



CONTRIBUTION TO THE BRYOFLORA OF THE ŚWIĘTOKRZYSKI NATIONAL PARK (CENTRAL POLAND)

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ABSTRACT. New distribution data for 183 species, one subspecies and four varieties of bryophytes in the Świętokrzyski National Park are provided. The most interesting species (rare, protected and new for the area) are *Anastrophyllum hellerianum*, *Buxbaumia viridis*, *Cephalozia catenulata*, *Dicranum viride*, *Lophozia ascendens*, *Mannia fragrans* and *Tetraplodon angustatus*.

KEY WORDS: mosses, liverworts, protected species, threatened species, distribution data, Świętokrzyski National Park, Poland

INTRODUCTION

The Świętokrzyski National Park was established in 1950, after over forty years of effort to protect this part of Poland. At present, its area covers 7626.45 ha.

According to physico-geographical division of Poland, the Świętokrzyski National Park is situated in the macroregion Kielecka Upland and mesoregion Świętokrzyskie Mountains (KONDRACKI 2009). In respect of geobotanical division it belongs to the Łysogórski

district (SZAFER 1977). The main nature values of the Park are represented by well-preserved forest phytocoenoses, especially Carpathian beech forest *Dentario glandulosae-Fagetum*, upland fir-dominated mixed forest *Abietetum albae* (= *Abietetum polonicum*), and characteristic periglacial stone runs, called here 'gołoborza', with many stations of relict bryophytes and lichens.

The bryoflora of the Świętokrzyski National Park is poorly known and till present few papers containing information on bryophytes have appeared (e.g. BŁOŃSKI 1888, 1889, 1890 a, b, LILIENFELD 1910, ŻMUDA 1917, WIŚNIEWSKI 1935, CZUBIŃSKI and LISOWSKI 1964 a, b, MICKIEWICZ 1965, KARCZMARZ and MICKIEWICZ 1970, BRÓŻ 1985, TRESKA 1990, GŁAZEK and WOLAK 1991). These data were summarized by TRESKA (2000).

The main purpose of this paper is to provide new distribution data for mosses and liverworts in the Park.

MATERIAL AND METHODS

The field investigations were carried out between 11 and 14 September 2012 during the 10th Bryological Workshops of the Polish Botanical Society. The taxa are listed in alphabetical order. Bryophyte nomenclature follows mainly KLAMA (2006 b) and OCHYRA et AL. (2003). Protected species in Poland are given after the 'Regulation of the Minister of the Environment' (2012), threatened species in Poland KLAMA (2006 a) and ŻARNOWIEC et AL. (2004), whereas threatened species in Europe SCHUMACKER and MARTINY (1995).

List of collecting sites

For each locality (Fig. 1) the following information is given: habitat, GPS coordinates, ATMOS grid square (according to OCHYRA and SZMAJDA 1981) and date of investigation.

1. **Święta Katarzyna**, village, between Biały Gościniec and blue tourist track, mixed forest; GPS: 50°54'36"N, 20°53'11"E; ATMOS grid: Ee 66; 11 September 2012.

2. **Łysica**, mount, stone runs on north-facing slope near the summit overgrown by moss-lichen communities, thicket and upland fir-dominated mixed forest (*Abietetum albae*); GPS: 50°53'32"N, 20°53'47"E; ATMOS grid: Ee 76; 12 September 2012.

3. **Agata**, mount, stone runs on north-facing slope near the summit overgrown by moss-lichen communities, thicket and upland fir-dominated mixed forest (*Abietetum albae*); GPS: 50°53'21"N, 20°54'20"E; ATMOS grid: Ee 76; 12 September 2012.

4. **Skarpa Zapusty** near Cząstków village, limestone outcrops overgrown by xerothermic grasslands, thicket and subcontinental linden-oak-hornbeam forest (*Tilio-Carpinetum*); GPS: 50°53'48"N, 21°06'02"E; ATMOS grid: Ee 77; 13 September 2012.

5. **Czarny Las**, strictly protected area, subcontinental linden-oak-hornbeam forest (*Tilio-Carpinetum*) with *Abies alba*, alder swamp forest, often with *Sphagnum* spp. and wetlands in the Czarna Woda stream valley; GPS: 50°54'46"N, 20°55'24"E; ATMOS grid: Ee 66; 14 September 2012.

