

Contribution to the bryoflora of the Chochołowska Valley in the Polish Tatra Mountains

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Received: 23 October 2018; Revised submission: 27 November 2018; Accepted: 19 December 2018

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DOI: <http://dx.doi.org/10.5281/zenodo.2546974>

ABSTRACT

The paper presents a list of 64 moss species recorded in the Chochołowska Valley (including Wyżnia Chochołowska Valley, Jarząbcza Valley and the surrounding peaks). Detected taxa belong to 25 families. Among them, the most commonly represented are Polytrichaceae (9 species), Dicranaceae (6), Pottiaceae (6), Hylocomiaceae (5), Hypnaceae (5), Grimmiaceae (4), and Bryaceae (4). Mosses were collected from different substrates, but they usually grew on humus (37 taxa), which sometimes covered with a thin layer of granite or limestone gravel. 15 species were found on epilithic habitats, especially on limestone rocks (10), while 8 species occurred on wood or tree trunks. Some mosses occupied synanthropic habitats (6 species). For example, apophytes widely distributed in the lowlands: *Tortula muralis*, *Dryptodon pulvinatus*, and *Schistidium crassipilum* were recorded on the wall near the PTTK shelter on the Chochołowska Glade, whereas an oreoapophyte – *Pogonatum urnigerum* grew on the path in Wyżnia Chochołowska Valley.

Keywords: Bryoflora; Mosses; Distribution; Tatra Mountains; Chochołowska Valley; Jarząbcza Valley.

1. INTRODUCTION

The Tatra Mountains form the highest massif in the Carpathians occupying about 785 km² of which 175 km² are located in Poland [1]. The Chochołowska Valley is the longest (9.7 km) and the largest in terms of area (34.78 km²) valley in the Polish Tatra Mts exhibiting considerable geological and geomorphological diversity [2, 3]. In the lower (northern) part, it narrows forming the so-called gates: Niżnia Chochołowska Gate and Wyżnia Chochołowska Gate. The upper (southern) part of the valley splits into three main branches: the Wyżnia Chochołowska, Jarząbcza, and Starorobociańska valleys. The upper part of the Chochołowska Valley developed mainly in the crystalline rocks (gneisses, schists, granites), and it has been shaped by the glacier action. In turn, the lower part of the valley is built of the sedimentary rocks (dolomites and limestones as well as marly shales and sandstones), and it is distinguished by the karst forms [2, 4].

The bryoflora of the Polish Tatras is very rich – it comprises about 450 mosses and about 200 liverworts [5-8] including about 70% of the moss species and about 80% of the liverworts known in Poland [9, 10]. On the other hand,

tourism-related anthropopressure, which has been growing for many years, may lead to the disappearance of rare and protected bryophytes and the expansion of common hemerophilic species. Large and easily accessible mountain valleys, such as the Kościeliska and Chochołowska valleys, are particularly susceptible to the unfavorable processes described above [11, 12]. In this context, it seems important to present unpublished bryological notes and to collect new data that could enrich our knowledge about the contemporary changes of the mountain plant cover. The article shows archival bryological data (from 2003-2004) obtained during two short field studies in the Chochołowska Valley.

2. MATERIALS AND METHODS

The present paper provides a list of the moss species found in the Chochołowska Valley (including Wyżnia Chochołowska Valley, Jarząbcza Valley and the surrounding peaks) during two Geobotanical Schools organized by the late Prof. Stanisław Balcerkiewicz (Department of Plant Ecology and Environmental Protection, Adam Mickiewicz University, Poznań, Poland). Field investigations were carried out in August 2003 and 2004. Mosses were collected from different substrates, including synanthropic habitats. The

species are listed according to families with the moss nomenclature following Ochrya et al. [9]. For each taxa the type of habitat, locality, and altitude above sea level (m a.s.l.) were given.

