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Boletus moravicus – ecological conditions of new localities in Slovakia

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Ecological conditions of four new localities where *Boletus moravicus* occurs are described. Oaks prevail in the studied forest communities. Our measurements of soil pH values showed that the localities, all on volcanic bedrock, have very acidic to mildly acidic soils. We can confirm the published fructification from July to October. Finds in Slovakia were recorded from altitudes of 210 m to 518 m a.s.l. mainly from *Carpinion betuli* forest communities.

Key words: red-listed species, ecology, pH values.

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Opisujeme ekologické podmienky štyroch nových lokalít s výskytom *Boletus moravicus*. V hodnotených lesných spoločenstvách dominujú duby. Merania hodnôt pH pôdy ukazujú, že naše lokality, všetky na sopečných horninách, sa nachádzajú na veľmi kyslých až mierne kyslých pôdach. Môžeme potvrdiť publikovaný výskyt plodníc od júla do októbra. Nálezy na Slovensku sme zaznamenali od 210 m do 518 m n.m. hlavne v lesných spoločenstvách *Carpinion betuli*.

INTRODUCTION

Boletus moravicus Vacek (Vacek 1946, Vacek 1950) is a generally very rare species only known from Europe. It is remarkable for its specific odour. It occurs from the meridional region to the southern part of the temperate zone (Anonymus 1 1998–2010), especially in the area of central European flora (Kotlaba et al. 1995). In Slovakia it is red-listed (as *Xerocomus moravicus*) (Lizoň 2001), included in the national Red Book (Kotlaba et al. 1995) and legally protected (Anonymus 2 2003). In Europe, where it occurs, it is often protected, e.g. in the Czech Republic (Antonín & Bieberová 1995), or red-listed, e.g. in Denmark (Wind & Pihl 2004), Czech Republic (Holec & Beran 2006), Bulgaria (Gyosheva et al. 2006), Switzerland (Senn-Irlet et al. 2007), Croatia (Tkalčec et al. 2007), and Austria (Dämon et

al. 2009). *B. moravicus* is included in the candidate species list for the European red-list (Anonymus 1 1998–2010).

Kotlaba et al. (1995) presents two localities in Slovakia – Kuchyňa, Malé Karpaty Mts. and Kozárovce, Štiavnické vrchy Mts. Beran & Tondl (1997) mention 14 localities of *B. moravicus* in the Czech Republic. Currently 13 localities are known to V. Janda (pers. comm.) in the Czech Republic. Šutara & Janda (2006) mention very often embankments of ponds as localities of *B. moravicus* in the Czech Republic.

The aim of this paper is to describe new localities of *B. moravicus* with notes on their ecology and to compare our finds with some data on the incidence in Slovakia and in the Czech Republic.

MATERIAL AND METHODS

M e t h o d s. Phytogeographical units follow the classification by Futák (1984). General geological conditions were taken from available geological maps issued by the State Geological Institute of Dionyz Stur (on-line) and visually confirmed at the site.

Soil samples were taken from sites at 10 to 30 cm from sporocarps of *B. moravicus*. The samples were taken from mineral soil at a depth of 10 cm. Soil sampling was carried out from September to November 2011. The soil samples were analysed in the laboratory of Technical University in Zvolen, Faculty of Ecology and Environmental Sciences, Department of Applied Ecology. Soil pH values were determined in water suspension (HANNA HI 9321).

Groups of forest types were taken from relevant forest management plans (maps of forest types), their terminology following Hančinský (1972). In general, it precisely characterizes ecological conditions of a site and potential natural vegetation. Moreover, we have also added names of relevant phytosociological units using the conversion table by Stanová & Valachovič (2002). The nomenclature of phytosociological units (alliance or association) of the Zürich-Montpellier school follows Jarolímek & Šibík (2008). Position of the localities is presented in the form of quadrants (Q) of the Central European grid mapping system (UTM).

