

***Cyphella digitalis* (Fungi, Agaricales)  
– new data on ITS barcode, ecology and distribution  
in the Czech Republic and Slovakia**

JAN HOLEC<sup>1\*</sup>, VLADIMÍR KUNCA<sup>2</sup>, MARTIN KRÍŽ<sup>3</sup>, PETR ZEHNÁLEK<sup>1,4</sup>

<sup>1</sup> National Museum, Mycological Department, Cirkusová 1740, CZ-193 00 Praha 9, Czech Republic

<sup>2</sup> Department of Applied Ecology, Faculty of Ecology and Environmental Sciences,  
Technical University in Zvolen, T.G. Masaryka 24, SK-960 01 Zvolen, Slovak Republic; kunca@tuzvo.sk

<sup>3</sup> Žukovova 1332/73, CZ-400 03 Ústí nad Labem, Czech Republic

<sup>4</sup> Charles University, Faculty of Science, Department of Botany, Benátská 2, CZ-128 01 Praha 2,  
Czech Republic

\*corresponding author: jan.holec@nm.cz

Holec J., Kunca V., Kríž M., Zehnálek P. (2022): *Cyphella digitalis* (Fungi, Agaricales) – new data on ITS barcode, ecology and distribution in the Czech Republic and Slovakia. – Czech Mycol. 74(1): 77–92.

Records of *Cyphella digitalis* from the Czech Republic and Slovakia are summarised and discussed. ITS barcode of two collections was obtained to document their conspecificity with the only so far sequenced sample originating from the Alps. In the study area, *C. digitalis* is rare with ten localities known from the 20<sup>th</sup> century and nine recorded in the 21<sup>st</sup> century. They are situated in the Bohemian Forest and several mountain ranges of the Western and Eastern Carpathians. The elevation range of the records is 525–1200 m a.s.l. All records are from *Abies alba*, mostly branches attached to freshly fallen trunks and sticking out into the air. Basidiomata occur in *Fagus-Abies* or *Fagus-Abies-Picea* forests from September to March with a peak in September–November. Most stands represent old-growth forests under protection. Ecology and distribution are discussed in a broad European context. The much lower number of records in the Czech Republic and Slovakia compared to more western countries could have, among other things, also biogeographical reasons, i.e. decrease in occurrence with increasing continentality to the east.

**Key words:** *Cyphellaceae*, *Abies alba*, old-growth forests, substrate, phenology.

**Article history:** received 21 February 2022, revised 30 March 2022, accepted 3 April 2022, published online 22 April 2022 (including Electronic supplement).

**DOI:** <https://doi.org/10.33585/cmy.74106>

Holec J., Kunca V., Kríž M., Zehnálek P. (2022): *Cyphella digitalis* (Fungi, Agaricales) – nové údaje o sekvenci ITS, ekologii a rozšíření v České republice a na Slovensku. – Czech Mycol. 74(1): 77–92.

Jsou shrnuty a diskutovány nálezy druhu *Cyphella digitalis* z České republiky a Slovenska. Byla získána sekvence oblasti ITS dvou sběrů, aby byla doložena jejich druhová příslušnost k jedinému dosud sekvenovanému sběru pocházejícímu z Alp. Ve studovaném území je druh *C. digitalis* vzácný s deseti lokalitami známými ve 20. století a devíti v 21. století. Nacházejí se na Šumavě a v několika pohořích Západních a Východních Karpat. Nadmořská výška nálezů je 525–1200 m n. m. Všechny jsou

z jedle bělokoré, většinou z větví čerstvě padlých stromů trčících do vzduchu. Druh se vyskytuje v bukojedlových nebo buko-jedlo-smrkových lesích od září do března s vrcholem v září až listopadu. Většina porostů představuje přirozené lesy vyhlášené jako rezervace nebo ležící ve velkoplošných chráněných územích. Ekologie a rozšíření jsou diskutovány v širokém evropském kontextu. Mnohem nižší počet nálezů v ČR a SR ve srovnání se zeměmi ležícími západně má zřejmě mimo jiné i biogeografické důvody, konkrétně pokles výskytu s kontinentalitou vzrůstající v Evropě směrem na východ.

## INTRODUCTION

*Cyphella digitalis* (Alb. et Schwein.) Fr. is a typical representative of so-called cyphelloid basidiomycetes. This morphological group is distinguished by disc-, tube-, or cup-shaped basidiomata, resembling some discomycetes of the phylum *Ascomycota*. Cyphelloid forms are a polyphyletic assemblage of reduced *Agaricales* (Bodensteiner et al. 2004). The genus *Cyphella* Fr.: Fr. belongs to the family *Cyphellaceae* Lotsy together with some agaricoid, crepidotoid and resupinate fungi (Knudsen et Vesterholt 2012). From an ecological perspective, *C. digitalis* is remarkable by its narrow substrate specialisation – living or dead Silver fir trees (*Abies alba*), on which it grows as a saprotroph on bark and wood (Agerer 1976).

The species was described from Upper Lusatia (Oberlausitz, Germany) by Albertini et Schweinitz (1805). Currently numerous records of *C. digitalis* are known from submontane and montane areas of Germany (e.g. Agerer 1976, Krieglsteiner 2001, DGfM on-line), France (e.g. Bourdot et Galzin 1928, Martini 2021), Switzerland (Breitenbach et Kränzlin 1986, SwissFungi on-line), and Austria (Österreichische Mykologische Gesellschaft 2017, Dämon et Krisai-Greilhuber 2017). These sources document its occurrence above all in the mountains (Pyrenees, Jura, Vosges, Schwarzwald, the Alps) and their foothills. There are also infrequent localities in Spain (Pyrenees – Escáñez 2012, [www.gbif.org/occurrence/2459208677](http://www.gbif.org/occurrence/2459208677)), Italy (e.g. Toscana – Bresadola et Cavara 1901), Denmark (Knudsen et Vesterholt 2012), Poland (Wojewoda 2003), Transcarpathian Ukraine (Pilát 1940) and Slovenia (Jurc et al. 2004, 2005, Šerod 2015). This shows that *C. digitalis* follows *A. alba* throughout the western and northern part of its natural distribution range. However, the occurrence in Denmark suggests that the species can even live outside of the natural range of *A. alba*. The temporary absence of data from the Balkans, i.e. from another important part of the distribution range of *A. alba*, may be a matter of neglect, lack of (published) data, or climatic differences (warm and dry weather possibly unsuitable for *C. digitalis*). *Cyphella digitalis* is also reported from the Russian Far East (Bukharova 2012, Vorobyova 2021). However, Bukharova gives no record details and Vorobyova mentions *Populus* as substrate, which suggests that it could be more likely a misidentified *Schizophyllum amplum*. We consider their information unreliable.

