

***Mniaecia jungermanniae* (Helotiales), an overlooked bryophilous ascomycete in the Liberec Region (Czech Republic)**

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Egertová Z., Gaisler J., Zemanová L., Hradílek Z. (2016): *Mniaecia jungermanniae* (Helotiales), an overlooked bryophilous ascomycete in the Liberec Region (Czech Republic). – Czech Mycol. 68(2): 149–165.

Mniaecia jungermanniae, a tiny inoperculate ascomycete growing on leafy liverworts of the order *Jungermanniales*, was recorded at 66 localities in the Liberec Region (Czech Republic) since December 2013 to May 2015. It was noticed on 17 species of liverworts, with *Cephalozia bicuspidata*, *Calypogeia neesiana*, *C. azurea* and *Diplophyllum albicans* being the most frequently inhabited ones. The species was recorded on rocks and boulders as well as on soil on forest tracks and along streams, exceptionally on wood. The geological bedrock was acidic in all cases – sandstone, granite or phyllite. The altitude of the localities ranged between 315 and 1215 m a.s.l. Localities were predominantly located in the shade in coniferous and broad-leaved forests, always with a rich occurrence of liverworts. Hitherto known localities in the Czech Republic are also summarised in the article.

Key words: bryophilous fungi, *Jungermanniales*, leafy liverworts, North Bohemia.

Article history: received 22 July 2016, revised 11 September 2016, accepted 14 September 2016, published online 14 October 2016.

Egertová Z., Gaisler J., Zemanová L., Hradílek Z. (2016): *Mniaecia jungermanniae* (Helotiales), přehlížená bryofilní vřeckovýtrusá houba, v Libereckém kraji (Česká republika). – Czech Mycol. 68(2): 149–165.

Mniaecia jungermanniae, drobná inoperkulární vřeckovýtrusá houba rostoucí na listnatých játrovkách z řádu *Jungermanniales*, byla v období od prosince 2013 do května 2015 nalezena na 66 lokalitách v Libereckém kraji (Česká republika). Byla zaznamenána na 17 druzích játrovek, přičemž nejčastěji osídlenými byly *Cephalozia bicuspidata*, *Calypogeia neesiana*, *C. azurea* a *Diplophyllum albicans*. Rostla na skalách a kamenech i na půdě na lesních cestách či podél potoků, výjimečně na dřevě. Geologický podklad byl ve všech případech kyselý – pískovec, žula nebo fylit. Nadmořská výška lokalit se pohybovala mezi 315 a 1215 m. Lokality se nacházely převážně ve stínu v jehličnatých i listnatých lesích, vždy šlo o místa s bohatým výskytem játrovek. V článku jsou dále shrnuty dosavadní známé nálezy *M. jungermanniae* z České republiky.

INTRODUCTION

Bryophilous ascomycetes are a very diverse group of fungi including approx. 400 species obligatorily growing on mosses or liverworts (Döbbeler & Hertel 2013). Foliose liverworts represent a favourite substrate of these fungi, being much more frequently inhabited than thallose liverworts (e.g. Felix 1988, Döbbeler 2002). At least 50 species have been reported growing on *Jungermanniales* sensu Crandall-Stotler et al. (2008), belonging to classes Pezizomycetes (Döbbeler 1978, 2011), Leotiomycetes (Racovitza 1949, Henderson 1972, Döbbeler 1986a, Hardtke 1994, Raspé & De Sloover 1998, De Sloover 2001, Huhtinen et al. 2010), Lecanoromycetes (Döbbeler & Triebel 1985), Sordariomycetes (Racovitza 1959, Döbbeler 1978) and Dothideomycetes (Watson 1913, Racovitza 1959, Döbbeler 1978, 1979, 1980, 1982, 1986b, Marsh et al. 2010).

In December 2013, an interesting member of Leotiomycetes, *Mniaecia jungermanniae* (Nees ex Fr.) Boud., was found in the surroundings of the Lemberk Castle near Jablonné v Podještědí. The fungus, known from several species of *Jungermanniales*, has tiny blue-green apothecia, which can easily be overlooked. On the other hand, it usually grows in large groups, which makes its discovery easier. Only a few collections of the species had been deposited in Czech herbaria. The oldest one, coming from Prague-Hvězda (deposited in PRM) was found in 1919 and together with two other localities from 1921 (probably not deposited in a public herbarium) published by Kavina (1921) and Klika (1926). Thereafter a long period with no documented collections of *M. jungermanniae* in the Czech Republic followed; further localities were recorded only after 1995, mainly by bryologists. The find from Jablonné v Podještědí gave an impulse to look for it also at other localities in the Liberec Region. A surprisingly high number of localities, which are presented in this paper, has been found.

MATERIAL AND METHODS

Mniaecia jungermanniae was searched for at suitable localities – shady places with *Jungermanniales* – in the Liberec Region (less often also elsewhere in the Czech Republic) from December 2013 to April 2015. Fungi were collected together with liverworts, which were identified by L. Zemanová and Z. Hradílek. Information on other localities was obtained from the PRM and CBFS herbaria and bryologists.

The description of macromorphological characters is based on fresh material. The microscopic structures were observed both in fresh and dried material using Olympus CX 21 and Zeiss Primo Star microscopes. Fragments of fruitbodies were examined in water and Lugol's solution at magnifications of 400× and 1000×.

Fifty values of spore size and at least twenty values of other microcharacters were measured.