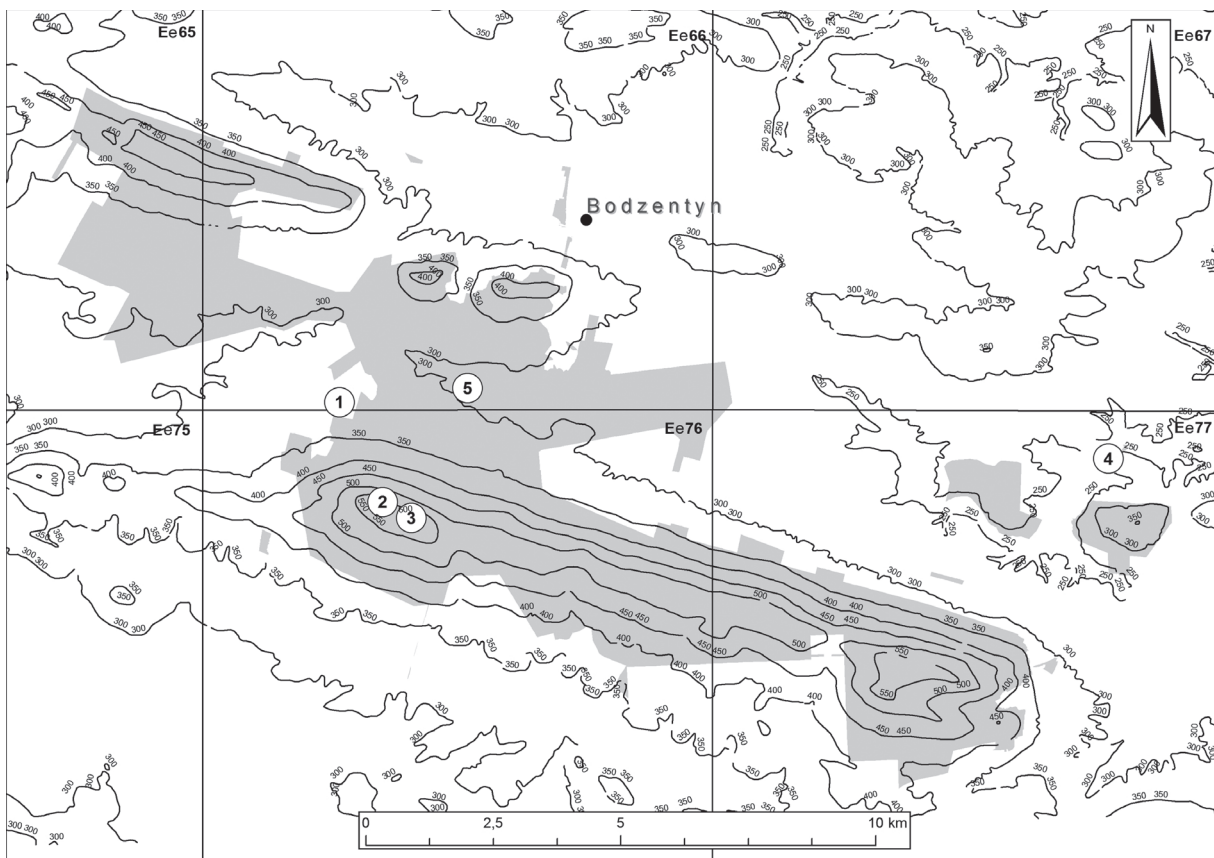


FIG. 1. Map of the investigated area: 1 – Święta Katarzyna, 2 – Łysica, 3 – Agata, 4 – Skarpa Zapusty, 5 – Czarny Las

RESULTS

As a result, localities of 183 species, one subspecies and four varieties of bryophytes were noted (42 species, one subspecies and one variety of liverworts and 141 species and three varieties of mosses). Noteworthy is the occurrence of protected (45) and threatened in Poland (12) and in Europe (5) bryophytes. The most interesting are such species, as *Anastrophyllum hellerianum*, *Buxbaumia viridis*, *Cephalozia catenulata*, *Dicranum viride*, *Lophozia ascendens*, *Mannia fragrans* and *Tetraplodon angustatus*. Their distribution in Poland is discussed below.