In spite of the fact that data from the Czech Republic and Slovakia (Pilát 1953, Kotlaba et al. 1995, Holec 1998, Kuthan et al. 1999, Škubla 2003, Adamčík et al. 2007) and the Transcarpathian Ukraine (Pilát 1940) have been published, these records are not included in some data sources, e.g. GBIF (<https://www.gbif.org/>) and Electronic Distribution Maps of Ukrainian Fungi (<http://www.cybertruffle.org.uk/ukramaps/>). Therefore, the first aim of this paper is to summarise and evaluate past and recent records of *Cyphella digitalis* in the Czech Republic and Slovakia, with a short note on the Ukrainian record preserved in Prague mycological herbarium (PRM). Secondly, we want to publish the ITS sequences obtained by us, as the species is poorly represented in GenBank.

## MATERIAL AND METHODS

**Data collection and interpretation.** Records by J. Holec are the result of a targeted search for *Cyphella digitalis* on freshly fallen firs in Czechia and Slovakia since 1995, especially in the Šumava Mts. (Bohemian Forest). The Czech record by M. Kříž was obtained during intensive mycological monitoring of fallen firs at the locality of Salajka (Kříž 2016). Records by V. Kunca were obtained occasionally in the last decade, especially during a pilot study in Slovak old-growth forests and mycological research aimed at decayed trunks of Silver fir (Kunca 2016, Kunca et al. 2022), but also during excursions to managed forests. In addition, voucher specimens from the most important Czech and Slovak herbaria (BRA, BRNM, BRNU, CB, HR, PRC, PRM) and relevant literature (above all Kotlaba et al. 1995) were excerpted for this study. For herbarium acronyms, see Index Herbariorum (<http://sweetgum.nybg.org/science/ih/>). Some voucher specimens are deposited in the private fungaria of V. Kunca (PVKU) and L. Majdanová (LMaj). Negative data, i.e. absence of records at the examined sites, were obtained during excursions over the past 10–30 years carried out by all authors and other Czech and Slovak field mycologists to both natural and man-influenced/man-made habitats with *Abies alba*. These excursions did not provide data other than those reported in the results.

For the list of records, original data from herbarium labels are translated or transliterated into English. Localities are arranged from west to east and, simultaneously, from north to south. Details on individual records, if available, are given in the Electronic supplement, where data missing on herbarium labels or in publications are added by us if careful interpretation was possible based on our knowledge of local conditions and reliable Czech/Slovak data sources. The geographic position, elevation, and current protection categories were derived from online maps ([www.mapy.cz](http://www.mapy.cz)). Forest naturalness of Czech localities was taken from the Czech Natural Forests website ([www.naturalforests.cz](http://www.naturalforests.cz)) and for the Slovak ones from an unpublished map related to the work by Jasík et al. (2017) and Mikoláš et al. (2019).

In Results, the term ‘study area’ refers to the territories of the Czech Republic and Slovakia.

**DNA study.** DNA was isolated from three dried herbarium specimens (Czech Republic: Debrník, PRM 956951; Slovakia: Palotská jedlina, PRM 956953 and Dobročský prales, PRM 956952; for details, see List of records in Results) with a Zymo Research Fungal/Bacterial Kit (Zymo Research, Orange, CA, USA). For each sample one well-developed, clean and undamaged basidioma was taken for the extraction. The PCR conditions for amplification of the ITS region were set up as described in Holec et Zehnálek (2020). The obtained sequences were edited in the Geneious 7.1.9 software (Biomatters, Auckland, New Zealand) and compared with an ITS sequence of *C. digitalis* available from GenBank (DQ486698) using MAFFT algorithms contained in Geneious 7.1.9.



**Fig. 1.** *Cyphella digitalis*, young basidiomata c. 5–7 mm wide. Udava, PRM 944454. Photo M. Kříž.



**Fig. 2.** *Cyphella digitalis*, young basidiomata c. 2–10 mm wide. Mláčik, PVKU 1957. Photo V. Kunca.



**Fig. 3.** *Cyphella digitalis*, mature basidiomata c. 7–12 mm wide. Palotská jedlina, PVKU 3421, duplicate PRM 956953 (sequenced). Photo V. Kunca.



**Fig. 4.** *Cyphella digitalis*, young and mature basidiomata c. 3–15 mm wide. Debrník, PRM 956951 (= JH 395/2021, sequenced). Photo J. Holec.



**Fig. 5.** *Cyphella digitalis*, old basidiomata c. 10–15 mm wide. Salajka, PRM 934746. Photo M. Kříž.



**Fig. 6.** Palotská jedlina, freshly fallen trunk of *Abies alba* with attached branches, some of them sticking out into the air. Such branches are the typical substrate of *Cyphella digitalis*. Photo V. Kunca.

## RESULTS

*Cypbella digitalis* (Alb. et Schwein.) Fr.

Figs. 1–6

Selected descriptions and illustrations: Agerer (1976), Breitenbach et Kränzlin (1986), Krieglsteiner (2001).

**List of records and published data**

Current protection category is added after the locality name (in brackets).

