

The moss *Rhabdoweisia crenulata* (Mitt.) H. Jameson in the Czech Republic and adjacent regions

IVAN NOVOTNÝ & SVATAVA KUBEŠOVÁ

Moravian Museum, Department of Botany, Hviezdoslavova 29a, CZ-62700 Brno, Czech Republic; e-mails: inovotny@mzm.cz, skubesova@mzm.cz

NOVOTNÝ I. & KUBEŠOVÁ S. 2010: The moss *Rhabdoweisia crenulata* (Mitt.) H. Jameson in the Czech Republic and adjacent regions. *Acta Musei Moraviae, Scientiae biologicae* (Brno) 95(1): 223–229. – In the Czech Republic, the moss *Rhabdoweisia crenulata* was known until very recently from only Český les [the Bohemian Forest]. In 2009, it was newly recorded in the Zkamenělý zámek Reserve (Žďárské vrchy Hills). We provide a detailed description of the new locality and review the distribution of the species in the Czech Republic and adjacent regions, with remarks on the fertility of herbarium specimens.

Keywords. Zkamenělý zámek Nature Reserve, Žďárské vrchy Hills, distribution, bryophyte

Introduction

Rhabdoweisia crenulata (Mitt.) H. Jameson was described from the eastern Himalayas (Sikkim) in 1859. Early European floras and keys did not distinguish between *R. crenulata* and *R. crispata*. It is a disjunctive Holarctic moss. In Europe, the main centre of its distribution lies in the British Isles (HILL *et al.* 1992) and it is also fairly common in the mountainous parts of the Black Forest in Germany. The distribution includes north-western Wales, north-western England, western Scotland and western Ireland, Belgium (Namur, Gravet), Spain, France (Pyrenees), Germany, Switzerland, western Norway, northern Italy (Piedmont and Lombardy), and Romania (southern Carpathians – Fagaras Mts.) (HEGEWALD 1972, SMITH 2003, EDERRA INDURAIN 1983, HERBEN 1987, NOVOTNÝ 2002, MISERERE & BRUSA 2003, NISM 2004). Outside Europe, it occurs in the Himalayas (Sikkim), China and Taiwan, on Maui in the Hawaiian Islands (STAPLES *et al.* 2004), in Greenland, North America (North Carolina, southern Appalachian Mountains), the Dominican Republic, and north-western South America (Colombia) (LAWTON 1961, ZANDER 1966, CRUM & ANDERSON 1981, FRAHM *et al.* 2000).

On the European continent the species was first recorded on the territory of what is now the Czech Republic, in Český Les (the Bohemian Forest; at Čertovo jezero). It was collected by VELENOVSKÝ (1897) as *R. denticulata* (Brid.) Bruch, Schimp. & W. Guemmel (= *R. crispata* (Dicks.) Lindb.) (HERBEN 1987). HERBEN (1987) showed that this specimen actually represents *R. crenulata*. So it has been known from the Czech Republic since 1987, from the 1897 collection by J. Velenovský. Velenovský also collected *R. crenulata* in rock crevices above the glacial cirque known as Černé jezero in 1901 (VELENOVSKÝ 1903, sub *R. denticulata*), and HERBEN (1987) confirmed this locality. SOLDÁN & VÁŇA (2002) considered the relative abundance of *R. crenulata* both at Černé jezero and Čertovo jezero as “frequent”.

In the Bavarian part of this mountain range (the Bayerischer Wald), the moss occurs at only a few sites around the Arbersee lakes, especially in its glacial cirque, where it is common. In Germany it also grows in the Black Forest (Schwarzwald) where it has been recorded at many sites (KOPPE & KOPPE 1931, DÜLL & MEINUNGER 1989, MEINUNGER & SCHRÖDER 2007).

R. crenulata grows on shaded ledges and in crevices of siliceous rocks in humid situations, often under overhangs. It occurs typically on north-facing crags, among scree boulders, and in ravines, especially near waterfalls (HILL *et al.* 1992). EDERRA INDURAIN (1983) mentions its occurrence on siliceous rocks in beech forest (*Saxifraga hirsutae-Fagetum* Br.-Bl. 1967) in Spain.

DE ZUTTERE & SCHUMACKER (1984) considered *R. crenulata* likely to be extinct in Belgium. In Norway it falls into the Data Deficient category (DD, KÅLÅS *et al.* 2006). MEINUNGER & SCHRÖDER (2007) considered it extremely rare in Germany. In the Czech Republic it is classified among endangered taxa (EN) (KUČERA & VÁŇA 2005), in Switzerland as a vulnerable species (VU) (SCHNYDER *et al.* 2004), but it is not threatened in the British Isles (CHURCH *et al.* 2004).