Anastrophyllum hellerianum – liverwort known from scattered localities mainly in NE Poland, the Sudetes and in the Carpathians (SZWEJKOWSKI 2006); new to Central Poland,

Buxbaumia viridis – moss very rare in the lowland part of Poland; from the Świętokrzyskie Mts. it is known only from Mt Łysica, where it was collected by K. Kaznowski in 1937 and 1938 (SZMAJDA et AL. 1991 b),

Cephalozia catenulata – liverwort known mainly from the Sudetes, Carpathians and N Poland (SZWEJKOWSKI 2006); new to Central Poland,

Dicranum viride – moss growing mainly in the Carpathians (STEBEL et AL. 2011), in the other parts of Poland on scattered localities; not reported previously from the Świętokrzyskie Mts.,

Lophozia ascendens – liverwort growing almost exclusively in the Sudetes and Carpathians (SZWEJKOWSKI 2006); in the Polish lowlands it is known only from one locality in N Poland (SZWEJKOWSKI and KOZŁICKA 1969); new to Central Poland,

Mannia fragrans – liverwort connected with xerothermic grasslands, at present vanishing in Poland (PIWOWARCZYK and STEBEL 2012); new to the Świętokrzyskie Mts.,

Tetraplodon angustatus – high mountain, coprophilous moss, in Poland known from the Sudetes and its foreland, Carpathians and Świętokrzyskie Mts. (SZMAJDA et AL. 1991 a); confirmed on the localities at Mt Łysica and Mt Agata.

List of species

For each species station habitat, altitude and initials of authors as well as status of the species (protection and threat categories) are provided.

Key: AP – Agnieszka Pierścińska, AR – Anna Rusińska, AS – Adam Stebel, ASa – Anna Salachna, BF – Barbara Fojcik, BP – Bartosz Piwowarski, DS – Dorota Smolińska, EF – Ewa Fudali, GJW – Grzegorz J. Wolski, GV – Grzegorz Vončina, MS – Mirosław Szczepański, MSK – Monika Staniaszek-Kik, MW – Marcin Wilhelm, PG – Piotr Górski, RZ – Robert Zubel, SR – Stanisław Rosadziński, TP – Tomasz Paciorek, ! – species partly protected in Poland, !! – species strictly protected in Poland, ● – species threatened in Europe, * – species threatened in Poland.

Liverworts Marchantiophyta

!! *(V) *Anastrophyllum hellerianum* (Nees ex Lindb.) R.M. Schust. – Agata, 570 m (PG); rotten wood in *Abies alba-Picea abies* forest.

Barbilophozia attenuata (Mart.) Loeske – Agata, 575-608 m (BP, MW, PG, SR); Łysica, 580-600 m (BF, RZ). Rotten wood, humic soil among stones.

Barbilophozia barbata (Schmidel ex Schreb.) Loeske – Agata, 575-608 m (EF, PG); Czarny Las, 310 m (BF); Łysica, 600 m (RZ). Rotten wood, humic soil among stones.

Barbilophozia hatcheri (A. Evans) Loeske – Agata, 575-608 m (AR, BP, EF, MW, PG, SR); Łysica, 550-600 m (AS, BF, DS, GV, RZ, SR). Humic soil, stones.

Barbilophozia lycopodioides (Wallr.) Loeske – Agata, 575-608 m (BP, MW, PG, SR); Łysica, 550-600 m (SR). Humic soil among stones.

! *Bazzania trilobata* (L.) Gray – Agata, 575-608 m (MS, MW); Łysica, 580-600 m (AS, BF, DS, TP). Humic soil among stones.

Blepharostoma trichophyllum (L.) Dumort. – Agata, 575-608 m (BP, PG, SR); Czarny Las, 300 m (GV, SR). Rotten wood.

Calypogeia azurea Stotler & Crotz – Czarny Las, soil, 285-295 m (AS, GV).

Calypogeia integristipula Steph. – Agata, 575-608 m (PG, SR); Czarny Las, 285 m (AS, ASa); Święta Katarzyna, 360-370 m (AS, DS). Rotten wood, humic soil.

Calypogeia muelleriana (Schiffn.) Müll. Frib. – Czarny Las, rotten wood (PG), alder trunk base, 298 m (SR).

*(V) *Calypogeia suecica* (Arnell & J. Perss.) Müll. Frib. – Agata, 575-608 m (BP, MSK, PG); Czarny Las, 290 m (PG). Rotten wood.

Cephalozia bicuspidata (L.) Dumort. – Agata, 575-608 m (AR, BP, SR); Czarny Las, 285-295 m (AS, BP, GV, PG, SR); Święta Katarzyna, 360-370 m (AS, DS). Rotten wood, mineral soil.

!! *(V) *Cephalozia catenulata* (Huebener) Lindb. – Agata, 570 m (PG); rotten wood in *Abies alba-Picea abies* forest.

