

**Distribution and ecology of *Camarops tubulina*
(Ascomycetes, *Boliniaceae*) in the Czech Republic
and remarks on its European distribution**

JAN HOLEC

National Museum, Mycological Department, Václavské nám. 68, 115 79 Praha 1, Czech Republic
jan.holec@nm.cz

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Camarops tubulina is a remarkable pyrenomycete included in the Red Book and protected by law in the Czech Republic. Until 1995, 8 localities were known. Due to intensive searching in the period 1996 – spring 2005, the species is currently known from 66 localities (94 finds). Its stromata mostly occur on old, fallen, decaying trunks of *Picea* and *Abies*, rarely of *Fagus*, especially in virgin forests or minimally influenced natural forests, but rarely also on old, decaying trunks lying in man-made forests. Most frequent habitats are submontane herb-rich beech forests with admixture of *Abies* and *Picea*, mixed mountainous forests composed of *Fagus*, *Picea* and *Abies*, natural spruce forests of the supramontane belt and bog spruce forests surrounding mountain peat bogs. The species also occurs in lowlands, but at sites with climatic inversion such as stream valleys, small canyons and gorges. An analysis of its habitats showed that the most important conditions necessary for its occurrence are the existence of more or less natural forest stands with presence of fallen, decaying trunks of *Picea*, *Abies* or *Fagus* (or, rarely, presence of such trunks in man-made forests) and a stable, humid and cool microclimate, best ensured by a closed forest stand. From the point of view of nature conservation, *Camarops tubulina* is an important bioindicator of natural forest ecosystems. The Czech Republic represents the richest area of its occurrence in Europe, where the species is currently known from northern and central part. Distribution maps for the Czech Republic and Europe are provided.

Key words: fungi, pyrenomycetes, *Camarops tubulina*, natural forests, virgin forests, bioindicator

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Camarops tubulina je pozoruhodný pyrenomycet, zahrnutý do Červené knihy SR a ČR a zároveň v ČR zákonem chráněný. Do roku 1995 byl v ČR znám z 8 lokalit. Díky intenzivnímu sledování v letech 1996 – jaro 2005 je nyní znám už ze 66 lokalit. Stromata se většinou vyskytují na starých padlých a tlejících kmenech smrků a jedlí, vzácně i buků, zejména v pralesovitých a přirozených lesních porostech, ale vzácně i na starých padlých kmenech ležících v kulturních lesích. Nejčastějšími biotopy jsou podhorské květnaté bučiny s příměsí jedle a smrku, horské smíšené lesy tvořené bukem, smrkem a jedlí, klimaxové horské smrčiny a podmáčené smrčiny lemující horská rašeliniště. Druh se vyskytuje i v nížinách, tam ovšem na místech s inverzním klimatem jako jsou údolí a kaňony potoků a rokle. Analýza stanovištních nároků ukázala, že nejdůležitějšími předpoklady výskytu *Camarops tubulina* jsou existence více či méně přirozených lesů se starými padlými kmeny smrků, jedlí a buků (nebo ve vzácných případech alespoň přítomnost takových kmenů v kulturních lesích) a zároveň stabilní, vlhké a chlad-

nější mikroklíma, které nejlépe zajistí uzavřený lesní porost. *Camarops tubulina* lze pokládat za významného bioindikátora přirozených až pralesovitých porostů. Česká republika nyní představuje nejbohatší arelu jeho výskytu v Evropě, kde se tento druh vyskytuje v její severní a střední části. To vše dokumentují mapy rozšíření v ČR a v Evropě.

INTRODUCTION

Camarops tubulina (Alb. et Schwein.: Fr.) Shear [= *Bolinia tubulina* (Alb. et Schwein.: Fr.) Sacc.] is a remarkable species in the Czech Republic. It is a saprotrophic fungus producing stromata on old, decaying trunks of conifers (*Picea*, *Abies*), less frequently of broadleaved trees. The first finds were published by Svrček (1969), who reported collections made by Z. Pouzar in virgin forests of Southern Bohemia (Boubínský prales, Žofínský prales) in 1967. Another 4 localities were published by Pouzar (1986), all of them natural or seminatural forests protected as nature reserves. These finds led to the inclusion of *Camarops tubulina* into the Red Book of the Slovak and Czech Republics (Kotlaba et al. 1995). In this book 2 more localities were reported and the species was characterised as a typical fungus of natural beech-fir and spruce forests of the submontane (500-800) and montane (800-1100) belt, producing stromata on old, fallen trunks of *Abies*, *Picea* and rarely *Fagus* in later stages of decay. At the same time the species was included into the list of fungi protected by law in the Czech Republic (Antonín and Bieberová 1995) as a critically endangered species. Some recent records were published by Holec (1998, 1999) and Réblová and Prášil (1999) from the Šumava Mts., and by Tomšovský (2000) from the Slezské Beskydy Mts. Beran and Tondl (1997) presented a distribution map for Southern Bohemia and a photograph by Holec.

During field work in natural forests of the Czech Republic the present author recorded *Camarops tubulina* at many new localities and several new regions. The aim of this paper is to evaluate the distribution and ecology of this remarkable species in the light of the newly obtained field data.

MATERIAL AND METHODS

Field work

Camarops tubulina was intensively searched for at all localities in the Czech Republic I visited in the period 1996 – spring 2005, especially in nature reserves and forests with a high amount of dead wood. Of course I was not able to visit all regions of the Czech Republic, but the areas with a richer occurrence of natural to

virgin forests (Šumava Mts., Krkonoše Mts., Brdy hills, Moravskoslezské Beskydy Mts., Javorníky Mts.) were included. Voucher specimens of these finds are kept at the Mycological Department of the National Museum, Prague (herbarium PRM). The data obtained from the field were supplemented by data from the herbaria PRM, CB and BRNM and data kindly provided by some Czech mycologists.

Terminology

Locality: for the purpose of this article, one locality is characterised as a place of occurrence of *Camarops tubulina* having the same type of vegetation, altitude and inclination and situated at a distance of about 0.5-1 km from neighbouring locality. At one locality, several trunks with stromata of *C. tubulina* can be present.

Find: record of *C. tubulina* on one trunk. The finds were documented by herbarium specimens, photographs or (exceptionally – at localities with several finds of *C. tubulina*) by records in a notepad.

Altitudinal distribution: for definitions of categories see Kotlaba (1984: 187).