For each of the 66 collections the following data are provided: cadastral municipality, locality, substrate, associated liverworts (all species bearing apothecia), GPS coordinates (given in the WGS 84 coordinate system), MTB (Central European grid mapping system, see Niklfeld 1971), altitude, date of collection, herbarium code and collector's name.

Abbreviations used. CBFS – herbarium of the Department of Botany of the Faculty of Science, University of South Bohemia, České Budějovice; HR – herbarium of the Museum of Eastern Bohemia, Hradec Králové; NM – Nature Monument; NNR – National Nature Reserve; NR – Nature Reserve; PRM – herbarium of the Mycological Department of the National Museum, Prague (herbarium abbreviations according to Thiers on-line).

RESULTS

***Mniaecia jungermanniae* (Nees ex Fr.) Boud., Hist. Class. Discom. Eur.: 99 (1907)** Figs. 1–7

- ≡ *Peziza jungermanniae* Nees ex Fr., Syst. Mycol. 2(1): 144 (1822)
- ≡ *Peziza bryophila* Pers., Mycol. Eur. 1: 305 (1822)
- ≡ *Ascobolus jungermanniae* (Nees ex Fr.) Berk. & Broome, Ann. Mag. Nat. Hist., Ser. 3, 15: 18 (no. 1082) (1865)
- ≡ *Pseudopeziza jungermanniae* (Nees ex Fr.) Fuckel, Jb. Nassau. Ver. Naturk. 23–24: 291 (1870)
- ≡ *Calloria jungermanniae* (Nees ex Fr.) Quél., Enchir. Fung.: 324 (1886)
- ≡ *Humaria jungermanniae* (Nees ex Fr.) Sacc., Syll. Fung. 8: 146 (1889)
- ≡ *Mollisia jungermanniae* (Nees ex Fr.) Rehm in Winter, Rabenh. Krypt.-Fl., Edn. 2, 1.3 (Lief. 36): 548 (1891)

Description. Apothecia 0.2–1 (rarely up to 2) mm in diameter, flat with a slightly raised margin, rounded, sessile, smooth, dark blue or blue-green, rarely light blue-green, almost black when dry, growing in large groups on different liverworts of the order *Jungermanniales*. Asci 138–195 × 17.5–22 µm, non-amyloid, cylindrical to clavate, containing 8 uniseriately to biseriately arranged spores. Ascospores (15)17–24 × (9)10–13 µm, Q = 1.6–2.1, variously shaped – ellipsoid to pyriform, often with one plane side, smooth, hyaline, filled with many small droplets (1–3 µm in diameter). Immature spores usually containing 1, sometimes 2 big guttules. Paraphyses 1.5–3 µm broad, often with capitate apex up to 8 µm broad, blue-green, septate, straight or bent, sometimes forked. Excipulum consisting of globose to slightly angular cells 7–16 µm in diameter.



Fig. 1. *Mniaecia jungermanniae* associated with *Cephalozia bicuspadata*, Oldřichov v Hájích, 700 m E of Na Pilách crossroads, Jizerské hory Mts., Czech Republic, 26 Feb. 2014, leg. J. Gaisler (HR 99099). Photo J. Gaisler.



Fig. 2. *Mniaecia jungermanniae* associated with *Calypogeia azurea*, Arnultovice u Nového Boru, 850 m N of Jelení skok vantage point, Czech Republic, 3 March 2014, leg. J. Gaisler (HR 99114). Photo J. Gaisler.



Fig. 3. *Mniaecia jungermanniae* associated with *Diplophyllum albicans*, Krompach, 250 m NE of the top of Kulich hill, Lužické hory Mts., Czech Republic, 28 Feb. 2014, leg. J. Gaisler (HR 99105). Photo J. Gaisler.



Fig. 4. *Mniaecia jungermanniae* associated with *Solenostoma hyalinum*, Harrachov, 560 m NW of Alfrédka signpost, Krkonoše Mts., Czech Republic, 3 May 2015, leg. J. Gaisler (HR 99172). Photo J. Gaisler.