Czech Republic. Šumava Mts., 1.6 km S of Železná Ruda, **Debrník**: Zámecký les (strictly protected zone of Šumava National Park), 810 m a.s.l., mixed forest of old *Abies* and *Picea* plus younger *Fagus*, on bark of branches of fallen *Abies alba*, 9 Nov 2021, leg. J. Holec and P. Zehnálek, JH 395/2021 (PRM 956951, sequenced: GenBank OM837173); *ibid.*, *Abies* stand with young *Fagus*, on bark of branch of fallen *Abies alba*, JH 394/2021 (PRM 956950). – Šumava Mts., near Nová Pec, below settlement named **Jelení vrchy** (in Šumava National Park), before 1995, pers. comm. F. Kotlaba 1998, no details available, most probably record by the late J. Lazebníček (cited in Kotlaba et al. 1995, Holec 1998). – Šumava Mts., E of Volary, near **Arnoštov**, above valley of Blanice stream (in Šumava Protected Landscape Area), before 1995, pers. comm. F. Kotlaba 1998, no details available, most probably record by the late J. Lazebníček (cited in Kotlaba et al. 1995: erroneously as ‘Arnoštov near Stožec’, Holec 1998). – Hostýnsko-Vsetínská hornatina Mts., Mt. **Cáb** (as ‘Vsacký Cáb’), on bark of dead trunk of *Abies alba*, 29 Jan 1951, leg. Z. Pouzar, det. A. Pilát (PRM 174153). – Moravskoslezské Beskydy Mts., near Bílá, **Salajka** (National Nature Reserve), 800 m a.s.l., on underside of fallen trunk of *Abies alba*, 23 Nov 2015, leg. and det. M. Kříž (PRM 934746). – Slezské Beskydy Mts., close to Nýdek near Třinec, Mt. **Velká Čantoryje**, 780 m a.s.l., on dead branch of *Abies alba*, 16 Sep 1987, leg. and det. F. Kotlaba (PRM 852225).

Slovakia. Oravská Magura Mts., Mt. **Kubínska hoľa**, on living trunk and dead branches of *Abies alba*, 18 Nov 1954, leg. and det. F. Kotlaba and Z. Pouzar (PRM 617449); *ibid.*, ca. 1200 m a.s.l., on dead branches of *Abies alba* in the air, 18 Nov 1954, leg. and det. F. Kotlaba, A. Novacký and Z. Pouzar (PRC). – Belianske Tatry Mts., **between Tatranská Kotlina and Šumivý prameň** (in Tatra National Park), 950 m a.s.l., on fallen branch of *Abies*, 1 Oct 1986, leg. M. Procházka, det. J. Kuthan (BRA CR20076); published in Škubla (2003) as ‘Dolina Siedmich prameňov’. – Pieniny Mts., close to Lesnica near Stará Ľubovňa, on slope of Mt. **Holica** (as ‘Golica’, in Pieniny National Park), ± 700 m a.s.l., on thin dead trunk of *Abies alba*, 26 Sep 1972, leg. and det. F. Kotlaba (PRM 718448). – Nízke Tatry Mts., near Kyslá, **Pod Latiborskou hoľou** (National Nature Reserve), on branches of fallen trunk of *Abies alba*, 21 Oct 1972, leg. and det. Z. Pouzar (PRM 874164). – Kremnické vrchy Mts., **Mláčik** (National Nature Reserve), 892 m a.s.l., on branch sticking up from fallen trunk of *Abies alba*, 7 Nov 2016, leg. and det. V. Kunca (PVKU 1957). – Starohorské vrchy Mts., **Staré Hory**, 570 m a.s.l., on branch sticking up from dead fallen trunk of *Abies alba*, 23 March 2015, leg. and det. V. Kunca (PVKU 1396); *ibid.*, 525 m a.s.l., dead twig of fallen *Abies alba*, 18 Dec 2015, leg. and det. V. Kunca (PVKU 1611). – Veporské vrchy Mts., near Čierny Balog, **Dobročský prales** (National Nature Reserve), on dead branch of *Abies alba*, 1 Sep 1961, leg. and det. F. Kotlaba and Z. Pouzar (PRM 537798); *ibid.*, 795 m a.s.l., on dead branch sticking up from fallen trunk of *Abies alba*, 27 Oct 2017, leg. and det. V. Kunca (PVKU 2144, duplicate PRM 956952, sequencing failed). – Vihorlatské vrchy Mts., S of Zemplínske Hámre, **Jedlinka** (Nature Reserve), ca. 800 m a.s.l., on damaged branch of living *Abies alba*, 24 Oct 2016, leg. and det. L. Majdanová (LMaj 1023). – Laborecká vrchovina Highlands, E of Medzilaborce, **Palotská jedlina** (National Nature Reserve), 580 m a.s.l., on dead branches sticking up from fallen trunk of *Abies alba*, 7 Oct 2016, leg. and det. V. Kunca (PVKU 1930); *ibid.*, 540 m a.s.l., *Abies alba*: on branch of fallen trunk, 1.5 m above the ground, 7 Oct 2016, leg. and det. L. Hagara (BRA); *ibid.*, 657 m a.s.l., on dead branches sticking up from fallen trunk of *Abies alba*, 2 Oct 2021, leg. and det. V. Kunca (PVKU 3421, duplicate PRM 956953, sequenced: GenBank OM837174). – Bukovské vrchy Mts., Snina

