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Racomitrium macounii (Bryophyta) in the Tatra Mountains, Slovakia

R. ŠOLTÉS
Institute of the High Mountains Biology, 059 56 Tatranská Javorina, Slovak Republic, e-mail: soltes@uniza.sk

Abstract. The paper deals with the chorology, ecology and phytocoenology of the moss species *Racomitrium macounii* in the Tatra Mts. The species was recently described and forms two subspecies, subsp. *alpinum* and subsp. *macounii*, The subspecies have different distributions and ecology. Both the subspecies are present in the Tatra Mts., though the subsp. *macounii* occurs very rarely. A distribution map is presented.

Key words: Slovakia, The Tatra Mts., bryophytes, *Racomitrium macounii*

Introduction

Racomitrium macounii Kindb. is a member of the *Racomitrium sudeticum* group. The species differs from *Racomitrium sudeticum* in being more robust, with a leaf margin that is bistratose in 2-4 rows of cells and a four-stratose nerve (Fig. 1). In comparison *Racomitrium sudeticum* has nerve mostly three-stratose with leaf margin unistratose, occasionally bistratose, but with a maximum of two rows of cells. *Racomitrium macounii* is a subarctic species (Düll 1994), forming two subspecies, ssp. *macounii* and ssp. *alpinum* (Frisvoll 1988). Subspecies *macounii* has leaves contorted when dry, with hair-point lacking or rarely longer than 100 µm, cells above isodiametric, and is found covering rocks in montane streams. The commoner subspecies *alpinum*, has leaves straight when dry, the hair-point being mostly longer than 100µm, with cells above usually rectangular to linear. The ssp. *alpinum* is less hygromorphic, occuping periodically irrigated rocks.

Racomitrium macounii was included in a list of the taxa found after 1960 (Soldán 1994).

In Slovakia, the species was first collected in the Tatra Mts. in 1919 by Siegel (1989). The author found the species in the Malá Studená dolina valley near Téryho chata (chalet) at an altitude of 2,000m a.s.l. (subsp. *alpinum*); Veľká Studená dolina valley, under Zbojnícka chata (chalet) at an altitude of 1,850m a.s.l. (subsp. *alpinum*); Mlynická dolina valley, the lake above Skok waterfall (subsp. *macounii*).

Subsequently the species was collected in the Czech Republic with subsp. *alpinum* reported in the Krkonoše Mts. by Buryová and Kučera (1999) and subsp. *macounii* by Kučera and Buryová (2001).

Material and Methods

The nomenclature follows Kubinská and Janovicová (1998), or Frisvoll (1988) respectively. All specimens are stored in the Museum of the Tatra National Park in Tatranská Lomnica, Slovakia. The geographical coordinates are recorded in the WGS 84 system, on a Garmin eTrex Vista GPS. All specimens were identified by the author**.**

Results and Discussion

Following revision of *Racomitrium* specimens in the collection stored in the Museum of the Tatra National Park in Tatranská Lomnica, Šoltés (2006) and with additonal collections since then, a list of all locations has been produced.

The following list is the known distribution of *R. macounii* subsp. *alpinum* in the High Tatra Mountains:

Racomitrium macounii subsp. *alpinum*

1. Veľká Zmrzlá dolina valley, the gully under the rocky spike „Loktibrada", 2,320m a.s.l., leg. Foltínová September 14, 1969;
2. Lomnický štít peak, wet granite rocks, *Andreaeetum nivalis*, 2,240m a.s.l., leg. Šoltés October 10, 1976;

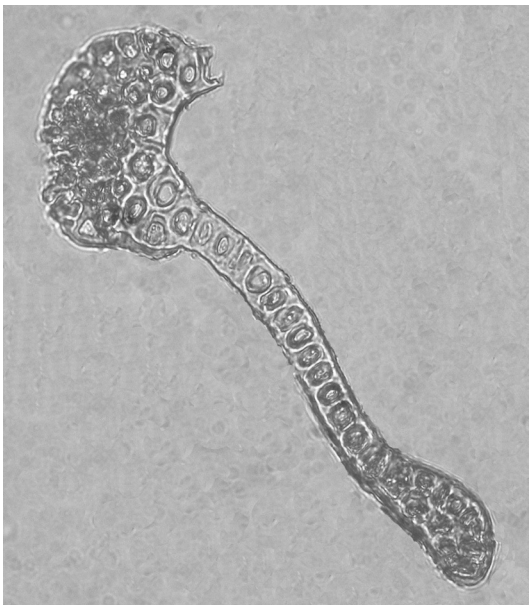

Fig. 1. The leaf cross-section. Nerve is four-stratose, with leaf margin bistratose in 2-4 rows of cells.