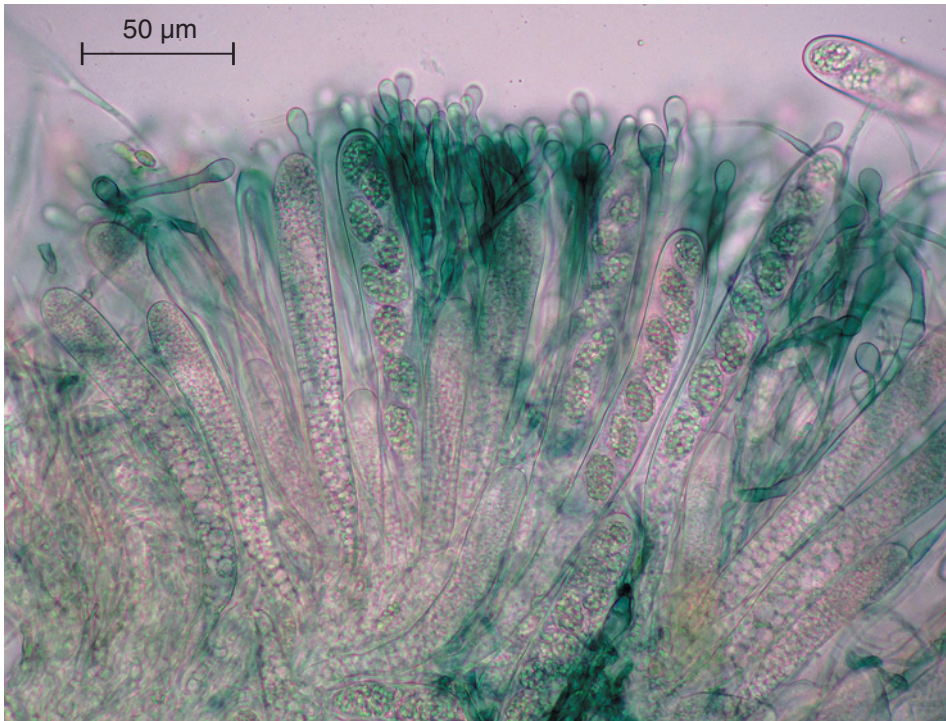


Fig. 5. *Mniaecia jungermanniae* – asci with ascospores and paraphyses. Specimen from Arnultovice u Nového Boru (HR 99114). Scale bar = 50 μm. Photo J. Gaisler.

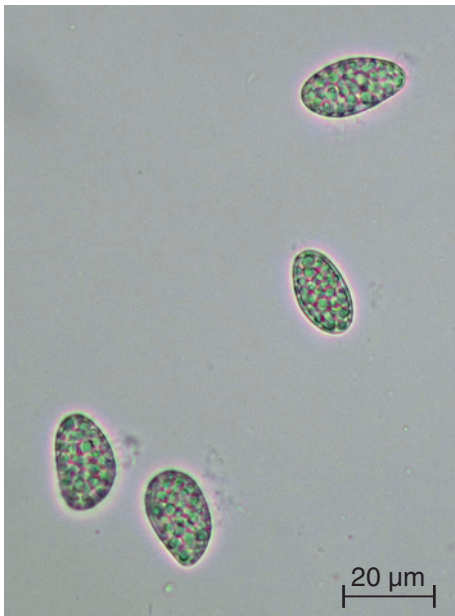


Fig. 6. *Mniaecia jungermanniae* – ascospores. Specimen from Arnultovice u Nového Boru (HR 99114). Scale bar = 20 μm. Photo J. Gaisler.

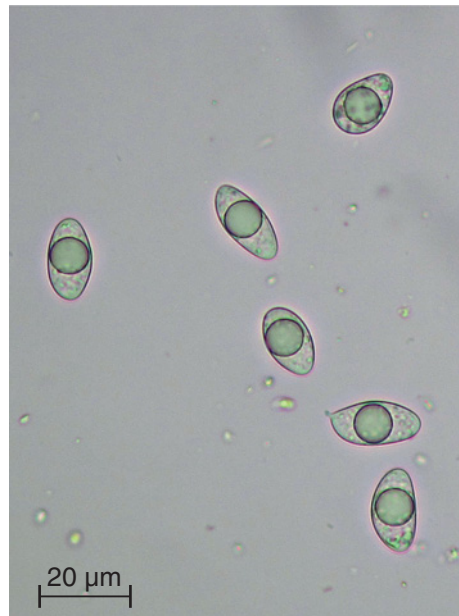


Fig. 7. *Mniaecia jungermanniae* – immature ascospores. Specimen from Bělá u Turnova (HR 99079). Scale bar = 20 μm. Photo J. Gaisler.

Distribution and ecology. *Mniaecia jungermanniae* was found at 66 localities in the Liberec Region, in all its four Districts – Česká Lípa, Jablonec nad Nisou, Liberec and Semily (Tab. 1). They were mostly situated in coniferous forests (with *Pinus* or *Picea*), less often in mixed forests or acidophilous beech forests. Most of the sites were shady and moist, which are important factors for the occurrence of the associated liverworts. The fungus was recorded with its hosts on sandstone rocks and boulders, on forest tracks and along forest streams. The geological bedrock at the localities was sandstone, granite or phyllite.

The fungus was found on the following liverworts (alphabetically ordered, number of records in brackets): *Calypogeia azurea* Stotler & Crotz (11), *C. muelleriana* (Schiffn.) Müll. Frib. (2), *C. neesiana* (C. Massal. & Carestia) Müll. Frib. (19), *Cephalozia bicuspidata* (L.) Dumort. (48), *Diplophyllum albicans* (L.) Dumort. (11), *Lepidozia reptans* (L.) Dumort. (2), *Lophozia guttulata* (Lindb. & Arnell) A. Evans (1), *L. ventricosa* (Dicks.) Dumort. (1), *Marsupella emarginata* (Ehrh.) Dumort. (3), *Mylia taylorii* (Hook.) Gray (1), *Nardia geoscyphus* (De Not.) Lindb. (1), *N. scalaris* Gray (5), *Pseudolophozia sudetica* (Nees ex Huebener) Konstant. & Vilnet (4), *Scapania nemorea* (L.) Grolle (3), *S. undulata* (L.) Dumort. (1), *Solenostoma hyalinum* (Lyell) Mitt. (2) and *S. sphaerocarpum* (Hook.) Steph. (4).

Altitude of the localities ranged between 315 and 1215 m a.s.l. Fungi were collected from 27 December 2013 to 17 May 2015, whereby most finds were made in February, March and April. In some places a very rich occurrence of *M. jungermanniae* (thousands of apothecia) was recorded.