Habitats: Chytrý et al. (2001). Names of geographic units are taken from the phytogeographical division of the Czech Republic (Skalický 1988).

Abbreviations

CR – Czech Republic, dia – photographed using colour slides (kept in PRM), digifoto – photographed with a digital camera (file kept in PRM), not. – a field record which is only noticed or photographed but not documented by a herbarium specimen, NP – National Park, PLA – Protected Landscape Area.

RESULTS

All findings presented in this chapter are based exclusively on data from the Czech Republic. Both published, herbarium, and personal data were evaluated. Their comparison with data from other European countries is presented in paragraphs „Discussion“.

Camarops tubulina (Alb. et Schwein.: Fr.) Shear

Figs. 4-8

= *Bolinia tubulina* (Alb. et Schwein.: Fr.) Sacc.

Basionym: *Sphaeria tubulina* Alb. et Schwein., Consp. fung. Lusat., p. 6, tab. 4, fig. 4, 1805.

For complete synonymy and taxonomy see Svrček (1969), Nannfeldt (1972), Hilber and Hilber (1980), Pouzar (1986).

Coloured illustrations published in Czech literature: Kotlaba et al. (1995: 33, picture), Beran and Tondl (1997: 21, photograph by J. Holec), Holec (2000: 166, photograph).

DISTRIBUTION

Number of known localities: 66

Number of finds: 94

In the following survey, the records published by Svrček (1969), Pouzar (1986) and Réblová and Prášil (1999) are cited in a shortened way. The codes of geographical units agree with the numbers in distribution map (Fig. 1).

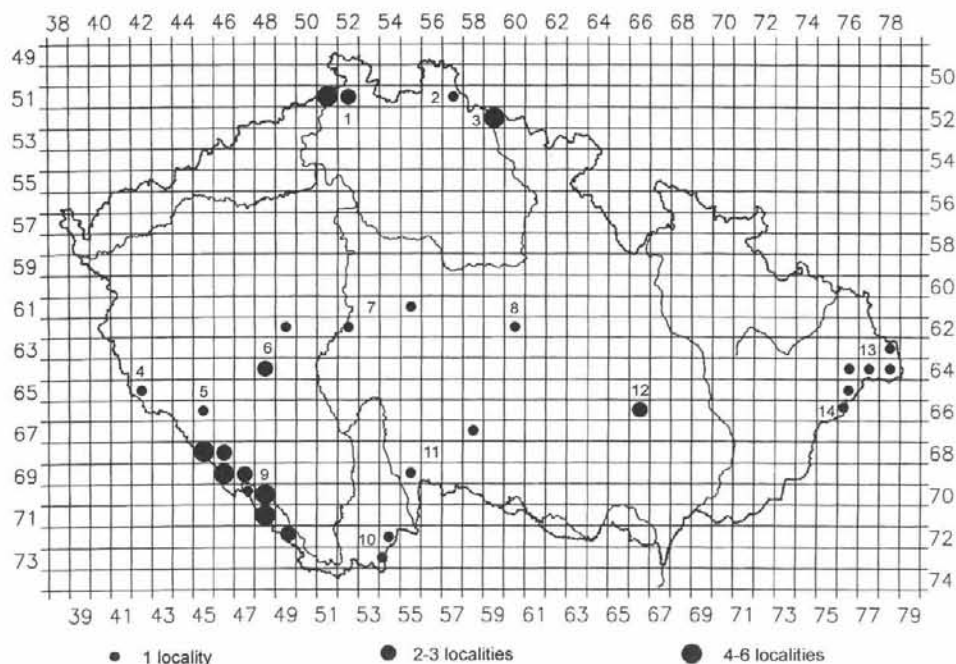


Fig. 1. Distribution of *Camarops tubulina* in the Czech Republic (MTB mapping grid). The numbers indicate geographical units (see Results, chapter Distribution). The find from Český Ráj, locality Prachovské skály by A. Lepšová (pers. comm.) is not included as not all data on it were available.

1. České Švýcarsko (Czech Switzerland) NP in Labské pískovce region

0.6 km SW of Vysoká Lípa (Lípa hotel) near Jetřichovice, Kostelní stezka path: bottom of the gorge, mixed forest on sandstone bedrock: mainly *Picea*, admixture of *Fagus*, *Pinus*, alt. 230 m, *Picea abies*: fallen, decaying trunk covered with mosses (diam. 0.5 m), 21 Sep 2002 leg. J. Holec JH 200/2002 (PRM 902210). – Ditto, *Picea abies*: decaying trunk covered with mosses, 21 Sep 2002 not. J. Holec. – Ditto, *Picea abies*: decaying trunk covered with mosses, 21 Sep 2002 not. J. Holec. – 0.7 km WSW of Vysoká Lípa (Lípa hotel) near Jetřichovice, Kamenice river valley between Kostelní stezka and Šindelový důl, mixed forest on sandstone bedrock: *Picea* + *Fagus*, *Carpinus*, *Fraxinus*, *Corylus*, alt. 190 m, *Picea abies*: fallen, decaying trunk, 21 Sep 2002 leg. J. Holec JH 212/2002 (PRM 902199). – 0.8 km ESE of Vysoká Lípa (Lípa hotel) near Jetřichovice, gorge between Jetřichovická Bělá stream and Intercamp, spruce forest on sandstone bedrock + *Fagus*, *Quercus*, alt. 220 m, *Picea abies*: fallen, decaying trunk, 23 Sep 2002 leg. J. Holec JH 241/2002 (PRM 902217). – 2.2 km WNW of Vysoká Lípa near Jetřichovice, deep gorge between Soorgrund („Kout“) gorge and Kamenice river (upper part), yellow-marked tourist path, *Picea* forest + *Fagus*, alt. 190 m, *Picea abies*: fallen, decaying trunk covered with mosses (diam. 30 cm), 23 Sep 2002 leg. J. Holec JH 243/2002 (PRM 902236). – 1.1 km S of Mezní Louka between Hřensko and Jetřichovice, soutěska Kamenice river canyon between Soorgrund gorge and Divoká soutěska, natural forest on sandstone bedrock (*Fagus*, *Carpinus*, *Acer pseudoplatanus*, *Picea*), alt. 165 m, *Picea abies*: fallen, decaying trunk (diam. 30 cm), 24 Sep 2002 leg. J. Holec JH 252/2002 (PRM 902229). – 0.2 km S of Mezná between Hřensko and Jetřichovice, gorge between Mezní můstek and Mezná, S slope, mixed forest on sandstone bedrock (old *Picea*, *Fagus*), alt. 210 m, *Picea abies*: fallen, decaying trunk (diam. 50 cm), 24 Sep 2002 leg. J. Holec JH 262/2002 (PRM 902222). – 1.9–2.4 km NNE of Klepáč hotel in Hřensko, Suchá Bělá stream valley, steep slope with sandstone rocks, mixed forest (*Fagus*, *Picea*), alt. 320 m, *Picea abies*: decaying trunk, 18 Sep 2003 leg. J. Holec JH 92/2003 (PRM). – ca. 1 km N of Mezní Louka near Hřensko, gorge between Gabrielina stezka path and stream from Ponova louka reserve, man-made spruce forest + *Fagus* on sandstone bedrock, alt. 320 m, *Picea abies*: fallen trunk without bark, 19 Sep 2003 leg. et det. W. Jaklitsch (herb. Jaklitsch?). – 2.1–2.3 km N of the church in Růžová near Hřensko, Kamenice river canyon, gorge between sandstone rocks: valley of a small stream flowing into the Kamenice river S of Mezní můstek, grown by *Acer pseudoplatanus*, *Picea*, *Fagus*, alt. 190 m, *Picea abies*: decaying trunk covered with mosses, 21 Sep 2003 leg. J. Holec JH 142/2003 (PRM).