3. RESULTS

During two short field investigations conducted in the Chochołowska Valley, 64 moss species from 25 families were found (Table 1). Polytrichaceae (9 species), Dicranaceae (6), Pottiaceae (6), Hylocomiaceae (5), Hypnaceae (5), Grimmiaceae (4), and Bryaceae (4) belonged to the most represented families. Mosses occurred mainly on humus (37 taxa), which sometimes covered with a thin layer of granite or limestone gravel. 15 species were collected from epilithic habitats, especially from limestone rocks (10), while 8 species grew on wood or tree trunks. Some mosses occupied synanthropic habitats (6 species). For example, apophytes widely distributed in the lowlands: *Tortula muralis*, *Dryptodon pulvinatus*, and *Schistidium crassipilum* grew on the wall near the PTTK shelter on the Chochołowska Glade. In turn, on the path in Wyżnia Chochołowska Valley, *Pogonatum urnigerum* – an oreoapophyte (montane species spreading on secondary habitats) was found.

Table 1. Moss species recorded in the Chochołowska Valley.

Andreaeaceae Dumort.	
<i>Andreaea rupestris</i> Hedw.	- on granite rocks, Mt Grześ, alt. 1620 m a.s.l.
Polytrichaceae Schwägr.	
<i>Atrichum undulatum</i> (Hedw.) P.Beauv.	- on humus, Chochołowska Valley, alt. 970 m a.s.l., Bobrowiecki Couloir, alt. 1130 m a.s.l.
<i>Oligotrichum hercynicum</i> (Hedw.) Lam. & DC.	- on humus in granite gravel, Wyżnia Chochołowska Valley, alt. 1470 m a.s.l.; on humus in granite gravel, Mt Grześ, alt. 1600-1650 m a.s.l.
<i>Pogonatum urnigerum</i> (Hedw.) P.Beauv.	- on humus in granite gravel, Mt Grześ, alt. 1620- 1650 m a.s.l.; on the path, Wyżnia Chochołowska Valley, alt. 1530 m a.s.l.
<i>Polytrichastrum alpinum</i> (Hedw.) G.L.Sm.	- on humus in granite gravel, Mt Wołowiec, alt. 1960 m a.s.l.
<i>P. formosum</i> (Hedw.) G.L. Smith.	- on humus, Jarząbcza Valley, alt. 1350 m a.s.l.
<i>P. sexangulare</i> (Brid.) G.L.Sm.	- on humus, Jarząbcza Valley, alt. 1660 m a.s.l.
<i>Polytrichum piliferum</i> Hedw.	- on humus, Chochołowska Valley, alt. 1070 m a.s.l.
<i>P. juniperinum</i> Hedw.	- on humus, Bobrowiecki Couloir, alt. 1180 m a.s.l.
<i>P. strictum</i> Menzies ex Brid.	- on humus in granite gravel, Mt Grześ, alt. 1610 m a.s.l.

Tetraphidaceae Schimp.

Tetraphis pellucida Hedw. - on rotten wood, Bobrowiecki Couloir, alt. 1240 m a.s.l.

Encalyptaceae Schimp.

Encalypta streptocarpa Hedw. - on limestone rock, Dudowa Valley, alt. 1080 m a.s.l.; on humus, Wyżnia Chochołowska Valley, alt. 1490 m a.s.l.

Ditrichaceae Limpr.

Ditrichum flexicaule (Schwägr.) Hampe - on humus, Wyżnia Chochołowska Valley, alt. 1430 m a.s.l.

Ceratodon purpureus (Hedw.) Brid. - on humus near the shelter, Chochołowska Glade, alt. 1140 m a.s.l.

Distichium capillaceum (Hedw.) Bruch & Schimp - on limestone rock, Dudowa Valley, alt. 1080 m a.s.l.

Dicranaceae Schimp.

Dicranum polysetum Sw. ex anon. - on humus, Mt Wołowiec, alt. 2010 m a.s.l.

D. scoparium Hedw. - on humus, Bobrowiecki Couloir, alt. 1160 m a.s.l.

Orthodicranum montanum (Hedw.) Loeske - on rotten wood, Chochołowska Glade, alt. 1140 m a.s.l.