District, Osadné, **Udava** (Nature Reserve), on branch sticking up from fallen trunk of probably *Abies alba*, 4 Oct 2016, leg. and det. R. Rutkowski and M. Kříž (PRM 944454); *ibid.*, 640 m a.s.l., on dead branches sticking up from fallen trunk of *Abies alba*, 4 Oct 2016, leg. and det. V. Kunca (PVKU 1903); *ibid.*, 4 Oct 2016, leg. and det. A. Polhorský, R. Rutkowski and V. Kunca (BRA CR26283). – Bukovské vrchy Mts., near Nová Sedlica, **Stužica** (National Nature Reserve), Mt. Prikry, 720 m a.s.l., on fallen branch of *Abies alba*, 27 Sep 1988, leg. and det. J. Kuthan (BRA CR20077); *ibid.*, 11 Oct 1990, leg. V. Macejka, det. J. Kuthan (BRA CR20078); both these records were published in Kuthan et al. (1999) and Škubla (2003). – Stužica, without exact localisation, natural *Abies-Fagus* forest, on bark of branch sticking from fallen trunk (tree species not mentioned, most probably *Abies alba*) 1 m above the ground, 6 Oct 2016, leg. and det. L. Hagara (BRNM 807735); *ibid.*, without details, 6 Oct 2016, leg. V. Kautman, det. P. Tomka (BRA CR26568); *ibid.*, ca. 700 m a.s.l., *Abies alba*: on bark of branch of fallen trunk, 1 m above the ground, 6 Oct 2016, leg. and det. F. Fuljer and L. Hagara (BRA); *ibid.*, without details, 6 Oct 2016, leg. and det. A. Polhorský (BRA CR26562).

Ukraine. Eastern Carpathians, NE of Dilove (formerly ‘Trebušany’), E of Kostylyvka, **valley of Velykyi stream** (formerly ‘Berlebaš’), 800–1000 m a.s.l., on *Abies alba*, Aug 1937, leg. and det. A. Pilát (PRM 488104).

### Sequence data

The sequences of the ITS region were obtained from three samples. Only one sequence (OM837174 from voucher PRM 956953, Palotská jedlina) was of good quality and its length sufficient for reliable comparison. There is only one ITS sequence in GenBank indicated as *Cyphella digitalis* (DQ486698), derived from culture in CBS and isolated from basidiomata collected on a trunk of *Abies alba* in Austria by W. Gams. The similarity of this to our sequence from PRM 956953 is 99.07 % (difference in three deletions and two substitutions in the ITS1 region). The sequence generated from PRM 956951, Debrník (OM837173), was too short and included only ITS1 region. In this part it was identical to the sequence from the Palotská jedlina sample except for one insertion. The sequence from PRM 956952 (Dobročský prales) was of very low quality with many ambiguous positions making any comparison dubious.

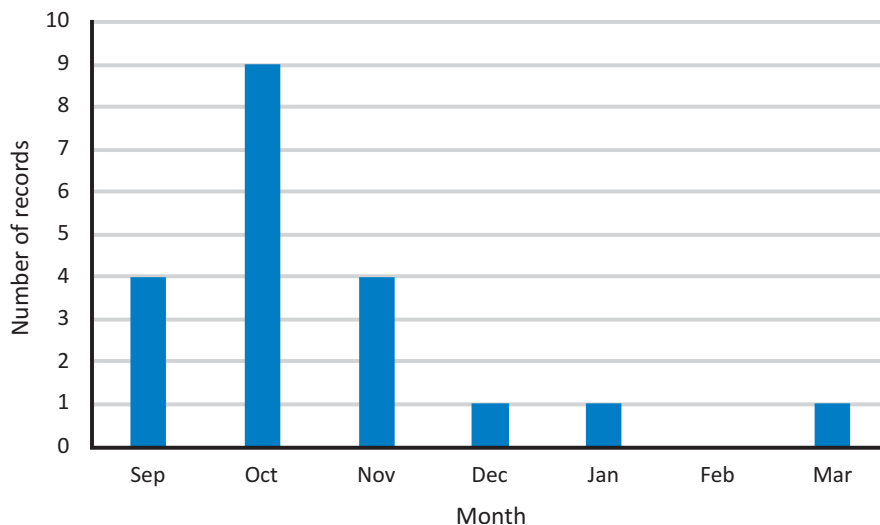
### Phenology

Basidiomata were observed from September to March, i.e. from late summer (1 September) through autumn and winter until early spring. Most records were made in autumn, namely in September (4), October (9) and November (4). Records from other months were rare (Fig. 7).

### Substrate

All records for which the substrate was indicated were from fir (*Abies*), namely Silver fir (*Abies alba*), the only native fir species occurring in the study area. Only three of them were from trunks, either fallen (2; in one case specified: on its lower half) or standing and living (1). Most records were from branches



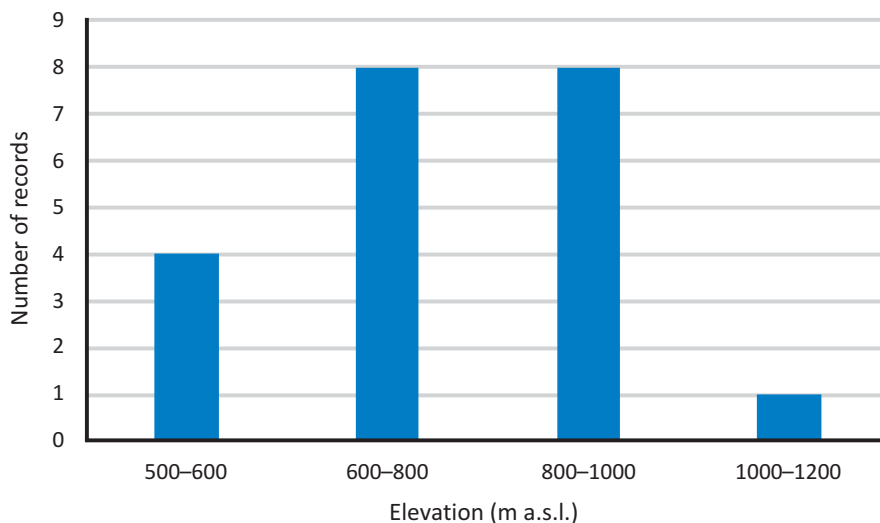


**Fig. 7.** Fructification of *Cyphella digitalis* in the study area. For details, see Material and methods and Electronic supplement. Records from the same locality and the same day (usually by different participants in the same excursion) were counted as one.

attached to fallen trees and sticking out into the air. Basidiomata of *C. digitalis* were observed 50–250 cm above ground level. Unfortunately, we know exactly how many years after tree fall the basidiomata appeared only in three cases (1–2 years). The trees themselves were both thick, having a trunk diameter at breast height of 60–105 cm, or medium thick, 30–50 cm in diameter. Records on thin, i.e. young trees, were rare. The diameter of branches inhabited by *C. digitalis* was 3–11 cm. The branches were in the initial decay stage, still having hard wood and complete bark cover. There was only one record on a damaged branch where the bark was injured.