2. Jizerské hory Mts.

Near Hejnice, Holubník mountain, *Picea abies*, 8 Oct 1970; for details see Pouzar (1986: 218).

3. Krkonoše Mts.

ca. 6 km NW of Špindlerův Mlýn, Labská rokla gorge below the Labská bouda cottage, old climax spruce forest with *Sorbus aucuparia*, alt. 1200 m, *Picea abies*: old, fallen, decaying trunk, 30 May 2002 leg. J. Holec JH 23/2002 (PRM 896415). – Ditto, *Picea abies*: old, fallen, decaying trunk, 30 May 2002 not. J. Holec. – Near Dolní Mísečky in Kotelský potok stream valley, nature reserve V bažinkách, natural mixed forest (*Picea*, *Fagus*), alt. 900 m, *Picea abies*: on fallen, decaying trunk covered with mosses, 29 May 2002 leg. J. Holec JH 19/2002 (PRM 896412). – Ditto, 29 May 2002 leg. J. Holec JH 22/2002 (PRM 896414). – 1.1 km W of Dolní Mísečky, nature reserve V bažinkách, upper part, E slope, natural mixed forest (*Picea*, *Fagus*), alt. 1020 m, *Picea abies*: on decaying trunk covered with mosses, 26 Sep 2001 leg. J. Holec JH 439/2001 (PRM). – 1.4 km NW of Dolní Mísečky, Kotelský potok stream valley below Mt. Kotel, E slope, natural mixed forest (*Fagus*, *Picea*), alt. 1050 m, *Picea abies*: on decaying trunk, 26 Sep 2001 leg. J. Holec JH 430/2001 (PRM). – Ditto, *Picea abies*: on decaying trunk, 26 Sep 2001 leg. J. Holec JH 428/2001 (PRM).

4. Český les Mts.

Near Díly in the Domažlice region, between Škarmanka and Tyrolka, alt. 700 m, *Abies alba*: on fallen trunk, 25 Sep 1989 leg. Z. Pouzar (PRM 871543).

5. Plánický hřeben ridge (Plzeň region)

10 km E of Klatovy, 1.5 km ESE of Habartice near Plánice, nature reserve Jelení vrch, natural forest (*Fagus*, *Picea*, *Abies*), alt. 620 m, *Picea abies*: on fallen, decaying trunk, 19 May 2004 leg. J. Holec JH 42/2004 (PRM 902168). – Ditto, *Picea abies*: on fallen, decorticated trunk, 2 Jul 2004 not. J. Holec.

6. Brdy hills

9 km W of Rožmitál pod Třemšínem, 3 km NE of Chynůn, nature reserve Chynůnské buky, old natural *Fagus* forest, alt. 745 m, *Picea abies*: on fallen trunks, 19 May 2004 leg. J. Holec JH 32/2004 (PRM 902160). – Ditto, *Abies alba*: on fallen, decaying trunk, 19 May 2004 not. J. Holec. – Ditto, *Picea abies*: on decaying trunk, 15 Sep 2004 not. J. Holec. – Near Nové Mitrovce, nature reserve Fajmanovy skály, *Picea abies*: on fallen trunk, 10 Sep 1989 leg. J. Vlasák (PRM 870725). – Near Míšov in Rožmitál pod Třemšínem region, nature reserve Míšovské buky, natural *Fagus* forest, alt. 740 m, *Fagus sylvatica*: on dead standing trunk, 26 Nov 1997 leg. J. Holec (PRM 891608). – Ditto, *Fagus sylvatica*: on dead standing trunk, 13 Nov 1997 leg. Š. Bayerová et D. Stříteská (PRM 891606). – Ditto, *Fagus sylvatica*: on dead standing trunk, 26 Nov 1997 leg. J. Holec (PRM 891609). – Ditto, *Picea abies*: on fallen trunk, 12 Dec 1997 leg. Z. Pouzar (PRM 891604). – Near Pičín, Kuchyňka forest, *Abies alba*, 30 Sep 1980; for details see Pouzar (1986: 218).

7. Střední Povltaví region

7 km NW of Sedlčany, 0.5 km NE of Nalžovské Podhájí, deep valley of a small stream on the left side of Musík stream (right of Vltava river), man-influenced forest (*Picea*, *Pinus*, *Carpinus*) with big *Picea* trees near the stream, alt. 330 m, *Picea abies*: fallen, decaying trunk covered with mosses (diam. 70 cm), 22 Aug 2003 leg. J. Holec JH 34/2003, digifoto (PRM). – Near Stříbrná Skalice, nature reserve Ve Studeném, *Fagus sylvatica*: 17 Oct 1982, *Abies alba*: 13 July 1985; for details see Pouzar (1986: 218).

8. Železné hory hills

Near Bradlo in Chotěboř vicinity, nature reserve Polom, natural forest (*Fagetum*), alt. 575 m, *Abies alba*: on fallen trunk, 17 Oct 1986 leg. Z. Pouzar (PRM 866546).