DISCUSSION

Distribution and ecology

Mniaecia jungermanniae has been recorded in several European countries – Iceland (Hallgrímsson & Eyjólfsdóttir 2004), Great Britain (Henderson 1972, Dennis 1981), France (De Sloover 2001), Italy (Tretiach 2004), Norway (Eckblad 1975), Sweden (Eriksson 2014), Belgium (De Sloover 2001), the Netherlands (Strijbosch 1972), Luxembourg (Schultheis & Tholl 2003), Germany (Benkert & Otte 2006), Austria (Maurer et al. 1983), Poland (Czarnota & Hernik 2013), Slovakia (Adam Polhorský pers. comm.) and Hungary (Bánhegyi et al. 1985).

In the Czech Republic the species was collected in 1919 at Prague-Hvězda for the first time (PRM, without number). Kavina (1921) and Klika (1926) reported also finds from Prague-Šárka and from the surroundings of Konárovice (Kolín District). However, the vouchers have probably been lost. Further localities documented in public herbaria have been found after 1995 (M. Šandová pers. comm.,

Vondrák on-line) in the Jizerské hory Mts. (Jizerskohorské bučiny NNR – PRM 908843, Jedlový důl NR – PRM 900781), Labské pískovce sandstone area (Děčín, Arnoltovice, Suchá Kamenice brook valley – CBFS 1021), Brdy hills (Hutě, path to Mt. Hřebenec – PRM 907836), Novohradské podhůří foothills (Kaplice, at the ruins of Sokolčí Castle, in Černá river valley – CBSF 7047, northern slope of Kamenec hill near Pohorská Ves – CBFS 1045), Šumava Mts. (Šumavské Hoštice, Včelná – CBFS 414), and Hostýnské vrchy hills (Košovy, along tributary of the Juhyně stream near cottage named “Zálesák” – PRM 891196). Unfortunately two specimens deposited in PRM are missing a label (PRM 727561 and PRM 727562). The fungi were collected in March, April, May, June, July and October. Beside the collections deposited in public herbaria, finds from the Jeseníky Mts. (Štěpán Koval pers. comm.) and Medník hill near Prague (J. Gaisler unpubl. data) are known. The species seems to be quite common also in the Chříby hills and Hostýnské vrchy hills (Z. Egertová unpubl. data).

Different opinions have been suggested concerning the nutrition of *Mniaecia jungermanniae*. Kavina (1921), who published the first records from the Czech part of Czechoslovakia, considered the fungus a parasite of terrestrial algae. He stated that the fungus was never found infecting liverworts and mosses, which he explained by a high content of tannins in these plants. Today it is generally accepted that the species is linked to leafy liverworts of the order *Jungermanniales*. However, there are different views on the relation between the fungus and the liverwort. *Mniaecia jungermanniae* is judged as a lichenised fungus (Hawksworth et al. 1980) or a biotrophic parasite (Stenroos et al. 2010). Raspé & De Sloover (1998) state that *Mniaecia* has to be viewed as a mycorrhiza-like ascomycete “farming” the liverworts, a biotrophic parasite or a neutral commensalist.

Pressel & Duckett (2006) suspected that *Mniaecia* could be the perfect stage of a symbiotic fungus found in rhizoids of *Cephalozia bicuspidata*. To test this hypothesis, they grew *Mniaecia* axenically and introduced it to axenically grown cultures of the liverwort. Surprisingly, *Mniaecia* remained extracellular, but dramatically influenced the female reproductive organs of the liverwort – a formation of giant perichaetia with a large amount of archeogonia was induced, followed by parthenogenetic and apogamous sporophytes.

Besides the liverworts published in this paper, the following taxa were observed as hosts: *Calypogeia arguta* Nees & Mont. ex Nees, *C. fissa* (L.) Raddi (Benkert & Otte 2006), *Solenostoma gracillimum* (Sm.) R. M. Schust. (as *Jungermannia gracillima* Sm.; Benkert & Otte 2006, Pressel & Duckett 2006), *Diplophyllum obtusifolium* (Hook.) Dumort. and *Scapania scandica* (Arnell & H. Buch) Macvicar (Benkert & Otte 2006, Pressel & Duckett 2006). The species prefers colder periods of the year – most of the observations were made from March to May (e.g. Hardtke 1994, De Sloover 2001, Czarnota & Hernik 2013).

Tab. 1. Localities of *Mniaecia jungermanniae* in the Liberec Region. Collectors' names are abbreviated as follows: J.G. – Jan Gaisler, M.S. – Michal Sochor, Z.E. – Zuzana Egertová.