Dicranella heteromalla (Hedw.) Schimp. - on tree stump, Bobrowiecki Couloir, alt. 1190 m a.s.l.; on humus in granite gravel, Wyżnia Chochołowska Valley, alt. 1470 m a.s.l.

Dicranodontium denudatum (Brid.) E.Britton - on rotten wood, Bobrowiecki Couloir, alt. 1280 m a.s.l.

Diobelonella palustris (Dicks.) Ochyra - on humus, near the Chochołowski Stream, alt. 1040 m a.s.l.

Grimmiaceae Arn.

Dryptodon pulvinatus (Hedw.) Brid. - on the wall near the shelter, Chochołowska Glade, alt. 1140 m a.s.l.

Schistidium crassipilum H.H.Blom - on the wall near the shelter, Chochołowska Glade, alt. 1140-1150 m a.s.l.

Racomitrium lanuginosum (Hedw.) Brid. - on humus in granite gravel, Mt Wołowiec, alt. 1950 m a.s.l.

Bucklandiella microcarpa (Hedw.) Bednarek-Ochyra & Ochyra - on granite, Mt Rakoń, alt. 1850 m a.s.l.

Pottiaceae Schimp.

Tortella tortuosa (Hedw.) Limpr. - stones near the stream, Wielkie Koryciska Valley, alt. 1050 m a.s.l.; on humus in limestone gravel, Dudowa Valley, alt. 1060 m a.s.l.; on limestone rock, Chochołowska Glade, alt. 1100 m a.s.l.

Bryoerythrophyllum recurvirostrum (Hedw.) P.C.Chen - on limestone rock, Chochołowska Glade, alt. 1100 m a.s.l.; on humus, Wyżnia Chochołowska Valley, alt. 1430 m a.s.l.

Gymnostomum aeruginosum Sm. - on humus, Wyżnia Chochołowska Valley, alt. 1440 m a.s.l.

Didymodon giganteus (Funck) Jur. - on humus in limestone gravel, Chochołowska Valley, alt. 980 m a.s.l.

Tortula muralis Hedw. - on the wall near the shelter, Chochołowska Glade, alt. 1140-1150 m a.s.l.

Syntrichia ruralis (Hedw.) F.Weber & D.Mohr - on humus, Chochołowska Valley, alt. 1020 m a.s.l.; on humus near the shelter, Chochołowska Glade, alt. 1140-1150 m a.s.l.; on humus, Mt Rakoń, alt. 1850 m a.s.l.

Bryaceae Schwägr.

Pohlia nutans (Hedw.) Lindb. - on humus in granite gravel, Chochołowska Valley, alt. 1030 m a.s.l.; on humus, Bobrowiecki Couloir, alt. 1180 m a.s.l.; on humus in granite gravel, Wyżnia Chochołowska Valley, alt. 1470 m a.s.l.

Pohlia cruda (Hedw.) Lindb. - on humus in granite gravel, Mt Rakoń, alt. 1830 m a.s.l.

Bryum caespiticium Hedw. - on humus, Chochołowska Valley, alt. 970 m a.s.l.

B. schleicheri Schwägr. - in the stream, Wielkie Koryciska Valley, alt. 1040 m a.s.l. (Fig. 1).

Aulacomniaceae Schimp.

Aulacomnium palustre (Hedw.) Schwägr. - on humus, Wyżnia Chochołowska Valley, alt. 1530 m a.s.l.

Bartramiaceae Schwägr.

Plagiopus oederiana (Sw.) Limpr. - on humus, Wyżnia Chochołowska Valley, alt. 1400 m a.s.l.

Cinclidiaceae Kindb.

Rhizomnium punctatum (Hedw.) T.J.Kop. - on humus, Chochołowska Valley, alt. 1050 m a.s.l.

Plagiomniaceae T.J.Kop.

Plagiomnium medium (Bruch & Schimp.) T.J.Kop. - on humus, Chochołowska Glade, alt. 1130 m a.s.l.

P. undulatum (Hedw.) T.J.Kop. - on humus, Chochołowska Valley, alt. 1060 m a.s.l.

Mniaceae Schwägr.