R. crenulata is autoicous and nearly always occurs with capsules (MEINUNGER & SCHRÖDER 2007).

The species demonstrates a certain variability in the size of the leaves and cells, but the shape and areolation of the leaves remain highly constant (KUČERA 2004).

Methods

Collections were studied in the following herbariums: CB, CBFS, BRNM, BRNU, MJ, OP, PR, PRC. The nomenclature of vascular plants follows KUBÁT *et al.* (2002), that of bryophytes KUČERA & VÁŇA (2005).

Results and discussion

Distribution in the Czech Republic

Specimens examined. Šumava Mts.: Jezerní stěna rocks above Čertovo jezero Lake, in rock fissures, VIII 1894 leg. J. Velenovský (sub *R. denticulata*), rev. T. Herben and J. Váňa, capsules common, PRC; *ibid.* c. 1150 m a.s.l., 22 VII 1996 leg. J. Váňa, capsules common, PRC; *ibid.* c. 1100 m a.s.l., 3 VIII 1994 leg. J. Váňa, capsules common, PRC; Glacier cirque of the Černé jezero Lake, 1000 m a.s.l. (VELENOVSKÝ (1903), HERBEN (1987), SOLDÁN & VÁŇA (2002)); *ibid.*, c. 1100 m a.s.l., wet granitic rocks, 25 VIII 1994 leg. J. Kučera, capsules common, CBFS no. 1115.

Žďárské vrchy Hills: Žďár nad Sázavou, Zkamenělý zámek Nature Reserve c. 1 km east of the village of Svratka, wet rock fissure at rock base [“Přírodní památka Zkamenělý zámek, skalní blok ca 1 km V od obce Svratka, vlhká škvíra u báze skály”], WGS-84: 49°42'32" N 16°04' 28" E, c. 740 m a.s.l., 1 V 2009 leg. I. Novotný, three capsules, BRNU no. 714454.

The distribution of this moss in the Czech Republic is shown in Fig. 1.

New record in the Žďárské vrchy Hills

We found *R. crenulata* in a rock crevice in the Zkamenělý zámek Nature Reserve in the Žďárské vrchy Hills in May 2009, at the base of the cliff (Fig. 2) known as “Hlava”

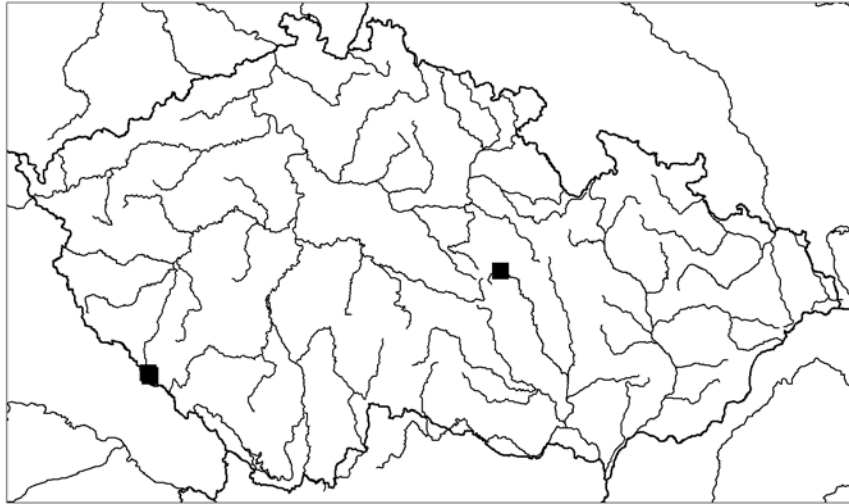


Fig. 1. Distribution of the moss *Rhabdoweisia crenulata* in the Czech Republic

(for details see DOLEŽAL 1983). The altitude is about 740 m. a.s.l. The rock consists of a zone of coarsegrained orthogneiss of the Svatka crystalline complex with frost disintegration during the later Quaternary (ČECH *et al.* 2002). Rock cliffs, as high as 10 m, occur in a horseshoe shape. The rocks abound in distinctive vegetation and there are wide crevices and occasional small crevice caves in the rock. Screes have formed below the cliffs nearby (ČECH *et al.* 2002). The climate is somewhat cold, wet and windy. Average temperature in January is between -3°C and -4°C , in July between 15°C and 16°C . Precipitation in the vegetation period (April – September) amounts to 500–600 mm, in winter (October – March) 350–400 mm (QUITT 1971).