Cadastral municipality	Locality	Substrate	Associated liverworts	Coordinates, MTB	Alt. (m)	Date	Herbarium code	Coll.
Albrechtice v Jizerských horách (Jablonec nad Nisou District)	50 m NNE of Pod Čihadlem signpost	soil in margin of path	<i>Nardia scalaris</i>	50°49'08"N, 15°14'09"E 5157c	880	11 April 2014	HR 99147	J.G.
	1350 m NNW of Jedlová waterfall	boulder in stream, soil near stream	<i>Solenostoma sphaerocarpum</i> , <i>Cephalozia bicuspidata</i>	50°48'32"N, 15°14'24"E 5157c	845	11 April 2014	HR 99145, HR 99146	J.G.
	15 m S of Jedlová waterfall	boulder on path, stump	<i>Cephalozia bicuspidata</i> , <i>Marsipella emarginata</i>	50°47'50"N, 15°14'43"E 5257a	780	11 April 2014	HR 99143, HR 99144	J.G.
	840 m SSW of Jedlová waterfall	soil of forest track, granite boulder	<i>Cephalozia bicuspidata</i> , <i>Calypogeia neesiana</i> , <i>Diplophyllum albicans</i>	50°47'24"N, 15°14'31"E 5257a	680	23 Feb. 2014, 11 April 2014	HR 99086, HR 99087, HR 99088, HR 99089	J.G.
Arnultovice u Nového Boru (Česká Lípa District)	1000 m SSW of Jedlová waterfall	granite boulder	<i>Pseudoplophozia svatetica</i> , <i>Diplophyllum albicans</i>	50°47'19"N, 15°14'32"E 5257a	655	18 April 2015	HR 99169	J.G.
	150 m W of Protržená přehrada dam	soil in margin of path	<i>Cephalozia bicuspidata</i>	50°48'00"N, 15°16'27"E 5257b	830	10 May 2014	HR 99164	J.G.
Bělá u Turnova (Semily District)	850 m N of Jelení skok vantage point	soil of forest track	<i>Calypogeia azurea</i>	50°46'21"N, 14°33'57"E 5253a	385	3 March 2014	HR 99114	J.G.
	50 m SW of Rotštejn Castle	soil of forest track	<i>Cephalozia bicuspidata</i>	50°35'38"N, 15°13'24"E 5457a	425	16 Feb. 2014	HR 99079	J.G.
Bílý Potok pod Smrkem (Liberec District)	220 m NW of Wenzlerich Memorial	soil of forest track	<i>Calypogeia neesiana</i> , <i>Cephalozia bicuspidata</i> , <i>Diplophyllum albicans</i>	50°52'00"N, 15°14'54"E 5157a	550	26 Feb. 2014	HR 99101, HR 99102	J.G.
	220 m N of the top of Vysoká hill	soil of forest track	<i>Cephalozia bicuspidata</i>	50°48'24"N, 14°51'44"E 5155c	470	28 Feb. 2014	HR 99103	J.G.
Držkov (Jablonec nad Nisou District)	250 m E of Plichov	soil of forest track	<i>Cephalozia bicuspidata</i> , <i>Nardia scalaris</i>	50°41'25"N, 15°17'23"E 5357b	510	2 March 2014	HR 99112	J.G.
	Betlém – 530 m S of Na Pláči signpost	soil of forest track, boulder in stream	<i>Calypogeia azurea</i> , <i>Diplophyllum albicans</i>	50°50'17"N, 15°05'38"E 5156d	450	14 March 2014	HR 99120, HR 99121	J.G.

Cadastral municipality	Locality	Substrate	Associated liverworts	Coordinates, MTB	Alt. (m)	Date	Herbarium code	Coll.
Frydštejn nad Nisou (District)	100 m W of Frydštejn Castle	sandstone rock	<i>Calypogeia neesiana</i> , <i>Calypogeia muelleriana</i>	50°38'56"N, 15°10'03"E 5357c	460	19 Jan. 2014, 4 April 2014	HR 99075, HR 99076	J.G.
Harrachov (Semily District)	470 m NE of Kamenice waterfall	boulder in stream, stream side	<i>Cephalozia bicuspidata</i> , <i>Solenostoma sphaerocarpum</i>	50°47'49"N, 15°27'05"E 5258b	1040	3 April 2014	HR 99135, HR 99136	J.G.
	560 m NW of Alfrédka signpost	soil of forest track, boulder in stream, soil in forest	<i>Calypogeia azurea</i> , <i>Cephalozia bicuspidata</i> , <i>Lophozia ventricosa</i> , <i>Solenostoma sphaerocarpum</i> , <i>Solenostoma hyalinum</i> , <i>Scapania undulata</i>	50°48'28"N, 15°26'28"E 5158d	990	3 April 2014, 3 May 2015	HR 99130, HR 99131, HR 99132, HR 99133, HR 99172, HR 99173	J.G.
	750 m NW of Alfrédka signpost	soil in wet ditch	<i>Solenostoma sphaerocarpum</i> , <i>Diplophyllum albicans</i> , <i>Cephalozia bicuspidata</i>	50°48'27"N, 15°26'14"E 5158d	965	3 May 2015	HR 99171	J.G.
	780 m NW of Alfrédka signpost	soil of forest track	<i>Nardia scalaris</i>	50°48'27"N, 15°26'12"E 5158d	960	3 May 2015	HR 99170	J.G.
	450 m SE of Alfrédka signpost	wood in stream	<i>Cephalozia bicuspidata</i>	50°48'03"N, 15°27'01"E 5158d	1065	3 April 2014	HR 99134	J.G.
	600 m ENE of CZ-PL customs office	soil in wet ditch	<i>Calypogeia azurea</i> , <i>Cephalozia bicuspidata</i> , <i>Pseudolophozia sudetica</i>	50°48'26"N, 15°25'52"E 5158d	905	17 May 2015	HR 99174, HR 99175	J.G.
	top of Mt. Žlabský vrch	soil of forest track	<i>Calypogeia azurea</i> , <i>Cephalozia bicuspidata</i>	50°47'51"N, 15°28'12"E 5258b	1215	17 May 2015	HR 99176, HR 99177	J.G.
	740 m E of Lesní Zátíší boarding house	soil of stream bank	<i>Calypogeia neesiana</i> , <i>Cephalozia bicuspidata</i>	50°45'12"N, 15°27'42"E 5258b	810	25 May 2014	HR 99165, HR 99166	J.G.
Hermanice v Podještědí (Liberec District)	near U Rozmoklé žaby NM	sandstone rock	<i>Cephalozia bicuspidata</i>	50°48'09"N, 14°42'05"E 5154c	400	23 Feb. 2014	HR 99085 M.S.	Z.E., M.S.
	770 m SW of the top of Kančí vrch hill	soil of stream side	<i>Calypogeia neesiana</i>	50°48'25"N, 14°43'13"E 5154c	390	28 Feb. 2014	HR 99104	J.G.
Hodkovice nad Mohelkou (Liberec District)	100 m S of shooting range	sandstone rock, soil of path	<i>Cephalozia bicuspidata</i>	50°40'21"N, 15°05'38"E 5356b	370	15 Feb. 2014, 11 March 2014	HR 99077, HR 99078	J.G.