L o c a l i t i e s a n d h a b i t a t c o n d i t i o n s. Data in Tab. 1 present phytogeographical unit, bedrock, exposition, slope inclination, position on the slope, altitude and forest characteristics of five localities in Slovakia. In the Štiavnické vrchy hills (SV) two localities of *B. moravicus* are known from the southern part of the area, near the villages of Hotianske Nemce (SV1) and Ladzany (SV2). Plot SV2 was already known (e.g. Škubla 2003), but published data on its ecology were missing. The locality was found by the author independently from published data. The locality in the Zvolenská kotlina basin (ZK) is situated between Zvolen and Banská Bystrica – near the village of Sebedín-Bečov. Localities in the Kremnické

vrchy hills (KV) are located in the SE part of the hills, near Zvolen – KV1 near Turová, KV2 near Budča.

Tab. 1. Habitat conditions of localities with *Boletus moravicus*.

locality	phytogeographical unit	bedrock	exposition	slope inclination	position on the slope	altitude (m)	forest characteristics
Štiavnické vrchy hills 1	Slovenské stredohorie subunit: Štiavnické vrchy	lava streams of andesite	S–SW	5-15°	bottom and central part of the longer slope	360	middle-aged xerophilous mixed forest with dominance of *Quercus cerris* and *Quercus petraea* with *Carpinus betulus*
Štiavnické vrchy hills 2	Slovenské stredohorie subunit: Štiavnické vrchy	lava streams of andesite	S	5°	plain base of slope	410	middle-aged xerophilous *Quercus cerris* forest with *Carpinus betulus*
Zvolenská kotlina basin	Slovenské stredohorie, subunit: Poľana	epiclastic volcanic breccias to conglomerates of andesites	S	25°	upper part of the steep slope	440	older xerophilous *Quercus cerris* forest
Kremnické vrchy hills 1	Slovenské stredohorie, subunit: Kremnické vrchy	epiclastic volcanic conglomerates of andesites	S–SE	3°	wider part of the flat ridge	485	old xerophilous mixed forest with dominance of *Quercus petraea* and *Quercus cerris*, *Carpinus betulus* and *Fagus sylvatica*
Kremnické vrchy hills 2	Slovenské stredohorie, subunit: Kremnické vrchy	epiclastic volcanic breccias of andesites	–	0°	large plain area	520	old mesophilous *Quercus robur* and *Quercus petraea* forest with *Carpinus betulus*

Specimens and collections. Herbarium collections and records from Slovakia are listed in chronological order. Abbreviation of the herbarium (BRA) is cited in accordance with the Index Herbariorum (Holmgren et al. 1990). Voucher specimens from field collections have been deposited in the author's private herbarium (PVKU), the BRA herbarium and the personal herbarium of Stanislav Glejdura, Slovakia, Zvolen (PSG).

Recent collections (published here)

Štiavnické vrchy hills (SV): Q7679d: SV1, Hontianske Nemce, 29 July 2008, herb. PVKU, BRA CR17829 (Fig. 1), ibid., 12 Aug. 2010, herb. PVKU, BRA CR17830; Q7779a: SV2, Ladzany, 7 Aug. 2008, leg. & det. V. Kunca, herb. PSG 4666 – Zvolenská kotlina basin (ZK): Q7381d: Sebedín-Bečov, 22 July 2009, herb. PVKU, BRA CR 17828, ibid., 6 Aug. 2010, herb. PVKU, BRA CR 17827, ibid., 8 Aug. 2011, herb. PVKU, BRA CR 17826, ibid., 12 Aug. 2011 (Fig. 2), herb. PVKU, BRA CR 17825. – Kremnické vrchy hills (KV): Q7480a: KV1, Turová, 19 Sept. 2009, herb. PVKU, BRA CR 17831; Q7480a: KV2, Budča, 22 Sept. 2009, herb. PVKU, BRA CR 17832, ibid., 18 July 2010, herb. PVKU, BRA CR 17833.