9. Šumava Mts.

near Železná Ruda, glacier cirque of the Černé jezero lake, *Abies alba*, 27 Aug 1997; for details see Réblová and Prášil (1999), and Holec (1998: 39), finds also in other years (Prášil, pers. comm.). – Near Železná Ruda, glacier cirque of the Čertovo jezero lake, *Picea abies*, 28 Aug 1997; for details see Réblová and Prášil (1999), and Holec (1998: 39), finds also in other years (Prášil, pers. comm.). – 1.7 km S of the church in Železná Ruda, site called Debrník (part of Medvědí jámy zone 1 of Šumava NP), old natural forest (*Fagus*, *Abies*, *Picea*), SW slope, alt. 800 m, *Picea abies*: on decaying fallen trunk, 6 June 2001 not. J. Holec, dia. – Ditto, *Abies alba*: on decaying fallen trunk, 19 June 1997 leg. J. Holec JH 56/1997 (PRM). – Ditto, *Picea abies*: on decaying fallen trunk covered with mosses, 16 Oct 1997 leg. J. Holec et Z. Pouzar JH

826/1997 (PRM 898618). – Ditto, *Picea abies*: on fallen trunk, 16 Oct 1997 leg. J. Holec (PRM 891595). – 2.2 km SSE of the church in Železná Ruda, Grosse Deffernick stream valley, mixed forest (*Fagus*, *Picea*, rarely *Abies*), alt. 780 m, *Abies alba*: on decaying fallen trunk, 6 June 2001 leg. J. Holec JH 46/2001 (PRM). – Ditto, *Abies alba*: on decaying fallen trunk covered with mosses, 16 June 1997 leg. J. Holec JH 19/1997 (PRM). – 3.7 km W of Prášily, near Laka lake, 1 km S of its centre, natural *Picea* forest with mosses and *Calamagrostis villosa*, alt. 1220 m, *Picea abies*: on decaying fallen trunk covered with mosses, 1 Oct 2001 leg. J. Holec JH 555/2001 (PRM). – 2.5–2.8 km W of Prášily, Ždanidla mountain, SW slope, natural mixed forest (*Fagus*, *Picea*, *Acer pseudoplatanus*), alt. 1160 m, *Picea abies*: on decaying fallen trunk covered with mosses, 8 Oct 2000 leg. J. Holec JH 196/2000 (PRM 897864). – 1.5 km SSW of Prášily, Ždanidla mountain, SE slope, valley of a small stream, waterlogged *Picea* forest with *Sphagnum* and *Vaccinium myrtillus*, alt. 950 m, *Picea abies*: on decaying fallen trunk covered with mosses, 16 July 2002 leg. J. Holec JH 56/2002 (PRM 898685). – 1.2 km S of Prášily, Prášilský potok stream valley, man-influenced *Picea* forest, alt. 900 m, *Picea abies*: on decaying fallen trunk covered with mosses, 16 July 2002 leg. J. Holec JH 54/2002 (PRM 898684). – 4.3 km SSE of Prášily, glacier cirque of Prášilské jezero lake, 0.9 km S of its centre, steep ENE slope, natural *Picea* forest, alt. 1200 m, *Picea abies*: on decaying fallen trunk, 2 June 1999 leg. J. Holec JH 13/1999 (PRM 897904). – 4.7 km SSE of Prášily, Stará jímka near Prášilské jezero lake, steep NE slope above the peat bog, waterlogged to climax *Picea* forest, alt. 1120 m, *Picea abies*: on decaying fallen trunk, 10 Oct 2000 leg. J. Holec JH 221/2000 (PRM 897888). – 3.5 km NNE of Srní, protected area Dračí skály, slope S of the rock ridge, WSW slope, seminatural *Abies* forest on stony slope with admixed *Picea* and *Fagus*, alt. 730 m, *Abies alba*: on decaying fallen trunk, 13 May 2004 leg. J. Holec JH 7/2004 (PRM 902095). – Ditto, *Abies alba*: on decaying fallen trunk, 10 Oct 2002 leg. J. Holec JH 460/2002 (PRM 900667). – 0.9 km NE of Srní, protected area Povydí, between Hrádecký potok stream and Čeňkova Pila, NE slope, old, man-made *Picea* forest, alt. 740 m, *Picea abies*: on decaying fallen trunk covered with mosses, 24 Sep 1998 leg. Z. Pouzar JH 724/1998 (PRM 897432). – 0.8 km SE of Srní, Hrádecký potok stream valley (protected area Povydí), SE slope, man-made *Picea* forest with *Betula*, *Pinus*, alt. 820 m, *Picea abies*: on decaying fallen trunk covered with mosses, 25 Sep 1998 leg. J. Holec JH 745 (PRM 897451). – Near Srní, Vydry river valley (protected area Povydí) between Čeňkova Pila and Turnerova chata, S slope, old mixed forest (*Picea abies*, *Abies alba*, *Ulmus glabra*, *Pinus sylvestris*), alt. 780 m, *Picea abies*: on decaying fallen trunk, 28 Oct 2002 leg. J. Holec JH 532/2002 (PRM 900965). – Valy hill near the village of Popelná, NW slope below Obří hrad, alt. 850 m, *Fagus* forest with admixed *Abies*, *Abies alba*: on thick fallen trunk without bark, 30 Apr 2005 leg. M. Tůmová (PRC). – 3.7 km S of Šumavské Hoštice, protected area Čertova stráň, stream valley in NW part, seminatural *Fagus* forest with *Picea* and *Abies*, SE slope, alt. 770 m, *Picea abies*: on decaying fallen trunk, 27 Oct 2003 leg. J. Holec JH 214/2003 (PRM). – 3.4 km NEN of Zatoň, nature reserve Boubínský prales, at S margin of the central part, virgin forest (*Fagus*, *Picea*, *Abies*), alt. 1000 m, *Picea abies*: on decaying fallen trunk covered with mosses, 28 Aug 2003 not. J. Holec, dia. – Ca. 1.8 km WSW of the top of Mt. Boubín, nature reserve Boubínský prales, between Bazumská and Lukenská cesta forest roads, mountain virgin forest (*Fagus*, *Picea*, *Abies*), ENE slope, alt. 1150 m, *Abies alba*: on decaying fallen trunk, 5 Aug 1997 leg. J. Holec JH 169/1997 (PRM 898206). – ca. 3.5–4.5 km NNE of Zatoň, nature reserve Boubínský prales, near Kaplický potok stream, virgin forest (*Fagus*, *Picea*, *Abies*), ENE slope, alt. 1000 m, *Abies alba*: on decaying fallen trunk, 12 July 2001 leg. P. Balda, not. J. Holec, dia. – Near Zatoň, nature reserve Boubínský prales, virgin forest (*Fagus*, *Picea*, *Abies*), alt. 950 m, *Picea abies*: on fallen trunk, 22 Oct 1988 leg. J. Vlasák (PRM 868652). – Ditto, alt. 950 m, *Picea abies*: on fallen trunk, 22 Oct 1988 leg. J. Vlasák (PRM 868652). – 4.7 km WNW of Strážný, protected area Častá, between Častá stream and Žďárská hora mountain, natural spruce forest around a peat bog, alt. 910 m, *Picea abies*: on decaying fallen trunk covered with mosses, 8 June 2001 leg. J. Holec JH 58/2001 (PRM). – 2 km W of Strážný, protected area Lískový vrch, natural mixed forest (*Picea*, *Fagus*, *Abies*, *Acer pseudoplatanus*), alt. 970 m, *Picea abies*: on decaying fallen trunk covered with mosses, 4 Sep 1999 leg. J. Holec JH 158/1999 (PRM 897988). – 1.7 km NNW of Strážný, protected area below Kunžvart castle on slopes of Strážný mountain, E slope, mixed forest (*Picea*, *Fagus*, *Abies*) on steep, stony slope, alt. 960 m, *Picea abies*: on decaying fallen trunk, 28 Aug 2001 leg. J. Holec JH 188/2001 (PRM). – 2 km SSE of Lenora, protected area Radvanovický hřbet, E slope of the