Cadastral municipality	Locality	Substrate	Associated liverworts	Coordinates, MTB	Alt. (m)	Date	Herbarium code	Coll.
Horní Maxov (Jablonec nad Nisou District)	120 m NW of Slovanka observation tower	soil in margin of path	<i>Cephalozia bicuspидata</i>	50°46'26"N, 15°11'42"E 5257a	805	20 April 2014	HR 99156	J.G.
Horní Rokytnice nad Jizerou (Semily District)	450 m ENE of Ručičky signpost 880 m SE of Krakonošova smídaně signpost	soil of forest track soil of stream side	<i>Cephalozia bicuspидata</i> <i>Cephalozia bicuspидata</i>	50°45'04"N, 15°29'29"E 5258b 50°45'39"N, 15°30'58"E 5259a	1050 1140	25 May 2014 25 May 2014	HR 99167 HR 99168	J.G. J.G.
Horní Světlá pod Luží (Česká Lípa District)	40 m W of U Jána signpost	soil in forest	<i>Calypogeia neesiana</i> , <i>Cephalozia bicuspидata</i>	50°49'49"N, 14°37'24"E 5153d	525	28 Feb. 2014	HR 99106	J.G.
Hraničná nad Nisou (Jablonec nad Nisou District)	280 m SW of Hasler Cottage	boulder in stream	<i>Cephalozia bicuspидata</i> , <i>Diplophyllum albicans</i> , <i>Marsipella emarginata</i>	50°46'26"N, 15°09'04"E 5256b	680	8 March 2014	HR 99115	J.G.
Hrubá Skála (Semily District)	130 m NW of St. Joseph Church	sandstone boulder	<i>Mylia taylorii</i> , <i>Scapania nemorea</i>	50°32'44"N, 15°11'31"E 5457c	345	1 March 2014	HR 99109, HR 99110	J.G.
Janov nad Nisou (Jablonec nad Nisou District)	300 m NE of chapel in Hrabětice 900 m E of Královka observation tower	soil of forest track, wood soil of forest track	<i>Cephalozia bicuspидata</i> <i>Calypogeia azurea</i>	50°47'01"N, 15°11'35"E 5257a 50°47'27"N, 15°10'13"E 5257a	740 825	9 March 2014 9 March 2014	HR 99116, HR 99117 HR 99118	J.G. J.G.
Jizerka (Jablonec nad Nisou District)	300 m NNE of Pešáková Cottage	soil of forest track	<i>Calypogeia azurea</i> , <i>Calypogeia neesiana</i> , <i>Cephalozia bicuspидata</i> , <i>Nardia geoscyphus</i> , <i>Pseudolophozia sudetica</i>	50°49'39"N, 15°20'18"E 5158c	870	26 April 2014	HR 99157, HR 99158, HR 99159, HR 99160, HR 99161	J.G.
Josefiv Důl u Jablonce nad Nisou (Jablonec nad Nisou District)	260 m NE of Kamená komora rocks	granite boulder in clearing, granite boulder in stream	<i>Pseudolophozia sudetica</i> , <i>Solenostoma hyalinum</i>	50°47'12"N, 15°14'04"E 5257a	720	11 April 2014, 26 April 2015	HR 99148, HR 99149, HR 99150	J.G.