Cephalozia lunulifolia (Dumort.) Dumort. – Agata, 575-608 m (PG, SR); Czarny Las, 290 m (GV, MW, PG, SR). Rotten wood.

Cephaloziella rubella (Nees) Warnst. – Agata, humic soil among stones, 575-608 m (MSK, PG, SR).

Chiloscyphus pallescens (Ehrh. ex Hoffm.) Dumort. – Czarny Las, rotten wood, wet soil, 290 m (ASa, BP, PG).

Conocephalum conicum (L.) Dumort. – Skarpa Zapusty, slope on the Pokrzywianka river, 245 m (BP); Święta Katarzyna, bank of stream, 360-370 m (AS, DS).

Jamesoniella autumnalis (DC.) Steph. – Czarny Las, rotten wood, 290 m (BP, PG, TP, SR).

Jungermannia gracillima Sm. – Święta Katarzyna, beginning of hiking trail to Mt Agata, wayside, 450 m (PG).

Jungermannia leiantha Grolle – Czarny Las, rotten wood, 290 m (AS, BP, MW, PG, TP).

Lepidozia reptans (L.) Dumort. – Agata, 575-608 m (EF, PG, SR); Czarny Las, 290-303 m (AR, AS, ASa, BF, BP, GV, MS, MW, PG, SR); Łysica, 540-600 m (BF, RZ). Rotten wood.

Lophocolea heterophylla (Schrad.) Dumort. – Agata, 575-608 m (AR, EF, MW, MSK, PG); Czarny Las, 290-303 m (AR, AS, ASa, BF, GV, MW, PG, SR); Łysica, 570-600 m (AS, DS); Skarpa Zapusty, 240 m (ASa). Rotten wood.

Lophocolea minor Nees – Skarpa Zapusty, soil, 240 m (PG, RZ, TP).

●(R) *Lophozia ascendens* (Warnst.) R.M. Schust. – Agata, rotten wood, in *Abies alba-Picea abies* forest, 575-608 m (PG, conf. J. Váňa).

Lophozia ventricosa (Dicks.) Dumort. – Agata, 575-608 m (BP, EF, MW, PG, SR); Łysica, 545-605 m (AS, DS, GJW, GV, RZ). Humic soil, rotten wood, lower part of trees.

!! *(E) *Mannia fragrans* (Balbis) Frye & L. Clark – Skarpa Zapusty, mineral soil in xerothermic grasslands and thicket, 235-240 m (AS, ASa, BP, GV, MS, MW, SR, TP).

Marchantia polymorpha L. subsp. *polymorpha* – Czarny Las, wet peaty soil among *Carex rostrata*, 290 m (ASa).

Marchantia polymorpha L. subsp. *ruderalis* Bischl. & Boisselier – Skarpa Zapusty, wayside, 230-240 m (AS, ASa, BF).

Metzgeria furcata (L.) Dumort. var. *furcata* – Czarny Las, 290-303 m (AS, GV, TP); Łysica, 600 m (RZ); Skarpa Zapusty, 240-245 m (BP, PG). Bark of trees, limestone boulders.

var. *ulvula* Nees – Czarny Las, bark of trees, 290 m (GV).

!! *(V) *Nowellia curvifolia* (Dicks.) Mitt. – Agata, 575-608 m (BP, PG); Czarny Las, 290-303 m (AR, AS, ASa, BF, BP, GV, MS, MW, PG, SR, TP). Rotten wood.

Pellia endiviifolia (Dicks.) Dumort. – Skarpa Zapusty, slope on the river Pokrzywianka, 245 m (BP).

Pellia epiphylla (L.) Corda. – Czarny Las, 285-300 m (ASa, BF, PG); Święta Katarzyna, 360-370 m (AS, DS). Soil.

! *Plagiochila asplenoides* (L. emend. Taylor) Dumort. – Agata, 575-608 m (PG); Czarny Las, 285-303 m (AP, AS, BF, GV, MS, SR, TP); Łysica, 540 m (AS, BF, DS); Święta Katarzyna, 360-370 m (AS, DS). Humic soil in *Abies alba-Picea abies* forest, wet soil in thicket.

Plagiochila porelloides (Nees) Lindenb. – Agata, 600 m (BP); Czarny Las, 290-303 m (AR, AS, ASa, BP, GV, PG); Skarpa Zapusty, 240 m (BP, PG, RZ). Rotten wood, limestone boulders, soil.