Mnium marginatum (Dicks.) P.Beauv. - on humus, Wyżnia Chochołowska Valley, alt. 1430 m a.s.l.

M. stellare Reichard ex Hedw. - on limestone rock, Dudowa Valley, alt. 1080 m a.s.l.

Climaciaceae Kindb.

Climacium dendroides (Hedw.) F.Weber & D.Mohr - on humus, Chochołowska Valley, alt. 940 m a.s.l.

Fontinalaceae Schimp.

Fontinalis antipyretica Hedw. - on granite rock in the stream, Jarząbcza Valley, alt. 1310 m a.s.l.

Neckeraceae Schimp.

Neckera crispa Hedw. - on limestone rock, Dudowa Valley, alt. 1070 m a.s.l.

Thuidiaceae Schimp.

Thuidium philibertii Limpr. - on limestone rock, Chochołowska Valley, alt. 1130 m a.s.l.

Helodiaceae (M.Fleisch.) Ochyra

Palustriella commutata (Hedw.) Ochyra - in the stream, Wielkie Koryciska Valley, alt. 1040 m a.s.l. (Fig. 1).

Hylocomiaceae (Broth.) M.Fleisch.

Hylocomium splendens (Hedw.) Schimp. - amongst grass, Dudowa Valley, alt. 1070 m a.s.l.

Pleurozium schreberi (Willd. ex Brid.) Mitt. - amongst grass, Bobrowiecki Couloir, alt. 1230 m a.s.l.; on humus, Jarząbcza Valley, alt. 1350 m a.s.l.; on humus, Mt Wołowiec, alt. 2010 m a.s.l.

Rhytidiadelphus loreus (Hedw.) Warnst. - amongst grass, Chochołowska Glade, alt. 1100 m a.s.l.

R. subpinnatus (Lindb.) T.J.Kop. - amongst grass, Chochołowska Glade, alt. 1120 m a.s.l.

R. triquetrus (Hedw.) Warnst. - amongst grass, Chochołowska Glade, alt. 1120 m a.s.l.

Rhytidiaceae Broth.

Rhytidium rugosum (Ehrh. ex Hedw.) Kindb. - on limestone rock, Chochołowska Valley, alt. 1060 m a.s.l.

Brachytheciaceae Schimp.

Homalothecium philippeanum (Spruce) Schimp. - on humus in limestone gravel, Wyżnia Chochołowska Valley, alt. 1580 m a.s.l.

Brachythecium rivulare Schimp. - on rocks near Bobrowiecki Stream, alt. 1210 m a.s.l.

B. glareosum (Bruch ex Spruce) Schimp. - on bark of tree, Bobrowiecki Couloir, alt. 1210 m a.s.l.

Plagiotheciaceae (Broth.) M.Fleisch.

Plagiothecium curvifolium Schlieph. ex Limpr. - on tree basis, Chochołowska Valley, alt. 960 m a.s.l.

Amblystegiaceae Kindb.

Sanionia uncinata (Hedw.) Loeske - on humus near stream, Chochołowska Valley, alt. 1030 m a.s.l.

Campylium stellatum var. *protensum* (Brid.) Bryhn - on humus, Chochołowska Valley, alt. 1160 m a.s.l.

Hypnaceae Schimp.

Buckiella undulata (Hedw.) Ireland - on wood, Chochołowska Valley, alt. 1020 m a.s.l.

Hypnum cupressiforme Hedw. - on the bark of tree, Bobrowiecki Couloir, alt. 1160 m a.s.l.

Callicladium haldanianum (Grev.) H.A.Crum - on humus, Wyżnia Chochołowska Valley, alt. 1400 m a.s.l.

Orthothecium rufescens (Dicks. ex Brid.) Schimp. - stones near the stream, Wielkie Koryciska Valley, alt. 1050 m a.s.l.; on limestone rock, Mt Wołowiec, alt. 2010 m a.s.l.

Ctenidium molluscum (Hedw.) Mitt. - on limestone rock, Chochołowska Glade, alt. 1050 m a.s.l. (Fig. 2).



