

# The Bialskie Mts. (Eastern Sudetes, Poland), an extraordinary bryological area

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**Abstract:** The results of the bryological investigations carried out in the years 2001-2005 in The Bialskie Mts. (E Sudetes, SW Poland) are presented by the authors. A total of 170 species of mosses have been recorded there. Comments about 34 threatened, rare, and most interesting species are given. The moss flora of the study area is briefly assessed and the ecological moss groups, e.g. terricolous, epiphytic, epixylous, coprophilous and others, are characterized in detail.

**Key words:** Bryophyta, mosses, flora, threatened species, Bialskie Mts., Sudetes, Poland

## 1. Introduction

The moss flora of the Bialskie Mts. has been thoroughly surveyed by the authors during the last five years. Up to date, 170 taxa have been documented in the mountain range. The total number is extraordinarily high in respect to such a small study area. Furthermore, it seems impressive that the percentage proportion of the species considered as remarkable, rare or even threatened is considerable. The high species richness is closely related to the number of miscellaneous types of biotopes connected with higher humidity. Both valleys of streams and shaded rocks proved to be the richest parts of the study area. Such study sites supported about 75% of all recorded moss species.

Some preliminary information assessing the results of the survey has already been published (Wierzcholska & Plášek 2005). Nevertheless, the complete recorded data and its analysis will be presented in a more detailed article. This paper serves as an introduction to the knowledge of how attractive the bryoflora in the Bialskie Mts is.

## 2. Material and methods

### 2.1. Study area

The Bialskie Mts. are a mountain range (spanning 60 km<sup>2</sup>) situated in the SW part of Poland along the

Polish-Czech border. It is composed mainly of granite and gneiss layers moderately enriched by limestone. The altitude oscillates from 450 to 1124 m a.s.l.

In the highest mountain areas prevail natural spruce forests (*Calamagrostio villosae-Piceetum* Schlüter 1969) grow in the highest mountain areas. In some places slopes are covered with rarely preserved fragments of primeval forest (classified as *Luzulo luzuloidis-Fagetum* Markgr. 1932 em. Meusel 1937). The remaining part of forest habitats is composed of managed spruce or beech forest cultivations.

The study area belongs to Śnieżnik Landscape Park and, moreover, two nature reserves were established there. The larger one (125 ha) called 'Puszcza Śnieżnej Białki' Nature Reserve lies at an altitude ranging from 980 to 1090 m a.s.l. The smaller one (22.16 ha) called 'Nowa Morawa' Nature Reserve is situated at an altitude ranging from 820 to 956 m a.s.l. Both of them are composed of acidophilous mountain beech forest.

Due to high rates of rainfall (about 1000 mm per year) and impermeable surface, the Bialskie Range belongs to an exceptionally humid regions. Moreover, there is a considerable amount of spring areas. Most of them rise on slopes at an altitude ranging from 1000 to 1080 m a.s.l. The mantle of snow persists for about 190-230 days. The month with the maximum total of rainfall is July (Walczak 1961). The duration of the vegetation season is 26 weeks (Kosiba 1948).

## 2.2. Methods

The mountain range has been divided into study sites according to map grid ATMOS (Ochyra & Szmajda 1981). The size of the site was 1 square kilometre. Each of 93 square unit has been thoroughly surveyed by authors. The moss species were noted in recording cards. Additionally, the cards comprised: GPS position with altitude, features of habitat, types of substrate, information about fertility and/or asexual reproduction. For each species the relative frequency in the square was recognised and then it was assessed as follows according to a three degree scale (1 – sporadic species, 2 – frequent species and 3 – general species). The same valuation method was used for the assessment of the relative frequency in plant communities.

Mosses which could not be identified in the field with certainty or considered useful for herbarium records, where intentionally collected, observing that no population was harmed by the amount of collected material. Specimens are housed both in the private herbarium of the first author and in the OP herbarium (Silesian Museum in Opava, Czech Republic). The species names follow the Census Catalogue of Polish Mosses (Ochyra *et al.* 2003). Categories of threatened mosses (given in parentheses after the species names) correspond to Żarnowiec *et al.* (2004).

## 3. Results

From amongst all the recorded taxa, only the mosses which due to their occurrence in the Bialskie Mts. are considered to be interesting, were chosen to be commented in the article. The below-mentioned species were divided according to different types of habitat and are arranged in alphabetical order.

### 3.1. Stream surroundings

Deep and shaded valleys in the mountains create suitable living conditions for a wide spectrum of hygrophilous bryophytes. The following mosses can be considered to be the most interesting among those recorded:

*Hygroamblystegium tenax* (Hedw.) Jenn. [R] – an occasionally occurring moss growing mainly on flooded stones in streams. In the mountains it was recorded only in the Morawka stream near the foot of Jawornik Kobyliczny hill.

*Blindia acuta* (Hedw.) Bruch & Schimp. – a species common on sprinkled stones and rocks in the high-mountain regions but occasionally it grows at medium altitudes. It was recorded in the stream near the base of Łysiec hill and in the Tylnik stream at the foot of Zawodzisko hill).