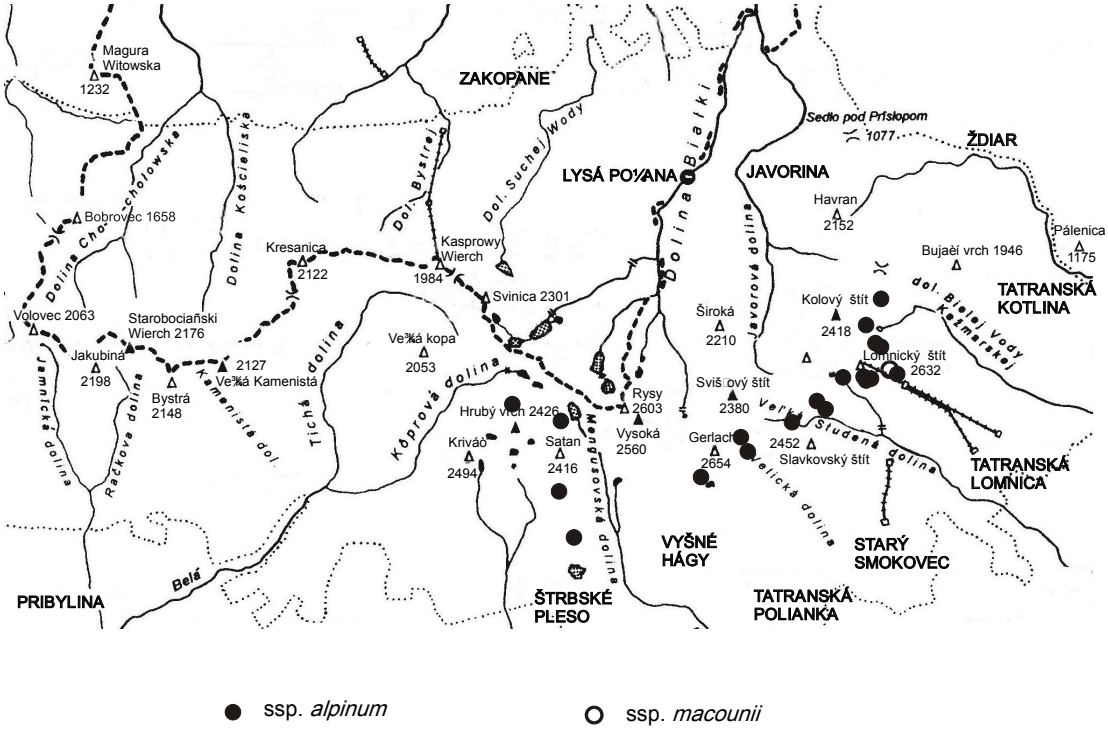

Fig. 2 Distribution map of *Racomitrium macounii* in the Tatra Mts. Graphical source: TPN Zakopane