### Habitats

*Cyphella digitalis* occurs in *Fagus-Abies* and *Fagus-Abies-Picea* forests (see Electronic supplement). More exact data, such as phytosociological units, are unknown for most records. Concerning naturalness, old-growth forests strongly prevail, namely near-natural stands (4 localities), natural ones (4) and a virgin forest (1). However, there are also two records from managed *Abies-Fagus* stands (Staré Hory: an even man-made forest). Almost all localities are under protection, either in small-scale nature reserves or large-scale protected areas like national parks or protected landscape areas.



**Fig. 8.** Vertical distribution of *Cyphella digitalis* in the study area. For data, see Material and methods and Electronic supplement. Multiple records from the same locality and the same elevation were counted as one. Records with uncertain elevation were not included. Records with cut-off values were assigned to a range best fitting local geomorphology (submontane or montane character). The first elevation interval was narrowed as there are no records below 500 m a.s.l.

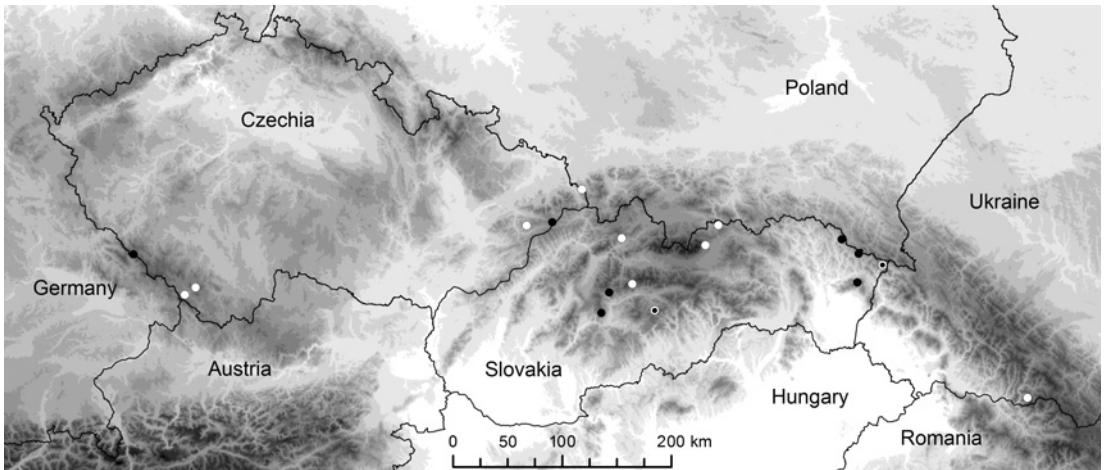
## Distribution

*Cyphella digitalis* occurs at higher elevations (Fig. 8), namely in submontane (525–795 m a.s.l.) and montane (800–1000 m a.s.l.) areas, exceptionally also in the supramontane belt (1200 m a.s.l.). Geographically, its sites are located in the Šumava Mts. (Bohemian Forest) and several mountain ranges of the Western and Eastern Carpathians. There are 10 localities known from the 20<sup>th</sup> century and 9 from the 21<sup>st</sup> century. The only localities where the species was collected in both centuries are Dobročský prales and Stučica virgin forests in Slovakia. At the level of higher geographical units like mountain ranges, its occurrence is mostly permanent, documented by past and recent records at various localities (Fig. 9).

## DISCUSSION

### Sequence data

Comparison of generated ITS sequences with the only *Cyphella digitalis* ITS sequence from GenBank showed their conspecificity relatively convincingly, at least for representative samples of the Palotská jedlina and Debrník localities. Incidentally, all four sequences of *C. digitalis* in GenBank available so far were



**Fig. 9.** Records of *Cyphella digitalis* in the study area. The collection by Pilát (1940) from Transcarpathian Ukraine kept in the PRM herbarium is added. White circles indicate 20<sup>th</sup>-century records, black circles 21<sup>st</sup>-century records, white circles with a black centre records in both centuries. The map was created by M. Čiliak using 30 arc-second DEM of Europe (GTOPO30) with data provided by the U.S. Geological Survey's Center for Earth Resources Observation and Science (EROS).

obtained from the same material, CBS strain 679.82 (isolated from the collection by W. Gams from Angerberg near Wörgl in Austria), although the source of two of them was specified as strain 'Thorn-617'. However, Greg Thorn confirmed to us (pers. comm., 14 Feb 2022) that his strain was obtained from the abovementioned CBS strain. Finally, our sequences contribute to the knowledge of ITS variability in *C. digitalis* across Europe, as sequences from three mountain ranges (the Alps, Bohemian Forest, Western Carpathians) are now available.

### Distribution, ecology and phenology

Data from the study area show that *Cyphella digitalis* occurs from the submontane to supramontane belts (525–1200 m a.s.l.) of the Šumava Mts. (= Bohemian Forest, Czechia), Western Carpathians (Czechia, Slovakia) and Eastern Carpathians (eastern Slovakia, Ukraine). Its preferred habitats are old-growth forests composed of *Fagus* and *Abies* (plus *Picea* at some sites), mostly under protection. Basidiomata are documented from September to March with a peak from September to November, mostly on bark of fir branches sticking out into the air from freshly fallen trees of medium to large diameter. Pilát's record from the Eastern Carpathians is from August, which shows that *C. digitalis* is able to produce basidiomata even during the summer.