*Hygrohypnum* ssp. – a bryophyte genus typical for flooded stones in mountain streams, where it forms loose, untidy patches, usually of a dull yellowish or

brownish green colour. Three species of the genus were recorded in the study area: *H. duriusculum*, *H. luridum* and *H. ochraceum*.

*H. duriusculum* D. W. Jamieson – the most interesting of them is considered to be very rare in the medium altitudes. Nevertheless, in the the Bialskie Mts. it seems to be fairly frequent with 6 known localities: the stream near the foot of Jawornik Krowi hill; the Lewa Widełka stream in the 'Nowa Morawa' Reserve; the valley of the Działowy Spław stream; the valley of the Biała Łądecka river near the village of Goszów; the valley of the Tylnik stream near the foot of Gierałtowska Kopa hill; the valley of the Biała Łądecka river between the villages of Nowy Gierałtów and Bielice.

*H. luridum* (Hedw.) Jenn. – occurs in only one locality (Morawka stream in Nowa Morawa Reserve) and seems to be very rare there.

*H. ochraceum* (Turner ex Wilson) Loeske – the most common species in the study area. Its plentiful populations overgrow many stones in the Tylnik stream; in the Biała Łądecka river; in a stream near the foot of Jawornik Krowi hill; in the Długi Spław valley; in the Bielawka stream; in a stream near the foot of Rudawiec Mt. and in the Działowy Spław stream.

### 3.2. Rocky outcrops

Rocks and rock outcrops are composed mainly of granite and gneiss layers in the region. Many of them are situated in shaded forests or in the valleys of streams. They are only sporadically situated on the summits of hills and then occur on exposed and dried rocks.

*Cynodontium strumiferum* (Hedw.) Lindb. grows predominantly on shaded but dried rock walls or ledges. The species can be confused with *C. polycarpon* (Hedw.) Schimp. which is very common in the Bialskie Mts., but when capsule-bearing *C. strumiferum* can be distinguished by its strumose capsule. Till this time only 4 localities were recorded there: Jawornik Krowi hill; Jawornik Kobyliczny hill; Zawodzisko hill and Piekelnica hill.

*Seligeria recurvata* (Hedw.) Bruch & Schimp. – is an only 2-6 mm long moss. The diagnostic character lies in the seta which is curved in the moist condition. It appears to be a primary colonist of sandstone rocks or stones, but demands a fair moisture supply and at least partial shade. There was just one locality found in the Bialskie Mts. – on a rock outcrop above the Młyńska path.

*Brachydontium trichodes* (F. Weber) Milde [R] – is a widely distributed but uncommon moss which resembles *Seligeria* ssp. in its minute size (only about 2-5 mm). However, *B. trichodes* forms capsules with conspicuous ridges and furrows, whereas all species of the genus *Seligeria* have a smooth capsule wall. It grows on moist and shaded siliceous rocks or boulders mainly

in mountain regions. In the whole Sudetes the species is considered to be scattered, potentially it can be overlooked. Due to the thorough survey, 12 localities were discovered in the mountains: the Kłodniczy Dół valley; the slopes of Jawornik hill; the Pod Działem saddle; the valley of the Bielawka stream near the Szarogłaz rocks; Chłopska Kopa hill; the valley of the Przednik stream; the valley of the Gołogórski stream; Czernica Mt.; Orlik Mt.; the valley of a stream at the foot of Jawornik Krowi hill; the valley of a stream near the foot of Pustosz hill; the valley of Złoty Potok stream.

*Campylostelium saxicola* (F. Weber & D. Mohr) Bruch & Schimp [I] – is a very small (about 3-6 mm) hygrophilous species. It prefers moist boulders near streams or shaded stones along forest paths. With regard to the fact that the ecological requirements of this species are very similar to that of *Brachyodontium trichodes*, it is not surprising they often grow together. However, *Campylostelium saxicola* seems to be less common. The species was found at 6 localities: on the slopes of Płaska hill; in the valley of the Gołogórski stream; in the Pod Działem saddle; in the valley of the Bielawka stream near the Szarogłaz rocks; on Jawornik Krowi hill and on Pustosz hill.

*Tetradontium repandum* (Funck) Schwägr. [I] – is a minute (only about 2 mm long) moss that grows on the underside of overhanging, moist, rock crevices near streams. It was recorded in 2 microlocalities within the valley of the Bielawka stream near the Szarogłaz rocks.

### 3.3. Forest habitats

Coniferous and mixed forest cultivations predominate in the mountain range. At higher altitudes also fragments of primeval forests have been preserved. The following mosses can be mentioned as the most interesting to colonize forest habitat:

*Ptilium crista-castrensis* (Hedw.) De Not – is a striking species, which occasionally grows on the ground beneath conifers, mainly in the mountain regions. In the whole Sudetes it seems to be a scattered species. In the study area it was found only two times. In both of those places the species overgrew decaying spruce wood in a managed coniferous forest (Jawornik Krowi hill; Szeroka Kopa hill).