northern top, natural mixed forest (*Fagus, Picea, Abies*), alt. 810 m, *Abies alba*: on decaying fallen trunk, 11 July 2001 leg. J. Holec JH 103/2001 (PRM). – 2.8-3 km NE of České Žleby, protected area Radvanovický hřbet, ENE slope of the southern top, natural forest composed of *Picea* and admixed *Fagus, Abies, Ulmus, Acer pseudoplatanus*, alt. 880 m, *Picea abies*: on fallen trunk, 18 Oct 1997 leg. Z. Pouzar (PRM 891593). – Ditto, alt. 900 m, *Picea abies*: on decaying fallen trunk covered with mosses, 14 July 1998 leg. J. Holec JH 275/1998 (PRM 897041). – 0.5 km SW of České Žleby, Žlebský kopec hill (protected area), E slope, natural ravine forest (*Acer pseudoplatanus, Fagus, Picea, Sorbus, Abies, Fraxinus*), alt. 990 m, *Picea abies*: on decaying fallen trunk, 3 Sep 1999 leg. J. Holec JH 145/1999 (PRM 897973). – 0.6 km SW of České Žleby, Žlebský kopec hill (protected area), E slope, natural mixed forest (*Picea, Fagus, Abies*), alt. 1040 m, *Picea abies*: on decaying fallen trunk, 6 Oct 2004 not. J. Holec, dia. – Ditto, *Picea abies*: on decaying fallen trunk covered with mosses, 13 Sep 1999 leg. J. Holec JH 176/1999, dia (PRM 897996). – 1.3 km E of the centre of České Žleby, Spáleníště hill (protected area), NNE slope, natural mixed forest (*Fagus, Picea, Abies, Ulmus glabra, Acer pseudoplatanus*), alt. 930 m, *Fagus sylvatica*: on decaying fallen trunk covered with mosses, 3 Aug 1998 leg. J. Holec JH 345/1998 (PRM 897097). – Near České Žleby in the vicinity of Volary, Spáleníště hill, old natural forest (*Fagus, Picea, Abies*), alt. 920 m, *Picea abies*: on fallen trunk, 15 Oct 1997 leg. Z. Pouzar (PRM 891597). – 2.6 km SW of Stožec, protected area Spálený luh, at N margin, moist *Picea* forest, alt. 800 m, *Picea abies*: on decaying fallen trunk, 28 Sep 2000 leg. J. Holec JH 154/2000 (PRM 897826). – 2.9 km NNE of Stožec, protected area Medvědice, on slopes of Stožec mountain, NE slope, natural mixed forest (*Fagus, Picea, Abies*), alt. 870 m, *Abies alba*: on decaying fallen trunk, 15 Oct 1996 leg. Z. Pouzar JH 738/1996, dia (PRM). – Near Nová Pec, Plechý mountain (protected area Trojmezna), 1.2 km NEN of the top, ENE slope, natural mixed forest (*Picea, Fagus, Abies*), alt. 1060 m, *Abies alba*: on fallen, decaying trunk, 20 May 2005 leg. J. Holec JH 27/2005 (PRM). – Near Nová Pec, Smrčina mountain (protected area), 1-1.2 km N of the top, N slope, valley of a small stream, climax *Picea* forest, alt. 1230 m, *Picea abies*: on strongly decayed fallen trunk, 4 June 1998 leg. J. Holec JH 42/1998 (PRM 892348).

10. Novohradské hory Mts.

Nature reserve Žofínský prales, virgin forest (*Fagus, Picea, Abies*), *Picea abies*, 18 Oct 1967 leg. Z. Pouzar (PRM 646760). – Ditto, alt. 780 m, *Abies alba*: on fallen trunk, 9 Oct 1968 leg. Z. Pouzar (PRM 661453). – Ditto, alt. 780 m, *Picea abies*: on fallen trunk, 9 Oct 1968 leg. Z. Pouzar et J. Kubička (PRM 661454). – Ditto, spruce stand on waterlogged soil, *Picea abies*: on fallen trunk, 18 Oct 1967 leg. Z. Pouzar (PRM 647008). – Ditto, flat site, alt. 790 m, *Picea abies*: on old, fallen, decaying trunk, 12 June 2004 leg. A. Lepšová (CB). – Ditto, NW slope, alt. 750 m, *Picea abies*: on fallen, decaying trunk, 3 May 2005 leg. M. Beran (CB). – Nature reserve Hojná Voda, between natural mixed forest (*Fagus, Picea, Abies*) and man-made spruce forest, E slope, alt. 840 m, *Picea abies*: on several fallen trunks without bark, 29 May 2004 leg. M. Beran (CB).

11. Českomoravská vrchovina highland

ca. 4 km E of Libořezy near Stráž nad Nežárkou, nature reserve Fabián: old natural *Fagus* forest with many fallen trees, alt. 600 m, *Picea abies*: on fallen, decaying trunk, 18 Oct 2003 leg. J. Holec JH 202/2003 (PRM). – 8 km NWN of Telč, 2 km NWN of the village of Doupě, nature reserve Roštejnská obora, alt. 650 m, on fallen trunk of *Picea abies*, 2 June 2005 leg. P. Vampola (PRM).

