *Picea abies* 46 cm in diameter, white rot, decay stage 2, 7 October 2021, leg. O. Bohoslavets (KW-M71506); *ibid.*, 48°28'19" N, 24°18'33" E, 1040 m a.s.l., on underside of fallen trunk of *Picea abies* 29 cm in diameter, white rot, decay stage 2, 18 October 2022, not. O. Bohoslavets; *ibid.*, 48°28'36" N, 24°18'11" E, 1020 m a.s.l., on underside of fallen trunk of *Picea abies* 53 cm in diameter, white rot, decay stage 3, 18 October 2022, not. O. Bohoslavets; *ibid.*, outside the UNESCO Site, 48°28'49" N, 24°17'13" E, 815 m a.s.l., near-natural spruce forest in lower part of the forest belt on rich soil, on saw cut surface of fragment of naturally fallen trunk of *Picea abies* 30 cm in diameter, white rot, decay stage 2, 30 September 2022, not. O. Bohoslavets. – Kosiv District, vicinity of the village of Yavoriv, 48°15'59" N, 24°58'15" E, 660 m a.s.l., highly fragmented man-influenced spruce forest in lower part of the forest belt on rich soil, on saw cut surface of naturally fallen trunk of *Picea abies* 60 cm in diameter, white rot, decay stage 2, 24 August 2022, not. O. Bohoslavets.

Hymenochaete fuliginosa (Fr.) Lév., Annl. Sci. Nat., Bot., sér. 5: 152, 1846

Notes. The species was formerly considered to be rare, but seems to be restricted to the highest elevations of the Eastern Carpathians (Holec 2008). In Ukraine, it was previously only known from the Carpathian Biosphere Reserve (Pilát 1940, Holec 2008).

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the village of Zelena, Gorgany Nature Reserve, northern slope of Mt Berezovachka, Ancient and Primeval Beech Forests UNESCO Site, 48°28'00" N, 24°19'11" E, 1490 m a.s.l., primeval arolla pine forest, on lying dead trunk of *Pinus cembra* 30 cm in diameter, white rot, decay stage 3, 21 October 2020, leg. O. Bohoslavets (KW-M71523).



Fig. 6. *Hermanssonia centrifuga* (KW-M71506).
Photo by O. Bohoslavets.



Fig. 7. *Inonotus cuticularis* (KW-M71524).
Photo by O. Tsymovskiy.

Inonotus cuticularis (Bull.) P. Karst., Meddn Soc. Fauna Flora fenn. 5: 39, 1879
Fig. 7

Notes. This species was found for the first time in the Ukrainian Carpathians by Pilát (1940) in territories which now belong to the Carpathian Biosphere Reserve. Its distribution in Ukraine is scattered over forest regions (Akulov et al. 2002).

According to Müller et al. (2014), *I. cuticularis* is one of the main agents of heart rot in beech, responsible for forming hollows in living trees. Halme et al. (2017) use it as an example of a keystone species, responsible for the creation of habitats for threatened beetles. The species is considered to be indicative of conservation value of beech forests in Europe (Christensen et al. 2004).

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the town of Nadvirna, Potoky protected area of local significance, 48°39'11" N, 24°34'03" E, 560 m a.s.l., near-natural neutrophilous beech forest, on living trunk of *Fagus sylvatica*, white rot, decay stage 1, 17 October 2021, leg. O. Bohoslavets (KW-M71524).

Lentinellus ursinus (Fr.) Kühner, *Botaniste* 17(1–4): 99, 1926

Fig. 8

Notes. The first record of *Lentinellus ursinus* (as *Lentinus ursinus* Fr.) in Ukraine was made by Pilát (1940), who discovered this species in the territory of Marmarosy protected massif of the Carpathian Biosphere Reserve. The species is rare in Ukraine, only known from a few more locations in Homilshanski Lis (Prylutskyi et al. 2017) and Carpathian National Nature Parks (Dudka et al. 2019) as well as in one of the city forests of Kyiv (Ivanenko 2020).

According to Christensen et al. (2004), *L. ursinus* is an indicator species of conservation value of European beech forests. The species is, however, not restricted to beech wood, but occurs also on wood of some other broadleaf trees and sometimes even conifers (Knudsen et Vesterholt 2012). Therefore, records of *L. ursinus* are known from other types of forests as well.

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the town of Nadvirna, Potoky protected area of local significance, 48°39'10" N, 24°34'35" E, 490 m a.s.l., near-natural neutrophilous beech forest, on fallen trunk of *Fagus sylvatica*, white rot, decay stage 2, 4 September 2022, leg. O. Bohoslavets (KW-M71530).

Phellinidium pouzarii (Kotl.) Fiasson et Niemelä, *Karstenia* 24(1): 26, 1984

Fig. 9

Notes. This is the first find of this species in Gorgany Nature Reserve and the third record in Ukraine. *Phellinidium pouzarii* (as *Phellinus pouzarii* Kotl.) was described by Kotlaba (1968) as a novel species, mentioning the collection of Pilát from the Svydovets protected massif of the Carpathian Biosphere Reserve in the protologue. Pilát (1940) himself identified this specimen as *Phellinus ferrugineofuscus* (P. Karst.) Bourdot et Galzin. The species was found in Ukraine once again by Holec (2008) in the Chornohora protected massif.