*Hylocomiastrum umbratum* (Ehrh. ex Hedw.) M. Fleisch. ex Broth. – is an uncommon montane moss known almost exclusively from southern Poland. It is widely distributed but scattered in the Sudetes. According to published data, the species only occasionally descends below 1000 m penetrating into the upper part of the lower forest belt (Ochyra *et al.* 1992). However, in the study area it grows at altitudes around 780 m a.s.l. – on the slope of Jawornik Krowi hill. Previously the species was observed by Lisowski in 1959 on Rudawiec hill (Ochyra *et al.* 1992).

*Orthodontium lineare* Schwägr. – an invasive moss growing mainly on dry rotten spruce stumps and logs in managed spruce monocultures e.g. in the village of Młynowiec, Jawornik Krowi hill; the E edge of the village of Nowa Morawa, Średniak hill; the E edge of village of Bolesławów, Suszyca Mt; Łysiec hill; Chłopska Kopa hill and its foothill. Precise data about the distribution and ecology of the species will be presently published (Stebel *et al.* 2005).

### 3.4. Bare soil

Places such as arable or stubble fields, edges of the forest paths, mole-hills on meadows and other short-term habitats are colonized mainly by ephemeral moss species, for example:

*Acaulon muticum* (Schreb. ex Hedw.) Müll. Hal. [R] – is a very rare, small (only 0.5-2 mm) moss colonizing open soil mainly in sunny and warm places. In mountain regions it occurs very sparsely. In the study area it grows in an open soil-gap between grass vegetation on a meadow near the village of Młynowiec.

Another small moss *Ephemerum serratum* var. *angustifolium* (Bruch & Schimp.) Bruch & Schimp. [R] was recorded in the same locality. Since the variety has not strictly been formerly distinguished, its current distribution in Poland is unknown. But it seems to be more frequent than *E. serratum* var. *serratum* which was not observed in the Bialskie Mts. till present.

On the bare wayside of forest paths, within the population of *Ditrichum heteromallum* (Hedw.) E. Britton, an occurrence of the rare moss *Dicranella subulata* (Hedw.) Schimp. was observed. It was recorded in 2 localities (Bialska Pętla forest path; at the foot of Jawornik Krowi hill) and produced both capsules and gemmae.

### 3.5. Old solitary and roadside trees

Epiphytic bryophytes as well as lichens were strongly harmed during the last five decades mainly by atmospheric pollution. At present we can witness the recolonization of epiphytes onto their previous habitats. In the Bialskie Mts., due to the quantity of old deciduous trees and humid climate, epiphytic covers are currently well developed. The Orthotrichaceae family seems to be the most interesting in this sense. Eleven species from the family were recorded there. All of them (*Orthotrichum affine* Schrad. ex Brid., *O. anomalum* Hedw., *O. diaphanum* Schrad. ex Brid., *O. obtusifolium* Brid., *O. pumilum* Sw. ex anon., *O. pallens* Bruch ex Brid., *O. stramineum* Hornsch. ex Brid. [R], *O. speciosum* Nees, *O. striatum* Hedw. [R], *Ulota bruchii* Hornsch. ex Brid. and *U. crispa* (Hedw.) Brid. grow on the bark of trees in spite of *O. anomalum* being above all an epilithic moss. Some of the recorded epiphytic bryophytes belong to expansive mosses, e.g. *Dicranoweisia cirrata* (Hedw.)

Lindb. and *Orthodicranum tauricum* (Sapjegin) Smirnova (Stebel & Plášek 2001). Large populations of *Dicranowiesia cirrata* were observed on the bark of old willows near the village of Młynowiec. The moss *Orthodicranum tauricum* was recorded on the bark of an old beech in the Działowe Siodło saddle.

### 3.6. Animal excrements

Some nitrophilic mosses, e.g. species within the Splachnaceae family, usually grow on the excrements of animals, utilising organic substances for their nutrition (coprophilous mosses).

The moss *Splachnum sphaericum* Hedw. [E] was observed as growing on the excrements of the deer (*Cervus elaphus*) on the slopes of Czernica Mts. Only a small and sterile population was recorded there, but in any case the species is unmistakable.

*Tayloria tenuis* (Dicks.) Schimp. [I] grows on animal excrements as well as on humus or rotten wood. In the study area the species was recorded on the decaying wood in the Puszcza Śnieżnej Białki Reserve. The rich, fertile population was observed there both in 2004 and 2005.

### 3.7. Anthropogenic surface

Human-made constructions like walls, roofs, bridges, roads or other artificial surfaces are colonised by mosses as commonly as natural habitats.

*Distichium capillaceum* – is a pale green moss which indicates the presence of even the smallest amounts of lime. It mostly colonizes basic rocks in mountains but in the study area it was recorded on an old concrete wall near the Morawka stream. Previously, the species was observed by Lisowski in 1959 on a concrete wall in the village of Bielice (Lisowski 1959).

## 4. Conclusions

The above-mentioned species are only a part of all recorded moss taxa in the Bialskie Mts. (34 out of 213 taxa). In this paper very interesting species are commented in detail in the light of their habitat, substrata preferences, way of propagation, presence of propagules and also of their spreading within the studied site. The gathered data allows us to precisely indicate both the most valuable part of the area and the method of conservation of valuable moss species.

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