Herbarium collections

Malé Karpaty hills: Q7569c: Kuchyňa, Vývrať, 23 Aug. 1977, leg. V. Volf, det. P. Lizoň, rev. J. Herink (1989) (BRA CR8164) – Zvolenská kotlina basin: Q7380d: Sliač, *Tilia* sp., 30 Aug. 1980, leg. M. Záparka, det. A. Dermek (BRA CR8162) – Malé Karpaty hills: Q7868a: Bratislava, garden, *Picea pungens*, 2 Oct. 1984, leg. I. Mišík, det. A. Dermek (BRA CR16858, as *Xerocomus leonis*) – Štiavnické vrchy hills: Q7679d: 15 Sept. 1998, leg., det. & herb. J. Šutara (locality identical with SV2) – Štiavnické vrchy hills: Q7679d: 5 Sept. 2002, 14 Sept. 2006, 12 Aug. 2010, 15 Aug. 2011 leg., det. & herb. P. Špinar (locality identical with SV2) – Trnavská pahorkatina upland: Q7769b: Viničné, Šenkvický háj, alt. 210 m, broadleaved forest of *Quercus cerris*, *Acer campestre*, 19 Sept. 2010, leg. J. Kuriplach, det. I. Kautmanová, J. Červenka (BRA CR16628).

Records not documented by voucher specimens

Krupinská planina plateau: Q7780d: 1 km SSE of Čabradský Vrbovok, Frčkov Laz, oak to oak-hornbeam forest, 29 Aug. 1994 (Škubla 1994, as *Boletus leonis*) – Pohronská pahorkatina upland: Q 7676d: Kozárovce (Kotlaba et al. 1995) – Štiavnické vrchy hills: Q7679d: Hontianske Nemce, 8 July 2008, leg. & det. M. Mikšík; 22 Sept. 2009, leg. V. Beňadik, det. V. Kunca (locality identical with SV1).

RESULTS AND DISCUSSION

Geological bedrock and soils

Soil pH values from the studied localities are listed in Tab. 2 and range from 3.9 to 6.27. According to Šály (1996) these values are typical of very acidic to mildly acidic soils. Pilát & Dermek (1974) mention soils with rich admixture of lime as typical for *B. moravicus*, whereas Antonín & Bieberová (1995) connect its occurrence with soils on calcareous bedrock. These data do not correspond with all our geological characteristics and measurements of pH values.

All our localities occur on volcanic bedrock, which are made of (or are very close to) andesite. The same can be assumed for some of the localities listed above – Čabradský Vrbovok on the Krupinská planina plateau and Kozárovce in the Pohronská pahorkatina upland. These localities, and localities SV1 and SV2

Fig. 1. *Boletus moravicus* at locality SV1 (29 July 2008; photo V. Kunca).

Fig. 2. *Boletus moravicus* at locality ZK (12 August 2011; photo V. Kunca).