12. Moravian Karst

ca. 5.5 km E of Blansko, nature reserve Vývěry Punkvy, Pustý žleb valley, E slope N of Skalní mlýn site, alt. 350 m, beech forest with admixed *Abies* and *Picea*, on fallen, decaying trunk of *Abies alba*,

5 May 2005 leg. D. Dvořák (herb. Dvořák + BRNM). – ditto, above left bank of Punkva stream ca. 100 m below Punkevní jeskyně caves, alt. 370 m, 49.22.12.7 N, 16.43.26.9 E (WGS-84), *Picea* forest on scree slope, on fallen trunk of *Picea abies* covered with mosses, 5 May 2005 leg. D. Dvořák (herb. Dvořák). – ditto, Suchý žleb valley, ca. 0.2 km E of Kateřinská jeskyně cave, at bottom of the valley, alt. 340 m, 49.21.37.8 N 16.42.43.8 E (WGS-84), mixed forest, on fallen, strongly decayed trunk of *Abies alba*, 8 June 2005 leg. D. Dvořák (herb. Dvořák).

13. Moravskoslezské Beskydy Mts.

3 km NE of Nýdek, nature reserve Čantorija, alt. 850 m, *Abies alba*: on fallen trunk, 2 Oct 1999 leg. M. Tomšovský (PRM 893043). – 3.5 km WSW of Dolní Lomná near Jablunkov, nature reserve Mionší, virgin forest (*Fagus, Picea, Abies*), alt. 750 m, *Abies alba*: on decaying trunk, 20 Oct 1998 leg. J. Holec JH 1062/1998 (PRM). – Ca. 8 km ESE of Horní Bečva, nature reserve Salajka, virgin forest (*Fagus, Abies*), alt. 760 m, *Abies alba*: on decaying trunk, 4 Oct 1999 leg. J. Holec JH 379/1999 (PRM). – Ca. 3 km SE of Ostravice near Frýdlant n. Ostravicí, nature reserve Mazácký Grůnik, natural forest (*Fagus, Picea, Abies*), alt. 700 m, *Abies alba*: on decaying trunk, 6 Oct 1999 leg. J. Holec JH 426/1999 (PRM). – Near Morávka in Frýdek region, Mt. Travný, virgin forest, *Abies alba*: on fallen trunk, 17 Sep 1987 leg. Z. Pouzar (PRM 866551).

14. Javorníky Mts.

7 km of centre of Velké Karlovice, nature reserve Razula, virgin forest (*Fagus, Abies*), alt. 750 m, *Abies alba*: on decaying trunk, 12 Sep 2001 leg. F. Jaskula JH 326/2001 (PRM).

Two distribution patterns of *Camarops tubulina* in the Czech Republic can be recognised: 1. relatively frequent occurrence in several geographical areas (which also represent distinct geomorphological and phytogeographical units). 2. isolated records from several other regions of the CR. These two patterns are described below (see also Fig. 1).

1. The areas with richer occurrence of *Camarops tubulina* are (in descending order according to the number of localities): 30: Šumava Mts. (National Park: NP), 9: České Švýcarsko National Park, 5: Moravskoslezské Beskydy Mts. (Protected Landscape Area: PLA), 4: Krkonoše Mts. (National Park), 4: Brdy hills. A common feature of these regions is their relatively high percentage of natural forest ecosystems (mostly protected in nature reserves), which is also clear from the fact that most of the regions are protected as a whole (NP or PLA). The regions mentioned above represent the most important refuges of *C. tubulina* not only in the CR, but in the whole of Central Europe. Most of them are mountainous areas, however, České Švýcarsko and Moravian Karst represent areas with a low altitude, where *C. tubulina* grows in stream canyons and gorges (cold sites typical of climatic inversion).

2. The isolated records are from nature reserves protecting small remnants of natural forests with a high amount of fallen, decaying trunks. The distribution of such habitats in the Czech Republic is irregular. In my opinion, based on rich field experience, such finds are to be expected in almost all „better“ forest re-



Fig. 2. Distribution of *Camarops tubulina* in Europe.

serves of the submontane and montane belt. However, the forest must be continuous (without clearings in the stand or around it) and rich in fallen trunks of conifers in appropriate stage of decay.

According to a personal communication by A. Lepšová, *C. tubulina* also occurs in sandstone gorges of the Český ráj Protected Landscape Area (Český ráj –

Prachovské skály, Fortna, on dry fallen trunk of *Picea abies*) where its occurrence has a similar character as in the České Švýcarsko National Park (see above).

In my opinion, other areas where *C. tubulina* could (and should!) be found are some nature reserves in the Českomoravská vrchovina highland and the Hrubý Jeseník Mts.

Discussion: In Europe, some localities were published by e.g. Nannfeldt (1972) and Hilber and Hilber (1980). At present, *Camarops tubulina* is known from the following European countries (Fig. 2):

Denmark, Sweden: up to the boreal zone and as a rare species (Hansen and Knudsen 2000).

Norway: one find from southeastern Norway collected in 1997, on a trunk of *Picea*, det. A. Granmo, material probably in Tromsø herbarium (personal communication by A. Granmo).

Switzerland: Nannfeldt (1972: 370).

Germany: e.g. Albertini et Schweinitz (1805: p. 6, tab. 4, fig. 4, as *Sphaeria tubulina* – original description, from the vicinity of Niesky near Görlitz, Saxony, Upper Lusatia = Oberlausitz), Hilber and Hilber (1980: Bayerischer Wald, near Zwiesel), Krieglsteiner (1991).

Poland: e.g. collections by Schröter (1908: 465, Lower Silesia, for comments on this find see Svrček 1969: 118), Z. Pouzar (Starożyn Reserve, *Picea abies*, leg. Z. Pouzar. – Hruskie near Augustów, in the forest with *Alnus glutinosa* and *Picea abies*, on dead trunk of *Picea abies*, 9 Sep 1974, leg. Z. Pouzar, PRM 815140), and A. Chlebicki (Białowieża National Park, personal communication).

Slovakia: Svrček (1969), Pouzar (1986), Kotlaba et al. (1995), Škubla (2003).