3. Lomnický štít peak, granite rocks with periodically streaming water, 2,260m a.s.l., leg. Šoltés October 8, 1976;
4. Lomnický štít peak, granite rocks with periodically streaming water, 2,300m a.s.l., leg. Šoltés October 8, 1976;
5. Huncovský štít peak, wet granite rocks, 2,280m a.s.l., leg. Šoltés October 8, 1977;
6. Lomnické sedlo saddle, slope to Malá Studená dolina valley, wet granite rocks, 2,100m a.s.l., leg. Šoltés October 10, 1977;
7. Lomnický štít peak, wet granite rocks in Lievikový kotol basin, 1,910m a.s.l., leg. Šoltés October 14, 1978;
8. Lomnický štít peak, granite rocks with periodically streaming water, *Andreaeetum nivalis*, 2,500m a.s.l., leg. Šoltés October 7, 1981;
9. Mlynická dolina valley, wet granite wall, 1,770m a.s.l., leg. Šoltés August 24, 1982;
10. Batizovská dolina valley, soil, *Brachythecio rivularis-Cardaminetum opicii*, 1,960m a.s.l., leg. Háberová, August 4, 1982;
11. Veľká Studená dolina valley, wet granite rocks, 1,570m a.s.l., leg. Šoltés September 8, 1982;
12. Hlinská dolina valley, spring, *Brachythecio rivularis-Cardaminetum opicii*, 1,730m a.s.l., leg. Šoltés August 2, 1983;
13. Mengusovská dolina valley, slope of Mengusovský štít peak above Hincovo pleso lake, wet rocks, 2,050m a.s.l., leg. Šoltés October 13, 1987;
14. Velická dolina valley, granite rocks with periodically streaming water, under Poľský hrebeň ridge, *Andreaeetum nivalis*, 2,170m a.s.l., leg. Šoltés August 5, 1992;
15. Veľká Studená dolina valley, Zbojnícky spád (gully), wet granite rocks, spring, 1,900m a.s.l., leg. Šoltés September 6, 1999;
16. Veľká Studená dolina valley, *Hygrohypnetum dilatati* in the outflow of Dlhé pleso lake, 1,870m a.s.l., leg. Šoltés September 6, 1999;
17. Patria peak, granite rocks, spring under summit, 2,150m a.s.l., leg. Šoltés October 24, 2000;
18. Malá Studená dolina valley, the edge of the terrace under Téryho chata (chalet), 1,800m a.s.l., leg. Šoltés August 7, 2003, E 20° 12'31'', N 49° 11'17'';
19. Červená dolina valley, wet granite rocks, 2,010m a.s.l., leg. Šoltés August 20, 2003, E 20° 13'59'', N 49° 12'28'';
20. Huncovská kotlina, wet granite rocks, *Andreaeetum nivalis*, 1,999m a.s.l., leg. Šoltés August 5, 2004;
21. Velická dolina valley, the shore of little pool under Dlhé pleso lake, wet granite rocks, 1,920m a.s.l., leg. Šoltés June 29, 2005;
22. Velická dolina valley, wet granite rocks, above Večný dažď (Eternal rain), 1,800m a.s.l., leg. Šoltés June 29, 2005;
23. Malá Studená dolina valley, wet rocks, 1,700m a.s.l., leg. Šoltés August 6, 2008, E 20° 12,384', N 49° 11,231';

The following is the known distribution of *R. macounii* subsp. *macounii* in the High Tatra Mountains:

Racomitrium macounii ssp. *macounii*

1. Lomnický štít peak, Lievikový kotol basin, granite rocks in waterfall, 1,910m a.s.l., leg. Šoltés August 11, 1977;

Racomitrium macounii subsp. *alpinum*

The world-wide distribution of the species has been published by Bednarek-Ochyra (1995). Subsp. *alpinum* occurs more frequently than subsp.

macounii. Despite the fact that the subspecies is acidopholous, it is tolerant to a slightly basic substratum. The characteristically coloured russet cushions cover boulders, rocks and walls usually along streams and springs, as well as in the vicinity of waterfalls. These habitats are permanently or periodically irrigated, and sometimes it grows on boulders wholly immersed in rapid mountain streams. Also it occurs on wet soil or rocks in snow beds (Bednarek-Ochyra 1995).

The subspecies is of a boreal distribution, showing some oceanic tendencies and in the mountains, the subspecies occurs at the subalpine and alpine level. This is a subspecies of distinct disjunctive and panholarctic distribution. Although described from North America, the main distribution center is Europe. The subspecies grows in Western and Northern Scandinavia up to the Cola Peninsula, Iceland, Faroe Islands, and also rarely in the British Isles. In the European continent it occurs in mountains areas from the Iberian Peninsula through Apeniny, the Carpathians, up to West Caucasus and Corsica in the south. In North America, the moss occurs in the Pacific part of the continent with scattered locations in the States of Idaho and Montana, growing at altitudes of 1,300 – 2,300m a.s.l. This subspecies is very scarce in Asia with one location in Japan, and another in the Aleutian Islands. In the Arctic, the species grows only in the most southerly point of Greenland. In Poland, the species occurs only in the Tatra Mts and in Krkonoše Mts. (Bednarek-Ochyra 1995). According the same autor the subsp. *alpinum* is common in the Polish Tatra Mts. at an altitude above 1,550m a.s.l. up to peak summits, and this correlates with our observations.

Racomitrium macounii subsp. *alpinum* can be found as a constituent in many communities as well as forming its own community where it is dominant.

The species sporadically occurs in the spring community *Brachythecio rivularis – Cardaminetum opizii* (Krajina 1933) Hadač 1983, associated with *Jungermannia obovata*, *Scapania undulata*, *Brachythecium rivulare*, *Bryum pseudotriquetrum*, *Cratoneuron decipiens*, *Kiaeria falcata*, *Palustriella commutata*, *Philonotis seriata, Pohlia drummondii, Polytrichum alpinum, Racomitrium sudeticum* and others, some of which are dominant. The moss layer in spring communities of the alliance *Philonodition seriatae* is formed by the presence of *Racomitrium macounii* subsp. *alpinum* together with *Gymnocolea inflata, Nardia scalaris, Pellia neesiana, Bryum pallescens, Bryum schleicheri, Philonotis seriata, Polytrichum sexangulare* along with other species.