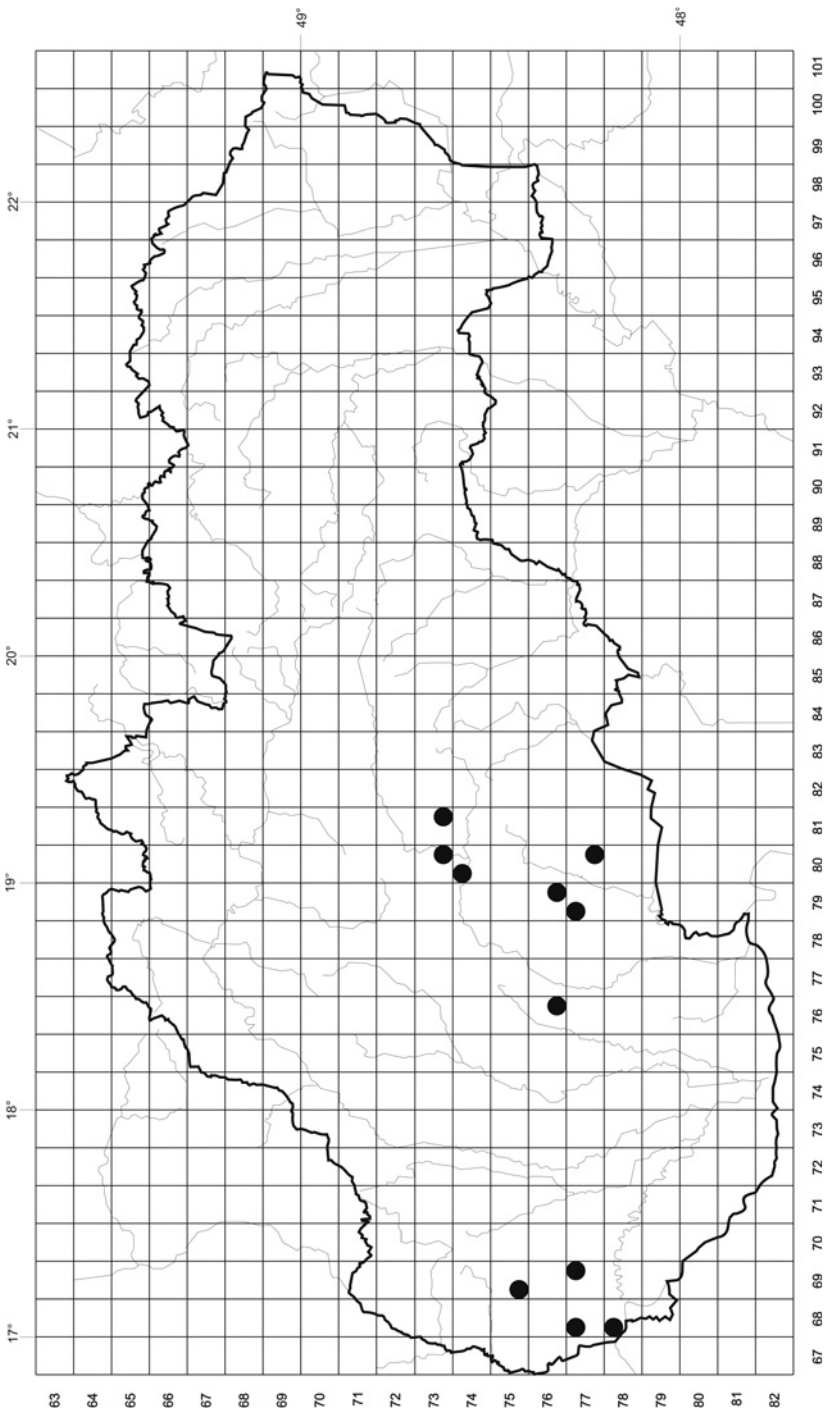

Fig. 3. Incidence of *Boletus moravicus* in Slovakia.

from the southern part of the Štiavnické vrchy hills, are in general influenced by nutrient rich eolian sediments (loess). This can explain higher pH values for the first two localities in comparison with the others.

Tab. 2. Soil pH of investigated localities with incidence of *B. moravicus*.

locality	SV1	SV2	ZK	KV1	KV2
pH value	6.27/5.99*	5.83	5.15	3.9	4.52

* values from 2 microlocalities

Fungal communities

Fungal species found together with *B. moravicus* at the localities can characterise the studied communities better. At SV1 these are *Boletus dupainii*, *B. fuscoroseus*, *B. regius*, *B. rhodoxanthus*, *B. fechtneri* and *Amanita caesarea*, at SV2 *Boletus dupainii*, *B. fuscoroseus* and *B. regius*, at ZK *Boletus regius*, *B. queletii* and *Amanita caesarea*, at KV1 *Boletus fuscoroseus* and *B. appendiculatus* and at KV2 *Boletus regius*, *B. fuscoroseus*, *B. legaliae*, *B. impolitus* and *Polyporus umbellatus*. Pilát & Dermek (1974) describe similar localities with occurrence of thermophilous boletes. Kluzák & Pravda (1985) reported *Boletus albidus*, *B. impolitus*, *B. rhodoxanthus* and *B. appendiculatus* from several localities with occurrence of *B. moravicus*. According to Fellner (1984), all these communities can be classified as the *Boleto (aerei)-Russuletum luteotactae* mycocoenosis where *Xerocomus moravicus* is listed as a characteristic species.