Phellinidium pouzarii is known from only a few localities in Eastern and Central Europe, representing the most preserved primeval forests. For this reason it is proposed as an indicator species of such ecosystems (Holec 2008, Holec et al. 2019). The species occurs at elevations of 710–1100 m a.s.l., and has a clear insular distribution pattern (Holec et al. 2019). The species is included in the red lists of Austria (EN; Dämon et Krisai-Greilhuber 2017), the Czech Republic (CR; Holec et Beran 2006), Germany (Extremely Rare; Dämmrich et al. 2016) and Slovakia (VU; Lizoň 2001), as well as in the Red Book of Croatian Fungi (CR; Tkalčec et al. 2008). In this regard, we suggest that *P. pouzarii* and its habitats are legally protected in Ukraine by including the species in the Red Data Book of Ukraine.

The examined specimen was found on the cross-section cut surface of a fir trunk naturally fallen across a forest trail, which Holec et al. (2019) describe as one of the typical microhabitats where fruitbodies of this species occur.



Fig. 8. *Lentinellus ursinus* (KW-M71530).
Photo by L. Berezovskiy.

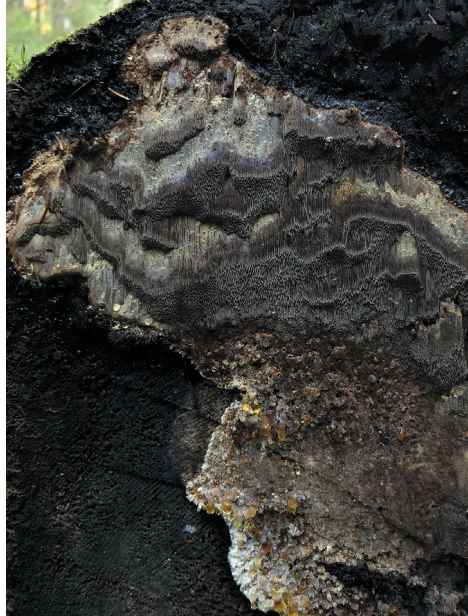


Fig. 9. *Phellinidium pouzarii* (KW-M71526).
Photo by A. Atamanchuk.

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the village of Zelena, Gorgany Nature Reserve, Dzhurdzhynets stream valley, Ancient and Primeval Beech Forests UNESCO Site, 48°28'27" N, 24°18'31" E, 1020 m a.s.l., primeval fir and spruce forest in lower part of the forest belt on rich soil, on saw cut surface of naturally fallen trunk of *Abies alba* 50 cm in diameter, white rot, decay stage 3, 2 September 2022, leg. O. Bohoslavets (KW-M71526).

Pluteus umbrosus (Pers.) P. Kumm., Führ. Pilzk. (Zerbst): 98, 1871

Notes. This species is new for Gorgany Nature Reserve. *Pluteus umbrosus* is rare in Ukraine, known from only a few locations: Chornohora, Svydovets and Marmarosy protected massifs of the Carpathian Biosphere Reserve (Pilát 1940, Wasser 1992, Holec 2008), Carpathian National Nature Park (Prydiuk 2016), vicinities of the villages of Pylypets (Transcarpathian Region), Slavske and Smozhe (Lviv Region) in the Ukrainian Carpathians, Ivan Franko forestry (Lviv Region) in Roztochchya, the vicinity of the village of Perevalne (Autonomous Republic of Crimea) in Mountain Crimea (Wasser 1992).

The species prefers natural habitats rich in deadwood (Holec 2008) and is indicative of conservation value of beech forests in Europe (Christensen et al. 2004).

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the village of Zelena, Gorgany Nature Reserve, Dzhurdzhynets stream valley, Ancient and Primeval Beech Forests UNESCO Site, 48°28'36" N, 24°18'11" E, 995 m a.s.l., primeval fir and spruce forest in lower part of the forest belt on rich soil, on lying fragmented solitary trunk of *Fagus sylvatica* 48 cm in diameter, white rot, decay stage 4, 5 October 2021, leg. O. Bohoslavets (KW-M71528).

Sistotrema alboluteum (Bourdot et Galzin) Bondartsev et Singer, *Annls mycol.* 39(1): 47, 1941 Fig. 10

Macroscopic and microscopic features. Fruitbody annual, resupinate, cottony, forming small (up to 4 cm in diameter) irregular patches on the underside of lying dead branches. Margin wide, fimbriate, but not usually forming rhizomorphs. Subiculum white to bluish, very thin and loose. Hymenophore poroid, pores 2–4 per mm, round to angular, shallow, white to somewhat yellowish. Fruitbody becoming brittle and easily separable from the substrate after drying, changing its colour to deep yellow.