Austria: W. Jaklitsch, personal communication: rare in Austria, but at least 3 finds by W. Jaklitsch from Niederösterreich, Ybbstaler Alpen, region Scheibbs, near Gaming, Rotwald: Kleiner Urwald, Großer Urwald, years 1997, 1999, herb Jaklitsch.

Ukraine: Pilát (1940): Eastern Carpathians, for interpretation of his localities see Holec (2002); my collection from the same area: NE of Kvasy near Rachiv, Menchul mountain, natural mixed forest composed of *Fagus* and *Abies*, alt. 650 m, *Abies alba*: on decaying trunk, 15 July 1999 leg. J. Holec JH 96/1999 (PRM 892904).

In all these countries the species is considered to be very rare. I agree that it is not a common species, but the relatively constant presence of this species at appropriate localities in the Czech Republic suggests that it should be more frequent, at least in the neighbouring countries. I think that it is overlooked or not recognised as its stromata resemble small black knobs produced on wood surface by *Fomitopsis pinicola*. This opinion is supported by the fact that the mapping in Sweden (Ek et al. 2003) showed a considerable number of localities in southern part of the country. *Camarops tubulina* occurs there in coniferous forests.

Based on currently available data from Europe, *Camarops tubulina* can be considered a species occurring in Central Europe and the southern part of North-

ern Europe. It would be interesting to know if it is present in the Mediterranean or Atlantic region. It is also known from e.g. North America (Miller 1961).

SUBSTRATE SPECTRUM

Tab. 1. Substrate spectrum.

	<i>Picea abies</i>	<i>Abies alba</i>	<i>Fagus sylvatica</i>
finds	65	26	3
%	69	28	3

Picea abies clearly prevails as a substrate. Records from broadleaved trees are rare and restricted to *Fagus*. Almost all records originate from fallen trunks. In one case (Míšovské buký nature reserve), *C. tubulina* was found on a dead, standing stump (about 10 m high fragment of a dead trunk). The fallen trunks are mostly very old and thick ones, having a diameter of about 0.5-1(-1.5) m. Concerning the stage of decay, most records are from moderately to strongly decayed trunks having soft wood and being covered with carpets of mosses. Stromata mostly occur on lateral or undersides of the trunks, however, their occurrence on the upper side was also observed. They are arranged in rows following fissures in wood (which may be caused by pressure of stromata protruding from the wood). In some trunks the rows with stromata are up to 5 m long, however, the stromata occur irregularly and with variously long gaps between them. Stromata were observed both on trunks with bark and on the decorticated ones. The wood decay caused by *C. tubulina* is very intensive. In trunks observed 3-5 years, the wood around and below the stromata changed from relatively hard to very soft and strongly decayed. At the same time the fungus ends its life, the stromata become sterile and decay together with the wood. In such case, the mycelium dislocates its active life to less decayed parts of the same trunk or the fungus spreads via ascospores to surrounding trunks or localities.

Discussion: The same substrate spectrum (*Picea*, *Abies*, *Fagus*) is given from Sweden and Denmark (Hansen et Knudsen 2000).

HABITATS AND ALTTUDINAL DISTRIBUTION

Tab. 2. Altitudinal distribution.

altitude (m a.s.l.)	100- 199	200- 299	300- 399	400- 499	500- 599	600- 699	700- 799	800- 899	900- 999	1000- 1099	1100- 1199	1200- 1299
localities	4	3	7	0	2	3	13	9	10	8	3	4

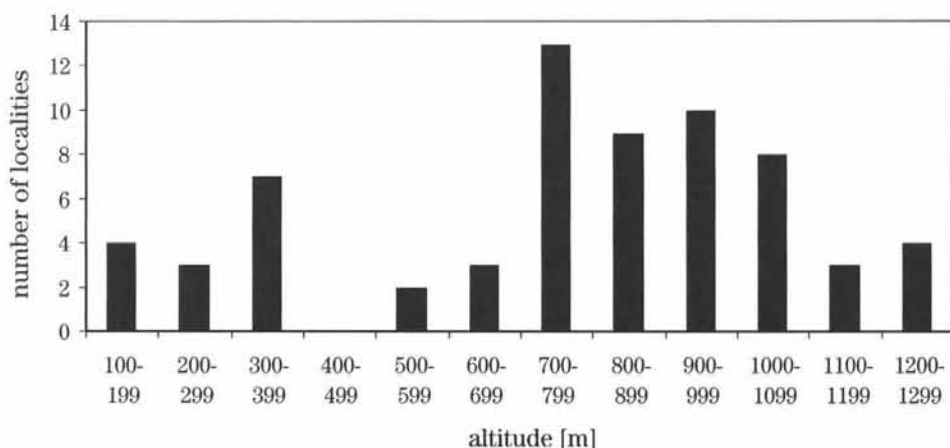


Fig. 3. Altitudinal distribution of *Camarops tubulina* in the Czech Republic.

Lowest find: Kamenice river canyon near Hřensko, alt. 165 m.

Highest find: Smrčina mountain near Nová Pec in the Šumava Mts., alt. 1230 m.

In the Czech Republic, *C. tubulina* is distributed from the lowest parts of the country up to the mountains. Surprisingly, the species has two distribution „centres“ along the altitude gradient (Fig. 3). One of them is represented by records from the planar belt and lower parts of the colline belt (lowlands and hills), ranging from 165 (Kamenice river canyon near Hřensko) to 370 m (in Moravian Karst). All these finds are from deeper stream valleys or gorges where *C. tubulina* occurs on slopes or on the bottom of valleys (České Švýcarsko National Park, Střední Povltaví region, Moravian Karst). A common feature of these habitats is climatic inversion causing cold, humid, and rather stable microclimate. Such habitat conditions enable a more or less natural occurrence of *Picea*, *Abies* or *Fagus* and a continuous decay of fallen trunks.

A second centre in altitudinal distribution is the altitude from 700 to 1230 m a.s.l., which covers upper parts of the submontane belt (up to 800 m a.s.l.), the whole montane belt (800-1100 m a.s.l.) and lower parts of the supramontane belt. *Camarops tubulina* occurs there in herb-rich beech forests with admixture of *Abies* and *Picea* (submontane belt), rarely having a slight ravine character (steep slopes with stones or rocks) and especially in mixed mountainous forests composed of *Fagus*, *Picea* and *Abies*. The species is less frequent in spruce forests of the supramontane belt, but is well documented from several natural *Calamagrostis* or *Athyrium* spruce forests and bog spruce forests surrounding peat bogs.