The collected occurrence data show that *C. digitalis* is relatively rare in the study area. This agrees with the personal experience of the first author, who has been searching for the species since 1995. Although the search period was long and included both extensive field studies (e.g. Holec 1998, Holec et al. 2015) and a detailed monitoring of fallen firs in the Boubínský prales virgin forest (Holec et Kučera 2020), the species was not found until 2021. However, *C. digitalis* may be partially overlooked due to its small size, unusual position on the substrate, and also the fact that some mycologists are generally not used to looking for fungi in winter.

By contrast, *C. digitalis* is much more frequently recorded in Germany (DGfM on-line) and Switzerland (SwissFungi on-line), having dozens of localities in each of these countries. In Switzerland, basidiomata appear from August to March but exceptionally also in June. The vast majority of records come from the cold part of the year (September–March). Records from branches and twigs lying on the ground are rarely reported (SwissFungi on-line), similarly like in our dataset.

An apt ecological summary of *C. digitalis* in Baden-Württemberg (Germany) was published by Krieglsteiner (2001). It includes records from September to April with a peak in December and January. Habitats are reported as shady fir-beech or fir-spruce forests, often ravine forests, with high air humidity, at elevations in the range of 375–925 m a.s.l. Basidiomata appear on bark of fir (*Abies alba*), on living, sick or dead standing and freshly fallen trees, on trunks and branches, rarely on decorticated wood. In Austria, Dämon et Krisai-Greilhuber (2017) characterise *C. digitalis* as a species of sites with humid air at elevations of about 300 to 1200 m, fructifying from August to January (for details, see <http://austria.mykodata.net>). Just like Krieglsteiner (2020), Breitenbach et Kränzlin (1986) stress the occurrence of *C. digitalis* on standing, relatively thin (i.e. young) trunks in Switzerland. Wojewoda (2003) also describes the growth on “bark of trunks and branches of dead young *Abies*” in Poland. Krieglsteiner (2001) mentions its occurrence in Liechtenstein, however without giving a reference to the original data source.

Regarding the elevation maximum of *C. digitalis*, there are records from sites as high as 1303 m a.s.l. (Merino Alcántara 2014) and 1500 m a.s.l. ([www.gbif.org/occurrence/2459208677](http://www.gbif.org/occurrence/2459208677), Escáñez 2012) in the Pyrenees. In Switzerland, the range is 430–1500 m a.s.l. (SwissFungi on-line). The highest situated record is from Berchtesgaden National Park in Germany (Fischunkelalm, ca. 1900 m a.s.l.; see DGfM on-line).

Most records of *C. digitalis* in the study area are not from winter like in West Germany and Switzerland (see above), but from autumn. This is probably due to the fact that the study area is more continental, i.e. with severer winter frosts stopping fructification of most fungi, and it is also poorer in precipitation (the latter fact has become even more pronounced since about 2015 due to the global

climate change, see e.g. CHMI on-line). In addition, juveniles and young generations of fir are rare here due to the fir decline in the past century (Elling et al. 2009, Dobrowolska et al. 2017) and current browsing by game animals. These are probable reasons why records of *C. digitalis* are quite rare in the study area. They are mostly limited to old-growth forests with a humid meso- and microclimate.

In literature, records from *Picea* are mentioned (e.g. Martini 2021, SwissFungi on-line). However, we have not seen any direct reference to herbarium specimens documenting it. We consider this information questionable, although we cannot completely rule it out.

According to the ECCF website (Red List candidates: <http://www.eccf.eu/activities-en.ehtml>), *Cyphella digitalis* is considered endangered in the following countries: Austria (Dämon et Krisai-Greilhuber 2017: vulnerable), Germany (Matzke-Hajek et al. 2016: strongly endangered), Poland (Wojewoda et Ławrynowicz 2006: endangered), Switzerland (Senn-Irlet et al. 2007: vulnerable). However, the high number of localities in Switzerland and Germany suggests that the real situation is more favourable. Krieglsteiner (2020) even states that the fungus is not so rare in these countries but rather abundant and “can be found everywhere in the fir range”, especially on branches and twigs of young standing firs at the head level and in places which the eyes can see. According to him, the best periods for targeted search are those after long rains (even in summer or autumn) and during winter/spring snow melting.

As shown above, the much lower number of records in the Czech Republic and Slovakia compared to more western countries such as Germany and Switzerland could have, at least in part, also biogeographical reasons, i.e. decrease in occurrence with increasing continentality across Europe. It is also connected with the fact that fructification of the species mainly occurs in very humid conditions, which are naturally more frequent in oceanic regions of Europe. Factors like sampling intensity, previous forestry management or the history of air pollution are certainly also important. However, it is difficult to compare and evaluate both the joint and individual influence of these factors.

For all the reasons previously discussed, *C. digitalis* should be considered for inclusion into the red lists of the Czech Republic and Slovakia, best in the Endangered category. Regarding Ukraine, the Data Deficient category would be appropriate.

#### ACKNOWLEDGEMENTS

We thank the curators of herbaria BRA (I. Kautmanová), BRNM (V. Antonín), BRNU (D. Dvořák), CB (M. Beran), HR (T. Tejklová) and PRC (O. Koukol) for data on the presence or absence of *C. digitalis* specimens, L. Majdanová for details on her record of *Cyphella digitalis*, M. Čiliak for preparation of

the map, and two anonymous reviewers for their valuable comments. The work by J. Holec and P. Zehnálek was sponsored by the Ministry of Culture of the Czech Republic (DKRVO 2019-2023/3.I.d, 00023272); P. Zehnálek was also supported by the Ministry of Education, Youth and Sports of the Czech Republic through Institutional Support for Science and Research. The work by V. Kunca was funded by the Scientific Grant Agency of the Ministry of Education of the Slovak Republic (VEGA 1/0295/20).