Hyphal system monomitic, hyphae 3–4 µm in diameter, hyaline, non-amyloid, clamped at all septa. Hymenium without cystidia or any other sterile elements. Basidia urn-shaped, 18–26 × 5–8 µm, thin-walled, 4-spored, sometimes 2-spored. Basidiospores (4.2)5–5.6(6.7) × 4.2–5.6 µm, Q = 1–1.3, av. L = 5.28 µm, av. W = 4.67 µm, av. Q = 1.13; globose to subglobose, hyaline, thin-walled, non-amyloid.

Habitat and distribution. Ectomycorrhizal (Nilsson et al. 2006), fruiting on the underside of strongly rotten pieces of fallen dead wood, in litter and on soil (Ryvarden et Melo 2014, Bernicchia et Gorjón 2020). Distribution scattered over both coniferous and hardwood forests in Eurasia and North America (Ryvarden et Melo 2014, Ben Hassine Ben Ali 2018).

Notes. This is the first record of this species for Ukraine and probably for the Carpathian Mountains. The examined specimen was previously misidentified as *Anomoporia bombycina* (Fr.) Pouzar and published in a paper dedicated to the fungal biodiversity of the Potoky protected area and its surroundings (Bohoslavets et al. 2020).

Sugawara et al. (2022) state that *S. alboluteum*, along with some other resupinate species of the genus, is polyphyletic. All the European samples in the conducted ITS phylogeny formed, however, a strongly supported monophyletic clade. The only sample (GenBank accession number KP814533) excluded from the clade was extracted from a North American specimen marked as having affinity but not identical to the description of *S. alboluteum*. Similar conclusions based on the same sequence were published earlier by Runnel et al. (2021). Considering the uncertainty of these results and the fact that the original description of the species was based on a holotype collected in Europe, we presume that the

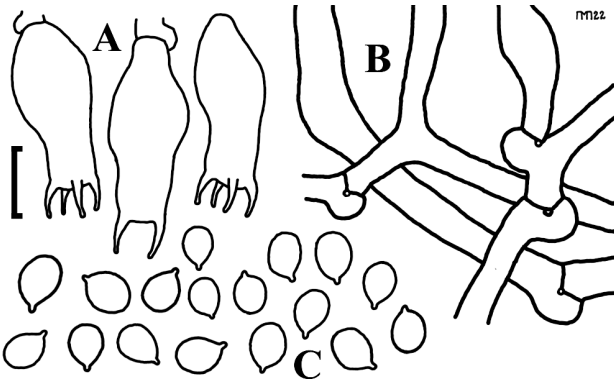


Fig. 10 (left photo, line drawing). *Sistotrema alboluteum* (KW-M71505): **A** – basidia, **B** – hyphae, **C** – spores. Bar = 10 µm. Photo by O. Bohoslavets, drawings by M. Prydiuk.

Fig. 11 (right photo). *Yuchengia narymica* (KW-M71529). Photo by V. Serheieva.

name *Sistotrema alboluteum* applies to our specimen. Still, the polyphyletic origin of the genus *Sistotrema* has been known for almost two decades (Larsson et al. 2004, Nilsson et al. 2006), and many of its currently distinguished species turned out to be clearly polyphyletic (Sugawara et al. 2022), so taxonomic revision of the genus and related genera in *Hydnaceae* is critically needed.

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the town of Nadvirna, Potoky protected area of local significance, 48°39'10" N, 24°34'35" E, 580 m a.s.l., man-influenced neutrophilous beech forest, on the underside of fallen beech branch 7 cm in diameter, brown rot, decay stage 5, 24 October 2019, leg. O. Bohoslavets (KW-M71505).

Yuchengia narymica (Pilát) B.K. Cui, C.L. Zhao et K.T. Steffen, in Zhao, Cui et Steffen, *Nordic J. Bot.* 31(3): 333, 2013 Fig. 11

Notes. In Ukraine, *Y. narymica* is known from only a few localities. It was reported [as *Perenniporia narymica* (Pilát) Pouzar] for the first time by Ordynets et Akulov (2006) from the Poltava region. The species was also found in the Uholka-Shyrokyi Luh primeval beech forest (Ordynets et Nadyeina 2013), Homilshanski Lisy National Nature Park (Usichenko 2009), and Iziumska Luka Regional Landscape Park (Ordynets et al. 2012). However, a recent study in Slovakia (Kunca et al. 2022) has shown that *Y. narymica* is not restricted to natural forests, occurring even in parks and intensively managed forests with small amounts of dead wood.

Specimen examined

Ukraine. Ivano-Frankivsk Region, Nadvirna District, vicinity of the town of Nadvirna, Bukove protected area of local significance, 48°39'11" N 24°34'03" E, 550 m a.s.l., natural neutrophilous beech forest, on remnants of standing beech stump approximately 40 cm in diameter, white rot, decay stage 4, 25 September 2021, leg. O. Bohoslavets (KW-M71529).

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