Figure 1. *Palustriella commutata* (Hedw.) Ochyra and *Bryum schleicheri* Schwägr. in the Wielkie Koryciska Valley.



Figure 2. *Ctenidium molluscum* (Hedw.) Mitt. on the Chochołowska Glade.

4. DISCUSSION

Bryological studies of the Tatra Mts date back to the beginning of the 19th century, when Göran Wahlenberg (1780-1851) in *Flora Carpatorum principalium...* from 1814 [13] reported 1 hornwort, 30 liverworts, and 130 mosses. In the second half of the 19th century, investigations of the Tatra mosses were conducted, among others, by Richard Fritze and Hugo Ilse [14], Karl G. Limpricht [15], Jakob Juratzka [16], and Frigyes Á. Hazslinszky [17]. Tytus Chałubiński (1820-1889) was the most famous Polish researcher [18, 19]. The first results of the floristic studies in the Tatra Mts he published in 1878 [20] and 1879 [21], listing 207 and 116 moss species, respectively. In the following years, Chałubiński prepared two outstanding monographs concerning the Tatra mosses: *Grimmieae tatrenses* in 1882 [22] and *Enumeratio muscorum frondosorum tatrensium, hucusque cognitorum* in 1886 [23]. In total, he described 422 mosses, of which 365 species were collected himself, including 59 for the first time from the Tatra Mts [19].

After the Second World War, detailed studies of the Tatra mosses were conducted by Stanisław Lisowski. In a monograph published in 1959, he reported 301 moss taxa, including 88 species from Chochołowska, Wyżnia Chochołowska and Jarząbcza valleys [24]. Modernly, it is assumed that about 450 moss species grow in the Tatras [5, 6, 19].

In our studies from the Chochołowska Valley we listed 64 moss species. These investigations were conducted only by some days in two seasons, and they were carried out only along hiking trails or paths. Nonetheless, presented work shows the large diversity and species richness of the Chochołowska Valley mosses. Among the species gathered by Chałubiński and handed in 1888 to the Tatra Museum in Zakopane, Ochyra & Cisło [19] report all collected by us mosses, with the exception of *Callicladium haldanianum*, *Plagiomnium medium* and *Schistidium crassipilum*. The above-mentioned species were also not sampled by Lisowski [24]. Additionally, this author did not list from Tatras some other observed by us mosses: *Bryoerythrophyllum recurvirostrum*, *Bryum caespiticium*, *Dicranum polysetum*, *Dryptodon pulvinatus*, *Mnium stellare*, and *Tortula muralis*. His

later investigations provided new data, including three localities of *Plagiomnium medium* in the Western Tatras [25]. Unfortunately, there is a lack of more recent detailed bryological studies covering the Chochołowska Valley. However, two works deserve special attention: the first one presents a brief review of the Tatra mosses in terms of habitats [6], and the second one describes mosses of the subnival belt from the Polish part of the High Tatras [26].

Our investigations show that the significant part of the Chochołowska Valley moss flora represents synanthropic species. Some of them belong to the apophytes widely distributed in the lowlands [27-29], e.g. *Bryum caespiticium*, *Ceratodon purpureus*, *Dryptodon pulvinatus*, *Hypnum cupressiforme*, *Schistidium crassipilum*, and *Tortula muralis* or they are typically mountain species that spread on secondary habitats beyond their main range of distribution [30] (*Encalypta streptocarpa*, *Mnium marginatum*, *Pogonatum urnigerum*, *Sanionia uncinata*, and *Tortella tortuosa*). Similarly, two other species found earlier in the Chochołowska Valley: *Dicranella staphylina* [11] and *Dicranoweisia cirrata* [12] represent apophytes with a tendency to the expansion.

AUTHOR'S CONTRIBUTION

TK: collecting of moss samples and photos; AR and TK: species identification; TK, AA and AR: a review of the literature; TK and AA: data analysis and manuscript preparation.

CONFLICTS OF INTEREST

The authors have no conflict of interest to declare.

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