Cadastral municipality	Locality	Substrate	Associated liverworts	Coordinates, MTB	Alt. (m)	Date	Herbarium code	Coll.
Kacanov (Semily District)	360 m ENE of cemetery	sandstone boulder	<i>Cephalozia bicuspidata</i>	50°33'16"N, 15°09'05"E 5456b	335	1 March 2014	HR 99108	J.G.
Kotel (Liberec District)	300 m WNW of the village	sandstone rock	<i>Cephalozia bicuspidata</i> , <i>Lepidozia reptans</i> , <i>Calyptogeia</i> sp.	50°41'16"N, 14°56'25"E 5355b	415	18 Feb. 2014, 2 March 2014	HR 99080, HR 99081	J.G.
Krompach (Česká Lípa District)	250 m NE of the top of Kulich hill	sandstone rock	<i>Diplazium albicans</i>	50°49'35"N, 14°41'22"E 5154c	475	28 Feb. 2014	HR 99105	J.G.
Kryštofovo Údolí (Liberec District)	850 m NW of Kostelní vrch hill	soil of stream side, stump	<i>Calyptogeia azurea</i> , <i>Cephalozia bicuspidata</i>	50°46'33"N, 14°55'07"E 5255b	460	27 March 2014	HR 99124, HR 99125	J.G.
Liberec (Liberec District)	at Starý Hřcov reservoir	soil of forest track	<i>Cephalozia bicuspidata</i>	50°46'08"N, 15°04'24"E 5256a	390	22 Feb. 2014	HR 99083	J.G.
Lvová (Liberec District)	400 m WSW of Lemberk Castle	sandstone rock	<i>Cephalozia bicuspidata</i> , <i>Lepidozia reptans</i> , <i>Calyptogeia neesiana</i>	50°46'35"N, 14°46'57"E 5254b	315	27 Dec. 2013, 28 Dec. 2013	HR 99069, HR 99070	Z.E., M.S.
	250 m SW of Lemberk Castle	sandstone rock	<i>Cephalozia bicuspidata</i> , <i>Calyptogeia neesiana</i>	50°46'35"N, 14°47'05"E 5254b	350	12 Feb. 2014	HR 99071	Z.E.
	220 m WSW of Lemberk Castle, near a weir	sandstone rock	<i>Calyptogeia neesiana</i>	50°46'36"N, 14°47'06"E 5254b	330	23 Feb. 2014	HR 99072	Z.E., M.S.
	Zdislava well	sandstone rock	<i>Cephalozia bicuspidata</i>	50°46'28"N, 14°46'52"E 5254b	315	24 Feb. 2014	HR 99073	Z.E., M.S.
	near forest graveyard	on forest track	<i>Cephalozia bicuspidata</i>	50°46'33"N, 14°47'35"E 5254b	340	29 March 2014	HR 99142	Z.E., M.S.
	130 m NNW of Lemberk castle	sandstone rock	<i>Cephalozia bicuspidata</i>	50°46'43"N, 14°47'14"E 5254b	320	24 Feb. 2014	HR 99074	Z.E., M.S.
Machnín (Liberec District)	800 m SE of Karlov pod Ještědem railway station	soil of forest track	<i>Calyptogeia neesiana</i> , <i>Cephalozia bicuspidata</i>	50°46'13"N, 14°59'38"E 5255b	420	25 Feb. 2014	HR 99096	J.G.

Cadastral municipality	Locality	Substrate	Associated liverworts	Coordinates, MTB	Alt. (m)	Date	Herbarium code	Coll.
Mašov u Turnova (Semily District)	310 m NW of St. Jan Nepomucký Church (Valdštejn)	soil of forest track	<i>Cephalozia bicuspidata</i>	50°33'53"N, 15°09'54"E 5456b	340	1 March 2014	HR 99111	J.G.
Mšeno nad Nisou (Jablonec nad Nisou District)	behind the 3rd dam, 250 m E of community garden	soil of forest track	<i>Calypogeia azurea</i>	50°44'55"N, 15°10'24"E 5257c	540	25 Feb. 2014	HR 99095	J.G.
	70 m NNE of trout hatchery	soil in forest, soil of forest track	<i>Lophozia guttulata</i> , <i>Calypogeia neesiana</i> , <i>Cephalozia bicuspidata</i>	50°44'38"N, 15°10'31"E 5257c	530	12 April 2014	HR 99151, HR 99152, HR 99153	J.G.
	730 m NE of trout hatchery	soil of forest track	<i>Calypogeia neesiana</i> , <i>Cephalozia bicuspidata</i>	50°44'53"N, 15°10'56"E 5257c	540	12 April 2014	HR 99154, HR 99155	J.G.
Noviny pod Ralskem (Česká Lípa District)	Ralsko NR	sandstone rock	<i>Cephalozia bicuspidata</i>	50°40'25"N, 14°46'06"E 5354b	590	22 Feb. 2014	HR 99084	Z.E., M.S.
Oldřichovv Hájích (Liberec District)	700 m E of Na Pliách crossroads	soil of forest track	<i>Calypogeia neesiana</i> , <i>Cephalozia bicuspidata</i> , <i>Diplophyllum albicans</i>	50°50'30"N, 15°06'12"E 5156d	475	26 Feb. 2014	HR 99097, HR 99098, HR 99099, HR 99100	J.G.
	540 m SW of Šolc pond	soil of stream side	<i>Calypogeia neesiana</i> , <i>Scapania nemorea</i> , <i>Cephalozia bicuspidata</i> , <i>Diplophyllum albicans</i>	50°52'21"N, 15°06'27"E 5156b	425	1 April 2014	HR 99126, HR 99127, HR 99128, HR 99129	J.G.
Rádlo (Jablonec nad Nisou District)	200 m NW of Srtní díl sport area	boulder in stream	<i>Diplophyllum albicans</i> , <i>Marsipella emarginata</i> , <i>Cephalozia bicuspidata</i>	50°43'01"N, 15°08'56"E 5256d	455	6 April 2014	HR 99141	J.G.
	250 m N of bicycle flyover over Road No. 65	soil of forest track	<i>Nardia scalaris</i> , <i>Calypogeia neesiana</i> , <i>Cephalozia bicuspidata</i>	50°42'43"N, 15°08'40"E 5256d	555	6 April 2014	HR 99138, HR 99139, HR 99140	J.G.
Raspnava (Liberec District)	1000 m NE of Oldřichovské sedlo	soil in forest	<i>Nardia scalaris</i>	50°52'12"N, 15°06'59"E 5156b	415	27 April 2014	HR 99162	J.G.
	100 m WNW of Emauzský obrázek	soil of forest track	<i>Calypogeia neesiana</i>	50°52'10"N, 15°07'37"E 5156b	440	27 April 2014	HR 99163	J.G.