The record in Žďárské vrchy Hills differs from those is relatively nearby localities (Bohemian Forest 1000–1150 m a.s.l., Italy 1500 m a.s.l., Romania *c.* 1000 m a.s.l.; see NOVOTNÝ (2002), MISERERE & BRUSA (2003)) in its lower altitude, and is analogous to the altitude range of 510–1340 m found in German records (NEBEL & PHILIPPI (2000). Nevertheless, it represents a common habitat – humid, shaded, acidic rock.

The rock cliffs are surrounded by forest consisting mostly of spruce plantations (*Picea abies*). Frequent plants at the locality include the trees *Betula pendula*, *Fagus sylvatica*, and *Sorbus aucuparia* with a herb layer containing *Avenella flexuosa*, *Dryopteris carthusiana* agg., *Oxalis acetosella*, *Polypodium vulgare*, *Vaccinium myrtillus*, and *Vaccinium vitis-idaea* (KUBEŠOVÁ *et al.* 2009). We recorded the liverworts *Lophozia hatcheri*, *Calypogeia neesiana*, *Chiloscyphus profundus*, *Lepidozia reptans*, *Lophozia ventricosa*, *Ptilidium ciliare*, *Ptilidium pulcherrimum*, *Scapania nemorea*, and



Fig. 2. Occurrence of the moss *Rhabdoweisia crenulata* in the Zkamenělý zámek Nature Reserve



Fig. 3. Fertile shoot (A), collected 1 May 2009, and turf (B, photo 15 July 2009) of the moss *Rhabdoweisia crenulata* in the Zkamenělý zámek Nature Reserve.

the mosses *Cynodontium polycarpon*, *Cynodontium strumiferum*, *Dicranum montanum*, *Dicranum scoparium*, *Dicranum tauricum*, *Grimmia hartmanii*, *Hedwigia ciliata*, *Herzogiella seligeri*, *Heterocladium heteropterum*, *Hypnum cupressiforme*, *Paraleucobryum longifolium*, *Plagiothecium curvifolium*, *Plagiothecium laetum*, *Plagiothecium nemorale*, *Pleurozium schreberi*, *Pohlia nutans*, *Polytrichastrum formosum*, *Polytrichastrum pallidisetum*, *Pseudotaxiphyllum elegans*, *Rhizomnium punctatum*, and *Schistostega pennata* on rocks or boulders in the Zkamenělý zámek Reserve. The immediate associates of *Rhabdoweisia crenulata* at the locality are the liverwort *Chiloscyphus profundus* and the mosses *Cynodontium polycarpon*, *Plagiothecium laetum*, and *Pseudotaxiphyllum elegans*.

The size of the *Rhabdoweisia crenulata* population is small, about 2 cm². The tuft was fertile with three ripe capsules (Fig. 3) in May 2009.

Conclusions

The locality described lies on the eastern boundary of the distribution area in Europe, whereas the easternmost record lies in Romania. It is detached from the two Czech records in Šumava bordering with the German records in this mountain range. It is illustrated by the state of the population in the Zkamenělý zámek Nature Reserve, where only three sporogons were recorded in May 2009 and none in the summer of the same year. The production of the sporophytes in optimal conditions is usually high.

The new record in the Žďárské vrchy Hills shows the importance of detailed bryofloristic research in a relatively well-explored area of central-eastern Europe.

Acknowledgements

First of all we extend our thanks the Žďárské vrchy Protected Landscape Area Administration for supporting field work and to the curators of the CB, CBFS, BRNU, MJ, OP, PR, and PRC herbariums for their help. Our thanks are also due to J. Kučera for revision of our specimen, to our colleague K. Sutorý for help in the source field work and to J.W. Jongepier for preliminary language revision. The study was partly supported under project ref. MK00009486201 (Ministry of Culture of the Czech Republic).

References

- CHURCH J.M., HODGETTS N.G., PRESTON C.D. & STEWART N.F. 2004: *British Red Data Books: mosses and liverworts*. JNCC, Peterborough, 168 pp (in English).
- CRUM H.A. & ANDERSON L.E. 1981: *Mosses of Eastern North America. Vol. 1*. Columbia University Press, New York, 663 pp (in English).
- CULEK M. (ed.) 1996: *Biogeografické členění České republiky*. Enigma, Praha, 347 pp (in Czech).
- ČECH L., ŠUMPICH J., ZABLOUDIL V. et al. 2002: *Jihlavsko*. In: MACKOVČIN P., SEDLÁČEK M. (eds.): *Chráněná území ČR, svazek VII*. AOPK ČR a EkoCentrum Brno, Praha, 528 pp (in Czech).
- DE ZUTTERE & SCHUMACKER R. 1984: Bryophytes nouvelles, méconnues, rares, menacées ou disparues de Belgique. *Travaux* 13: 1–160 + 40 Figs. (in French).