Fructification

Fruitbody production of *B. moravicus* takes place from July to October (22 July – 2 Oct.). Šutara et al. (2009) mention its fructification period from August to October. Our field experience shows that sporocarps occur in low numbers and regularly grow at the same microlocalities. The highest number found was 10 sporocarps during one trip (collection). The largest one-day collection from one locality comprises 12 sporocarps (P. Špinar, pers. comm.) Based on 17 years of observation in the Luční locality, Czech Republic, Špinar (1998) mentions *B. moravicus* sporocarp occurrence during four months (July–October), the highest number being found in September. Data from all our collections and records presented above show that August is the most suitable month for sporocarp production (Tab. 3).

Tab. 3. Number of *B. moravicus* collections (based on all available data from Slovakia) found during four sporocarp production months.

	July	August	September	October
number of sporocarps	2	10	6	1

Localities and habitats

Pilát & Dermek (1974) did not cite any locality of *B. moravicus* from Slovakia. Based on data published here, there are two regions in Slovakia where *B. moravicus* grows (Fig. 3) – thermophilous deciduous forest in SW and Central Slovakia. Dominant tree species in these forests are oaks (*Quercus* spp.). Based on published data, many collections are from the vicinity of oak or from forests with dominance of oak (Kluzák & Pravda 1985). The same conditions are reported by Šutara & Janda (2006) and Šutara et al. (2009). Beran & Tondl (1997) mention four species of *Quercus* in xerophilous and subxerophilous forests as typical mycorrhizal partners of *B. moravicus*. The following tree species were found to be associated with *B. moravicus* at our localities: *Quercus cerris*, *Quercus petraea*, *Quercus robur*, *Carpinus betulus*, and *Fagus sylvatica*.

Based on our phytosociological relevés (Tab. 4), we can assign the occurrence of *B. moravicus* to the second (*Fageto-Quercetum*) or third altitudinal forest zone and to the mesotrophic series (Hančinský 1972). The only find classified in the third vegetation zone (KV1: *Querceto-Fagetum*) is probably marginal or in a position transitional between the second and third vegetation zone, among others due to the specific local conditions of the microlocality (south-facing flat part of the ridge).

The altitudinal range of the Slovak localities is from 210 m to 518 m. The highest locality in the Czech Republic is at 437 m above sea level (Pilát & Dermek 1974: Ždánický les). Janda (pers. comm.) calls uplands the typical landscape for *B. moravicus* in the Czech Republic, where the lowest known locality is at ca. 200 m.

Tab. 4. Vegetation of investigated localities with incidence of *Boletus moravicus*.

Locality	**Forest type group** according to Zlatník's typological school (Hančinský 1972)	**Syntaxonomical unit** according to the Zürich-Montpellier school
SV1	*Fageto-Quercetum*	*Carpinion betuli* Issler 1931
SV2	*Fageto-Quercetum*	*Carpinion betuli* Issler 1931
ZK	*Fageto-Quercetum*	*Carpinion betuli* Issler 1931
KV1	*Querceto-Fagetum*	*Carici pilosae-Fagetum* Oberd. 1957
KV2	*Fageto-Quercetum*	*Carici pilosae-Carpinetum* Neuhäusl et Neuhäuslová ex Neuhäuslová-Novotná 1964

The data on occurrence of *B. moravicus* in Slovakia are probably underestimated. In some cases it is probably misidentified as *Xerocomus subtomentosus*. Our experience show that it is collected together with other *Xerocomus* species for consummation, especially in time of massive growth of sporocarps of boletoid fungi.

Taxonomic note

Specific odour is very typical for almost all sporocarps of *B. moravicus*. In my opinion it is a combination of dill and coco scent. However, Vacek (1946) did not mention any one in his original description of *B. moravicus*. Beran & Tondl (1997) describe very intense odour of cinnamon and Šutara (pers. comm.) characterises the odour as a mixture of dill, coco and vanilla.

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