NATURALNESS OF VEGETATION

Almost all finds of *Camarops tubulina* in the CR are from nature reserves, where the forest vegetation is much more natural than in man-made forest cultures covering most areas of the CR. Three degrees of naturalness can be recognised in these reserves:

1. Virgin forests (in the European sense, as true virgin forest untouched by man are no more present in Europe). Old forests with original tree species composition, heterogeneous age structure of trees, never cut, fallen trunks not removed, almost untouched by man, surrounded by forests with natural tree species composition.

2. Minimally influenced natural forests. Forests with original tree species composition, heterogeneous age structure of trees, influenced by partial cutting in the past or selective cutting at present, most fallen trunks not removed, surrounded by forest cultures with unnatural tree species composition (mostly *Picea* stands).

3. Moderately influenced natural forests. Forests having an original tree species composition but homogeneous age structure. Influenced by cutting and removing of some fallen trunks, surrounded by forest cultures.

Camarops tubulina is most frequently found in virgin forests (examples: Boubínský prales, Žofínský prales), where it regularly occurs on many old, fallen trunks. Such localities are very rare in the CR but represent the most important refuges for *C. tubulina*. Most localities of this species are in minimally influenced natural forests. *C. tubulina* is not frequent at such localities. It usually occurs there on one or two fallen trunks. This is probably caused by the lower amount of dead wood in appropriate stages of decay, smaller pool of spores necessary for successful spreading and smaller continuity of vegetation (interrupted by cutting or other types of forestry management) which is connected with instability of microclimatic conditions.

In about 5 cases (from 94 finds) the species was found on old, thick, fallen trunk of *Picea* (diameter about 0.5 m) lying in man-made forest. At all these localities the fallen trunks clearly represented the last remnants of more natural forests which were present there in the past but were cut and replaced by man-made stands. In addition, such records were always from small stream valleys (both deep and shallow) where the microclimate was more humid and colder than in the vicinity.

This analysis can be concluded with the statement that *Camarops tubulina* is a species clearly preferring natural forests (or their remnants represented by old fallen trunks) with a high amount of dead wood (especially fallen trunks). Therefore, it can be considered a bioindicator of natural or even virgin forest stands.

Discussion: Christensen et al. (2004) consider *Camarops tubulina* an indicator of high habitat quality of European beech forests growing there on „large logs of beech and fir, where the species often occur in abundance, sometimes forcefully protruding through the outermost layers of wood“. The species is included in



Fig. 4. Krkonoše Mts., nature reserve V bažinkách, 29 May 2002. A typical habitat of *Camarops tubulina* – natural mixed mountainous forest (*Picea*, *Fagus*). The fungus was found on the second fallen trunk (*Picea abies*: PRM 896414, for details see collections studied).



Fig. 5. České Švýcarsko National Park, Kamenice river canyon between Soorgrund gorge and Divoká soutěska, 24 Sep 2002. An example of occurrence in the lowlands (alt. 165 m), but in a canyon with an inverse climate (on fallen trunk of *Picea abies* in the foreground, PRM 902229, for details see collections studied).



Fig. 6. Šumava Mts., Grosse Deffernick stream valley, 6 June 2001. A typical substrate of *Camarops tubulina* – a thick fallen trunk of conifer (*Abies alba* in this case) in later stage of decay, covered with mosses (the same trunk on which the specimen JH 19/1997 kept in PRM was collected). All photographs by J. Holec.



Fig. 7. *Camarops tubulina*. Moravskoslezské Beskydy Mts., nature reserve Mionší, 13 Sep 2001. A typical feature of younger stromata is a pale reddish-brown colour of their marginal part (a shot from the same trunk on which the specimen JH 1062/1998 kept in PRM was collected).



Fig. 8. *Camarops tubulina*. For explanations see Fig. 6. A detailed view of fully mature stromata which are characteristic for their „dotted“ surface (from ostiolae of the perithecia) and thin film of water (a manifestation of the mature state of perithecia). All photographs by J. Holec.

red lists of 6 European countries: Sweden (Larsson 1997), Denmark (Stoltze and Pihl 1998), Germany (Benkert 1992), Poland (Wojewoda and Ławrynowicz 2004), Czech Republic (Kotlaba 1995: Red Book) and Slovakia (Lizoň 2001), mostly as an endangered or vulnerable species. This shows that *C. tubulina* represents a remarkable and rare species of European fungi which is of high value for nature conservation.

CONCLUSIONS

Until the last decade of the 20th century, *Camarops tubulina* was considered a rare and critically endangered species (see Introduction) in the Czech Republic. However, the numerous recent finds from the period 1996-2005 (94 finds from 66 localities) show that the species is well established in virgin, natural and near-natural forest stands, in almost all cases protected as nature reserves. The habitats are herb-rich beech forests with admixture of *Abies* and *Picea* (submontane belt), and especially mixed mountainous forests composed of *Fagus*, *Picea* and *Abies*. The species is less frequent in spruce forests of the supramontane belt, but is well documented from several natural *Calamagrostis* or *Athyrium* spruce forests and bog spruce forests surrounding peat bogs. Furthermore, the species also occurs in stream valleys, small canyons and gorges characteristic of climatic inversion causing humid, cold, and rather stable microclimate. Such habitat conditions enable a more or less natural occurrence of *Picea*, *Abies* or *Fagus* and a continuous decay of fallen trunks. In the stream valleys the species was also rarely found on old thick fallen trunk of *Picea* lying in man-made forests.

The conditions necessary for the occurrence of *Camarops tubulina* are:

1. more or less natural forest stands with presence of fallen, decaying trunks of *Picea*, *Abies* or *Fagus* (especially old, thick trunks) or a presence of such trunks in man-made forests (a rare but possible case),
2. stable, humid and cool microclimate of the locality (either in places with climatic inversion such as stream valleys or at localities at higher altitudes – optimally 700-1100 m a.s.l.). The stable microclimate is best ensured by a closed forest stand (no cutting at the locality, no clearings or deforested areas around it).

The relatively frequent occurrence of *C. tubulina* in the Czech Republic (66 localities) and the concentration of finds in some areas (mostly National Parks or Protected Landscape Areas) means, that the Czech Republic represents (at the present state of knowledge) the richest area of its occurrence in Europe. However, I think that the situation in neighbouring countries could be similar and the species must have been overlooked or not recognised there. From the point of view of nature conservation, *Camarops tubulina* is an important bioindicator of natural forest ecosystems.

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