- DOLEŽAL F. 1983: *Žďárské vrchy. Průvodce po horoložeckých terénech Vysočiny*. TJ Vysočina, Žďár nad Sázavou, 173 pp (in Czech).
- DÜLL R. & MEINUNGER L. 1989: *Deutschlands Moose*. IDH-Verlag, Bad Münstereifel, 368 pp (in German).
- EDERRA INDURAIN A. 1983: *Rhabdoweisia crenulata* (Mitt.) Jameson novedad para la flora briológica española. *Annales Jardin Botánico Madrid* **40**: 463.
- FRAHM J.-P., AHMED J., HAGEN M. & PELES M. 2000: Revision der Gattung *Rhabdoweisia* (Musci, Dicranaceae). *Tropical Bryology* **18**: 161–172 (in German).
- HEGEWALD E. 1972: *Rhabdoweisia crenulata* – neu für Fennoscandien. *Lindbergia* **1**: 191–192 (in German).
- HERBEN T. 1987: *Moerckia blytii*, *Rhabdoweisia crenulata*, and *Dicranodontium uncinatum* (Bryophyta) new for the Czechoslovak part of the Šumava Mountains. *Preslia* **59**: 173–177 (in English).
- HILL M. O., PRESTON C.D. & SMITH 1992: *Atlas of Bryophytes of Britain and Ireland. Volume 2. Mosses (except Diplolepidae)*. Harley Books, Colchester, 400 pp (in English).
- KÁLÁS J.A., VIKEN Å. & BAKKEN T. (eds.) 2006: *Norsk Rødliste 2006*. Artsdatabanken, Norway, 416 pp (in Norwegian, in English).
- KOPPE F. & KOPPE K. 1931: Beiträge zur Moosflora des Bayerisches Waldes. *Kryptogamische Forschungen* **2**: 198–225 (in German).
- KUBÁT K., HROUDA L., CHRTEK J. jr., KAPLAN Z. & KIRSCHNER J. 2002: *Klíč ke květeně České republiky*. Academia, Praha, 928 pp. (in Czech).
- KUBEŠOVÁ S., NOVOTNÝ I. & SUTORÝ K. 2009: *Inventarizační průzkum cévnatých rostlin a mechorostů PP Zkamenělý zámek*. Ms., 9 pp. [depon. in: Žďárské vrchy Protected Landscape Area Administration, Žďár nad Sázavou and Department of Botany, Moravian Museum, Brno] (in Czech).
- KUČERA J. 2004: *Rhabdoweisia* – pruhovka. In: KUČERA J. (ed.): *Mechorosty České Republiky, on-line klíče, popisy a ilustrace*. <http://botanika.bf.jcu.cz/bryoweb/klic/prehled.html> (in Czech).
- KUČERA J. & VÁŇA J. 2005: Seznam a červený seznam mechorostů České republiky (2005). *Příroda* **23**: 1–104 (in Czech).
- LAWTON E. 1961: A revision of the genus *Rhabdoweisia*. *The Bryologist* **64**: 140–156.
- MEINUNGER L. & SCHRÖDER W. 2007: *Verbreitungsatlas der Moose Deutschlands. Band 2*. Herausgegeben von O. Dürhammer für die Regensburgische Botanische Gesellschaft, Regensburg, 699 pp (in German).
- MISERERE L. & BRUSA G. 2003: *Rhabdoweisia crenulata* (Mitt.) H. Jameson new to Italy. *Cryptogamie, Bryologie* **24/1**: 53–57 (in English).
- NISM 2004. *Nationales Inventar der Schweizer Moosflora – Online-Atlas of Swiss Bryophytes*. <http://www.nism.uzh.ch>. [Accessed April 2010.]
- NEBEL M. & PHILIPPI G. (eds.) 2000: *Die Moose Baden-Württembergs. Band 1*. Eugen Ulmer, Stuttgart, 512 pp (in German).
- NOVOTNÝ I. 2002: *Rhabdoweisia crenulata* (Mitt.) H. Jameson. In: BLOCKEEL T.L., ARTS T.T., BRUGGEMAN-NANNENGA M.A., BRUSA G., HEDENÄS L., NOVOTNÝ I., OCHYRA R., SABOVLJEVIĆ M.S. & TOWNSEND C.C.: New national and regional bryophyte records 6. *Journal of Bryology* **24**: 329–332 (in English).
- QUITT E. 1971: Klimatické oblasti Československa. *Studia Geographica* **16**: 1–73 (in Czech).
- SCHNYDER N., BERGAMINI A., HOFMAN H., MÜLLER N., SCHUBIGER-BOSSARD C. & URMI E. 2004: *Rote Liste der gefährdeten Moose der Schweiz*. BUWAL, FUB & NISM, Bern 99 pp (in German).
- SMITH A.J.E. 2003: *The moss flora of Britain and Ireland, second edition*. Cambridge University Press, Cambridge 1012 pp (in English).
- SOLDÁN Z. & VÁŇA J. 2002: Srovnání bryoflorý karů české části Šumavy. *Silva Gabreta* **8**: 117–142 (in Czech).
- STAPLES G.W., IMADA C.T., HOE W.J. & SMITH C.W. 2004: A revised checklist of Hawaiian mosses. *Tropical Bryology* **65**: 35–69 (in English).
- VELENOVSKÝ J. 1897: Mechy české (Czech mosses). *Rozpravy České Akademie* **6**: 1–348 (in Czech).
- VELENOVSKÝ J. 1903: Bryologické příspěvky z Čech za rok 1901 – 1902. *Rozpravy České Akademie* **12/11**: 1–20 (in Czech).
- ZANDER R. 1966: *Rhabdoweisia crenulata* new to North America. *The Bryologist* **69/3**: 356–358 (in English).