## REFERENCES

- ADAMČÍK S., CHRISTENSEN M., HEILMANN-CLAUSEN J., WALLEYN R. (2007): Fungal diversity in the Poloniny National Park with emphasis on indicator species of conservation value of beech forests in Europe. – *Czech Mycology* 59(1): 67–81. DOI: <https://doi.org/10.33585/cmy.59107>
- AGERER R. (1976): *Cyphella digitalis* A. & S. ex Fr. – Ein schüsselförmiger Basidiomycet. – *Zeitschrift für Pilzkunde* 42: 39–44.
- ALBERTINI J.B., SCHWEINITZ L.D. (1805): *Conspectus fungorum in Lusatae superioris agro niskiensi crescentium e methodo Persooniana*. – Kummerian, Leipzig.
- BODENSTEINER P., BINDER M., MONCALVO J.-M., AGERER R., HIBBETT D. (2004): Phylogenetic relationships of cyphelloid homobasidiomycetes. – *Molecular Phylogenetics and Evolution* 33(2): 501–515. DOI: <https://doi.org/10.1016/j.ympev.2004.06.007>
- BOURDOT H., GALZIN A. (1928): *Hyménomycètes de France*. – Marcel Bry, Sceaux.
- BREITENBACH J., KRÄNZLIN F. (1986): *Pilze der Schweiz, Band 2, Nichtblätterpilze*. – Verlag Mykologia, Luzern.
- BRESADOLA G., CAVARA F. (1901): *Funghi di Vallombrosa. Contribuzione II*. – *Nuovo Giornale Botanico Italiano, Nuova Serie*, 8: 163–186.
- BUKHAROVA N.V. (2012): O nekotoryh redkih vidah gribov Evreyskoy avtonomnoy oblasti [On some rare fungal species of the Jewish Autonomous Region]. – <https://cyberleninka.ru/article/n/o-nekotoryh-redkih-vidah-gribov-evreyskoy-avtonomnoy-oblasti/viewer> [accessed 25 Mar 2022; in Russian]
- CHMI [CZECH HYDROMETEOROLOGICAL INSTITUTE] (on-line): Climate maps. – <https://www.chmi.cz/historicka-data/pocasi/mapy-charakteristik-klimatu?l=en> [accessed 25 Mar 2022]
- DÁMON W., KRISAI-GREILHUBER I. (2017): *Die Pilze Österreichs, Verzeichnis und Rote Liste 2016, Teil: Makromyzeten*. – Österreichische Mykologische Gesellschaft, Wien.
- DGF [DEUTSCHE GESELLSCHAFT FÜR MYKOLOGIE] (on-line): *Cyphella digitalis* (Alb. & Schwein.) Fr. 1822. – <https://www.pilze-deutschland.de/organismen/cyphella-digitalis-alb-schwein-fr-1822-1> [accessed 15 Dec 2021]
- DOBROWOLSKA D., BONČINA A., KLUMPP R. (2017): Ecology and silviculture of silver fir (*Abies alba* Mill.): a review. – *Journal of Forestry Research* 22: 326–335. DOI: <https://doi.org/10.1080/13416979.2017.1386021>
- ELLING W., DITTMAR C., PFAFFELMOSER K., RÖTZER T. (2009): Dendroecological assessment of the complex causes of decline and recovery of the growth of silver fir (*Abies alba* Mill.) in Southern Germany. – *Forest Ecology and Management* 257: 1175–1187. DOI: <https://doi.org/10.1016/j.foreco.2008.10.014>
- ESCÁNEZ L. (2012): *Fongs lignícolas dels Pirineus*. – *Moixeró* 4: 20–28.
- HOLEC J. (1998): Zákonem chráněné nebo v Červené knize zahrnuté druhy hub na Šumavě – shrnutí literárních údajů a současný stav výskytu [Šumava's fungi protected by law or included in Red Book: a review of literature and current distribution]. – *Silva Gabreta* 2: 35–52. [in Czech with English abstract]