The alpine or subnivale community *Andreaeetum nivalis* Krajina, 1933 is dominated by *Andreaea nivalis* with *Racomitrium macounii* subsp. *alpinum* entering as an associate species together with *Kiaeria blyttii, Pohlia ludwigii, Polytrichum sexangulare* and other species. These are communities of granite walls in the alpine or subnivale levels occasionally heavily irrigated by running water during springtime from melting snow, and also from melting snow running in the summertime at these altitudes. Rainfall can often be heavy and intense, but in the summer months, irrigation by spring water can be lacking which leads to total dessication in this community.

The community *Hygrohypnetum dilatati* Krajina, 1933, covering granite boulders in rapidly running mountain streams in alpine levels, is dominated by *Hygrohypnum duriusculum*. In this community *Racomitrium macounii* subsp. *alpinum* occurs as an associated species together with *Scapania subalpina, Scapania undulata, Brachythecium rivulare, Philonotis seriata, Philonotis tomentella* and others.

Racomitrium macounii subsp. *alpinum* also forms its own community, which until now was undescribed, closely allied to *Racomitrion sudetici* Herzog 1943 where the subspecies is dominant. The community covers periodically irrigated granite rocks and walls in the alpine or subnivale zone where the associates include: *Jungermannia confertissima, Jungermania obovata, Lophozia incisa, Lopezia ventricosa, Marsupella emarginata, Andreaea frigida, Andreaea rothii, Hydrogrimmia mollis, Philonotis seriata, Polytrichum alpinum, Polytrichum sexangulare* and *Racomitrium aquaticum*.

Racomitrium macounii subsp. *macounii*

According to Bednarek-Ochyra (1995) the ecological relations of *Racomitrium macounii* subsp. *macounii* are still incompletely known. Poor ecological information recorded on labels of herbaria collections indicates that this is an acidophilous species occupying wet habitats. For example, specimens collected from the Tatra Mts. were growing on rocks in waterfalls as are those collected from the Sudety Mts. This suggests that *Racomitrium macounii* subsp. *macounii* is a hydrophilous subspecies (Bednarek-Ochyra 1995).

The phytocoenological relations of *Racomitrium macounii* subsp. *macounii* are still unknown due to lack of data. We only have a single collection from rocks in a waterfall where the associates include: *Lophozia sudetica, Racomitrium sudeticum* and *Rhizomnium magnifolium*. It seems that *Racomitrium macounii* subsp. *macounii* growing on rocks in waterfalls is more hydrophilous than *Racomitrium macounii* subsp. *alpinum* requiring only periodic irrigation. In these situations, the water is fast flowing, cold, oligotrophic and slightly acidic or neutral. *Racomitrium macounii* subsp. *alpinum* is known to tolerate total dessication.

The world distribution map of the subspecies has been published by Bednarek-Ochyra (1995). This shows that *Racomitrium macounii* subsp. *macounii* is an alpine, Euro-American moss. In North America, the subspecies has a rather narrow distribution, growing in coastal mountains, the Rocky Mountains - from North California to the southern part of British Columbia and Alberta, eastwards to Montana and Wyoming. Here the moss grows exclusively in the alpine zone from 1,700 to 2,225m. a.s.l. In Europe it occurs mainly in the Alps, where is rather common in the altitudes 1,900-2,700m. a.s.l., but occurs rarely in the Sudety Mts. and in the Carpathians. The subspecies was recorded in the Rila Mts. in Bulgaria, Corsica, the Pyrenees and in the Iberian Peninsula (Bednarek-Ochyra 1995). In Poland, the subspecies *macounii* is extremely rare, occuring in only two locations in the Tatra Mts. and one location in the Sudety Mts. (Bednarek-Ochyra 1995).

Threat

The species *Racomitrium macounii* was evaluated in the old IUCN system in Slovakia (Kubinská *et al.* 2001) as EN (Endangered). Under the revised IUCN threat categories (Hallingbäck *et al.* 1998, ECCB 1995, IUCN 1994) the subspecies *macounii* meets the criteria for EN (B2a, C2a). The subspecies is potentialy endangered from the air pollution load within the high altitude alpine region. In the Czech Republic, the subspecies *macounii* is designated as EN and subspecies *alpinum* is designated as LC (Kučera and Váňa 2005). Subspecies *alpinum* doesn´ t satisfy any criteria of the threatened categories of IUCN.

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