APPENDIX

Selected specimens outside the Czech Republic

Germany: Bayerischer Wald, Arberseewand above Großer Arbersee lake [“montes Böhmerwald, loc. Arberseewand apud lac. Gr. Arbersee”], c. 1300 m a.s.l., 10 IX 1997 leg. J. Váňa, capsules common, PRC; Mt. Arber, in Rissloch waterfall, in crevices [“Böhmerwald, Arber in ‘Rissloch’ in Felsspalten”], 7 VIII 1887 leg. V. Schiffner, capsules common, OP (the earliest specimen in Czech herbarium collections). Black Forest, Belchen massif, south-east of the town of Bad Krozingen, north-facing, granite-porphyre rock, on rocks covered with humus [“Forêt-Noir, Massif du Belchen, versant nord, roches: granit-porphyre, sur les roches ± couvertes d’humus”], 1200–1300 m.a.s.l., 6 IX 1971 leg. J.L. De Sloover, BRNM; in upper Zastler valley on Mt. Feldberg, on mica schist rocks, along brook by reservoir [“Baden: Auf Gneiâfels im oberen Zastlertale am Feldberge, neben dem Bache bei Klausen”], 6 VI 1901, autumn 1903 leg. C. Müller Frib. (Bauer Musci eur. exs. 74), sporophytes rare, BRNM, BRNU, PR; Oberrieder valley, “Hexenküche”, on wet, shady gneiss rock [“Baden, Schwarzwald, Oberriedertal, Hexenküche, ad rupes gneissaceas, hygrophila, skiophila”], c. 600 m a.s.l., VIII 1934 leg. and det. T. Herzog (Musci selecti et Critici edidit Fr. Verdoorn exs. 150), BRNM, BRNU, PR.

France: crevices of wet rocks above the Enfer cascade, Luchon, Haute Garonne, 30 VII 1902 leg. Nicholson and Dixon, BRNU.

Great Britain: Wales, Moelwyn Bach, Merioneth, IX 1911 leg. A.A. Jones and P.G.M. Rhodes, BRNU, BRNM, PR; *ibid.*, on vertical walls of entrance to a mine adit [“Merionethshire, auf den senkrechten Seiten des Zuganges zu einem Bergwerksstollen”], 360 m a.s.l., 24 VII 1925 leg. P.G.M. Rhodes (Bauer, Musci eur. et amer. exs. 1807), with capsules, BRNM, BRNU, PR, MJ (“Locality discovered by Messr. D.A. Jones and S.J. Owen. Associated with *Polytrichum*, which tends to displace it. In tufts nearly 10 cm high when growing.” “A well known locality, to which the following records refer, Moss Exchange Club Reports 1904 p. 158, 1906 p. 212, 1910 p. 336, 1912 p. 44, 1917 p. 186; Moss Exchange Club (sect. II) Reports 1915 p. 5; British Bryolog. Society Report 1923.” Prof. Rhodes on label).