Cadastral municipality	Locality	Substrate	Associated liverworts	Coordinates, MTB	Alt. (m)	Date	Herbarium code	Coll.
Rychnov u Jablonce nad Nisou (Jablonce nad Nisou District)	460 m SW of railway station	soil of forest track	<i>Diplazium albicans</i> , <i>Cephalozia bicuspидata</i>	50°40'51"N, 15°08'21"E 5356b	455	23 Feb. 2014, 16 March 2014	HR 99090, HR 99091	J.G.
	300 m W of the village of Dolní Dobrá Voda	soil of forest track	<i>Calypogeia azurea</i> , <i>Calypogeia neesiana</i> , <i>Cephalozia bicuspидata</i>	50°41'58"N, 15°08'46"E 5356b	500	24 Feb. 2014	HR 99092, HR 99093, HR 99094	J.G.
Smržovka (Jablonce nad Nisou District)	550 m ENE of Černá Studnice observation tower	soil of forest track	<i>Cephalozia bicuspидata</i>	50°42'49"N, 15°14'25"E 5257c	830	15 March 2014	HR 99122	J.G.
Svor (Česká Lípa District)	300 m SW of Nová Huť v Lužických horách railway station	sandstone boulder	<i>Cephalozia bicuspидata</i>	50°49'45"N, 14°34'56"E 5153c	530	28 Feb. 2014	HR 99107	J.G.
Vitkovice v Krkonoších (Semily District)	450 m SE of the settlement of Rezek	soil of forest track	<i>Calypogeia azurea</i>	50°42'12"N, 15°31'11"E 5259c	850	22 March 2014	HR 99123	J.G.
Vičetín u Bílé (Liberec District)	15 m SW of sandpit between Vičetín and Bohdánkov	soil of forest track	<i>Cephalozia bicuspидata</i> , <i>Scapania nemorea</i>	50°41'04"N, 15°01'59"E 5356a	390	13 March 2014	HR 99119	J.G.
Vrkoslavice (Jablonce nad Nisou District)	1000 m N of the village of Dolní Černá Studnice	soil of forest track	<i>Calypogeia neesiana</i>	50°42'44"N, 15°11'48"E 5257c	575	20 Feb. 2014	HR 99082	J.G.
Záhoří u Semil (Semily District)	480 m SW of church in Proseč	soil in forest	<i>Calypogeia muelleriana</i>	50°37'27"N, 15°17'11"E 5357d	410	6 April 2014	HR 99137	J.G.
Zlatá Olešnice (Jablonce nad Nisou District)	920 m W of Sklenářice-Mexiko signpost	soil of forest track	<i>Cephalozia bicuspидata</i>	50°42'13"N, 15°22'23"E 5258c	530	2 March 2014	HR 99113	J.G.

Taxonomical notes

Currently there are two more species, *Mniaecia nivea* (P. Crouan & H. Crouan) Boud. and *M. gloeocapsae* (Boud.) Van Vooren, treated in the genus.

Mniaecia nivea has sometimes been considered to be not more than an albinotic form of *M. jungermanniae* (Benkert & Otte 2006). However, De Sloover (2001) supported separation of the two species due to the following differences. Beside the whitish colour of its apothecia, *M. nivea* differs in having a medullary excipulum consisting of a textura intricata (versus a textura globulosa or globulosa-angularis in *M. jungermanniae*), shorter asci, a different length-width ratio of the spores (average 2.15 in *M. nivea*, while approx. 1.85 in *M. jungermanniae*) and filiform paraphyses without a broadened apex. It is known to grow in association with *Calypogeia arguta*, *C. muelleriana* (De Sloover 2001), *Diplophyllum albicans* and *Blepharostoma trichophyllum* (L.) Dumort. (Henderson 1972). Stenroos et al. (2010) found a significant difference between *M. jungermanniae* and *M. nivea* in a large molecular study on bryophilous fungi. However, only one specimen of each species was used.

Mniaecia gloeocapsae (syn. *Epiglia gloeocapsae* Boud.), growing on liverworts of the genus *Jungermannia*, has whitish, sometimes lilac tinged apothecia, which are 0.25–0.5 mm broad, smooth, subhyaline. Spores measure 12–16 × 5–6 µm, are obtuse-fusiform and filled with droplets. Paraphyses are thin, curved and forked (Boudier 1885). Its inclusion in the genus (Ayel & Van Vooren 2005) was questioned by Stenroos et al. (2010).

Grelet (1979) distinguished the form *major* (with apothecia 1–2 mm broad) and f. *minor* (0.1–0.3 mm) in *Mniaecia jungermanniae*. Raspé & De Sloover (1998) suggest two taxa are possibly included under the name *M. jungermanniae* – one with larger apothecia, longer asci, elliptic spores and capitate paraphyses, the other one with smaller apothecia, shorter asci, more rounded spores and clavate paraphyses.

ACKNOWLEDGEMENTS

We thank Markéta Šandová (National Museum, Prague) and Jan Vondrák (University of South Bohemia, České Budějovice) for information on collections of *Mniaecia jungermanniae* deposited in PRM and CBFS, Štěpán Koval (Czech Republic) and Adam Polhorský (Slovakia) for information on their finds of *M. jungermanniae* in Moravia and Slovakia, Chris Yeates for linguistically reviewing the paper, Michel Hairaud (France) and Tereza Tejklová (Museum of Eastern Bohemia, Hradec Králové) for providing literature, and Michal Sochor for assistance in the field. Jan Gaisler's work was financially supported by the

Ministry of Agriculture of the Czech Republic (project RO0415). Zbyněk Hradílek and Zuzana Egertová were supported by an internal grant from Palacký University (PrF 2016/001).

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