- HOLEC J., KRÍŽ M., POUZAR Z., ŠANDO VÁ M. (2015): Boubínský prales virgin forest, a Central European refugium of boreal-montane and old-growth forest fungi. – *Czech Mycology* 67(2): 157–226.  
DOI: <https://doi.org/10.33585/cmy.67204>
- HOLEC J., KUČERA T. (2020): Richness and composition of macrofungi on large decaying trees in a Central European old-growth forest: a case study on silver fir (*Abies alba*). – *Mycological Progress* 19(12): 1429–1443. DOI: <https://doi.org/10.1007/s11557-020-01637-w>
- HOLEC J., ZEHNÁLEK P. (2020): Taxonomy of *Hohenbuehelia auriscalpium*, *H. abietina*, *H. josserandii*, and one record of *H. tremula*. – *Czech Mycology* 72(2): 199–220.  
DOI: <https://doi.org/10.33585/cmy.72204>
- JASÍK M., POLÁK P., VYSOKÝ J. (2017): Výsledky inventarizácie pralesov na Slovensku v rokoch 2009–2015 [The results of an old-growth forests inventory in Slovakia in 2009–2015]. – *Naturae Tutela* 21(2): 153–184. [in Slovak with English summary]
- JURC D., PILTAVER A., DOLENC A., OGRIS N. (2004): List of species and distribution of fungi in Slovenia. – <https://www.zdravgozd.si/boletus/arealne Karte/eng/bi.htm> [accessed 16 Feb 2022]
- JURC D., PILTAVER A., OGRIS N. (2005): Fungi of Slovenia. – Gozdarski inštitut Slovenije, Ljubljana.
- KNUDSEN H., VESTERHOLT J., eds. (2012): *Funga Nordica*. Agaricoid, boletoid, clavarioid, cyphelloid and gastroid genera. – Nordsvamp, Copenhagen.
- KOTLABA F. et al. (1995): Červená kniha ohrozených a vzácných druhov rastlín a živočíchov SR a ČR. Vol. 4. Sinice a riasy, Huby, Lišajníky, Machorasty [Red book of threatened and rare species of the Slovak and Czech Republics. Vol. 4. Cyanobacteria and Algae, Fungi, Lichens, Bryophytes]. – Príroda, Bratislava. [in Slovak]
- KRIEGLSTEINER G.J., ed. (2001): *Die Großpilze Baden-Württembergs, Band 3, Ständerpilze: Blätterpilze I.* – Ulmer, Stuttgart.
- KRIEGLSTEINER L. (2020): Pilz des Monats Februar 2020 – Tannen-Fingerhut (*Cyphella digitalis*). – <https://www.pilzkunde.de/index.php/pilz-des-monats?start=12> [accessed 15 Dec 2021]
- KRÍŽ M. (2016): Lignikolní makromycety na tlejících jedlích na lokalitě Salajka (CHKO Beskydy) [Lignicolous macromycetes on decaying firs at the locality of Salajka (Beskydy PLA)]. – Research report, depon. in *Silva Tarouca* Research Institute for Landscape and Ornamental Gardening, Brno, Czech Republic.
- KUNCA V. (2016): Indikačné druhy makromycétov na hrubom mŕtvom dreve jedle bielej (*Abies alba*) v dvoch prírodných lesoch Slovenska [Indicator macromycetes species on the European silver fir (*Abies alba*) coarse woody debris in two natural forests in Slovakia]. – In: Hlaváč P., Vidholdová Z., eds., *Ochrana drevín a dreva 2016* [Protecting trees and wood], Zborník recenzovaných vedeckých prác a abstraktov, pp. 49–56, Zvolen. [in Slovak with English summary]
- KUNCA V., PEIGER M., TOMKA P., VAMPOLA P. (2022): Old-growth forest fungi – new localities and habitat and host preferences in Slovakia (I). – *Czech Mycology* 74(1): 33–55.  
DOI: <https://doi.org/10.33585/cmy.74103>
- KUTHAN J., ADAMČÍK S., TERRAY J., ANTONÍN V. (1999): Huby národného parku Poloniny [Fungi of the national park Poloniny]. – *Správa národných parkov SR, Liptovský Mikuláš*. [in Slovak with English summary]
- MARTINI E. (2021): *Cyphella digitalis*. – <https://www.aphyllo.net/spec.php?id=442300> [accessed 15 Dec 2021]
- MATZKE-HAJEK G., HOFBAUER N., LUDWIG G., eds. (2016): *Rote Liste gefährdeter Tiere, Pflanzen und Pilze Deutschlands. Band 8: Pilze (Teil 1) – Großpilze.* – Landwirtschaftsverlag, Münster.
- MERINO ALCÁNTARA D. (2014): *Cyphella digitalis*. – <http://www.micobotanicajaen.com/Revista/Articulos/DMerinoA/Pirineos20142/CyphellaDigitalis.pdf> [accessed 15 Dec 2021]
- MIKOLÁŠ M., UJHÁZY K., JASÍK M., WIEZIK M., GALLAY I., POLÁK P., VYSOKÝ J., ČILIAK M., MEIGS G.W., SVOBODA M., TROTSIUK V., KEETON W.S. (2019): Primary forest distribution and representation in a Central European landscape: Results of a large-scale field-based census. – *Forest Ecology and Management* 449: 117466. DOI: <https://doi.org/10.1016/j.foreco.2019.117466>

- ÖSTERREICHISCHE MYKOLOGISCHE GESELLSCHAFT (2017): Datenbank der Pilze Österreichs, Bearbeitet von Dämon W., Hausknecht A., Krisai-Greilhuber I. – <http://www.austria.mykodata.net> [accessed 17 Feb 2022]
- PILÁT A. (1940): Hymenomycetes Carpatorum orientalium. – Acta Musei Nationalis Pragae, Ser. B, Historia Naturalis, 2(3): 37–80.
- PILÁT A. (1953): Hymenomycetes novi vel minus cogniti Cechoslovakiae, II. – Acta Musei Nationalis Pragae, Ser. B, Historia Naturalis, 9(2): 1–109.
- SWISSFUNGI (on-line): SwissFungi Verbreitungskarte, *Cyphella digitalis* (Alb. et Schwein.: Fr.) Fr. – [www.wsl.ch/map\\_fungi/search?taxon=2038&start=1991&end=2021&lang=de](http://www.wsl.ch/map_fungi/search?taxon=2038&start=1991&end=2021&lang=de) [accessed 17 Feb 2022]
- SENN-IRLET B., BIERI G., EGLI S. (2007): Rote Liste, Grosspilze, Rote Liste der gefährdeten Arten der Schweiz, Ausgabe 2007. – BAFU and WSL, Bern.
- ŠEROD M. (2015): Cyphella digitalis, jelkova kajfežulja. – <http://www.gobe.si/Gobe/CyphellaDigitalis> [accessed 18 Feb 2022]
- ŠKUBLA P. (2003): Mycoflora slovac. – Pavol Škubla, Šaľa.
- VOROBYOVA E.E. (2021): Derevorazrushayushchie griby rekreatsionnyh zon g. Blagoveshchenska [Wood-destroying mushrooms of recreational areas of Blagoveshchensk]. – <https://naukaip.ru/wp-content/uploads/2021/10/%D0%A3-333.pdf#page=18> [accessed 25 Mar 2022; in Russian]
- WOJEWODA W. (2003): Checklist of Polish larger Basidiomycetes. – W. Szafer Institute of Botany, Kraków.
- WOJEWODA W., ŁAWRYNOWICZ M. (2006): Red list of the macrofungi in Poland. – In: Mirek Z., Zarzycki K., Wojewoda W., Szeląg Z., eds., Red list of plants and fungi in Poland, pp. 53–70, Kraków.