*(E) *Porella platyphylla* (L.) Pfeiff. – Skarpa Zapusty, limestone outcrops, 235-245 m (AS, ASa, BF, GV, MS, PG, RZ, SR).

Ptilidium pulcherrimum (Weber) Vain. – Agata, 575-608 m (AR, BP, EF, MS, MW, PG); Czarny Las, 290 m (AS); Łysica, 545-610 m (AS, BF, DS, GJW, GV, RZ, TP). Rotten wood, stones, bark of trees.

Radula complanata (L.) Dumort. – Skarpa Zapusty, limestone boulder, 240 m (PG).

Riccardia latifrons (Lindb.) Lindb. – Czarny Las, rotten wood, 290-300 m (ASa, BF, GV, PG, SR).

Riccardia palmata (Hedw.) Carruth. – Czarny Las, rotten wood, 285-295 m (AS, BP, GV, MW, PG).

Riccia sorocarpa Bisch. – Skarpa Zapusty, soil, 245 m (ASa, BP).

Scapania irrigua (Nees) Nees – Czarny Las, peaty soil on edge of wetlands, among *Carex rostrata*, 285 m (AS, ASa).

Scapania nemorea (L.) Grolle – Czarny Las, rotten wood, 290-300 m (AS, BF, BP).

Scapania undulata (L.) Dumort. – Czarny Las, at base of *Salix* sp. on edge of wetlands, on ground in alder

forest, 285 m (ASa, PG); Święta Katarzyna, boulders in stream, 360-370 m (AS, DS).

Mosses Bryophyta

! *Abietinella abietina* (Hedw.) M. Fleisch. – Skarpa Zapusty, limestone outcrops, grassland, 230-240 m (AR, AS, GV, MS, MW, RZ, SR).

Aloina rigida (Hedw.) Limpr. – Skarpa Zapusty, mineral soil on limestone outcrop, 245 m (BF).

!!●(R)* (R) *Amblystegium radicale* (P. Beauv.) Schimp. – Czarny Las, on ground in alder forest, 285 m (BF).

Amblystegium serpens (Hedw.) Schimp. – Agata, 598 m (EF, MSK); Skarpa Zapusty, 230-245 m (BF, BP, GV, MS, MW, RZ, SR). Bark of trees, soil.

!! *Andreaea rupestris* Hedw. – Agata, 580-590 m (MS); Łysica, 570-600 m (AS, DS, GJW, TP). Insolated stones.

!! *Anomodon attenuatus* (Hedw.) Huebener – Skarpa Zapusty, limestone outcrops in thicket, 240-245 m (BF, RZ, SR).

!! *Anomodon viticulosus* (Hedw.) Hook. & Taylor – Skarpa Zapusty, limestone outcrops, 235-245 m (AS, BF, BP, GJW, GV, MS).

Atrichum undulatum (Hedw.) P. Beauv. – Czarny Las, 285-310 m (AS, BF, MS, SR); Łysica, 590 m (BF); Skarpa Zapusty, 230-240 m (AS, BF, BP, MS, MW, RZ, SR). Soil in forest, moist loess.

Aulacomnium androgynum (Hedw.) Schwägr. – Czarny Las, rotten wood, 290-303 m (AR, BF, GV, SR); Skarpa Zapusty, soil, 240-245 m (MS).

! *Aulacomnium palustre* (Hedw.) Schwägr. – Czarny Las, wetlands, moist soil in alder forest, 285-290 m (AR, AS, BF, BP, GV, SR).

Barbula convoluta Hedw. – Skarpa Zapusty, soil, limestone outcrop, 240-245 m (MS, SR).

Barbula unguiculata Hedw. – Skarpa Zapusty, soil, 245 m (AR, BF, GV, SR).

Brachythecium velutinum (Hedw.) Ignatov & Huttunen – Agata, 598 m (EF, MSK); Czarny Las, 285-303 m (AS, BF, GV); Skarpa Zapusty, 245 m (BF, SR). Rotten wood, bark, soil.

Brachythecium glareosum (Bruch ex Spruce) Schimp. – Skarpa Zapusty, grassland, 235-245 m (AR, GJW, MW).

Brachythecium rivulare Schimp. – Czarny Las, wet place, 290 m (GV, SR); Święta Katarzyna, boulders in stream, 360-370 m (AS, DS).

Brachythecium rutabulum (Hedw.) Schimp. – Agata, 598-604 m (AR, MW, MSK); Czarny Las, 285-303 m (AR, AS, BF, BP, GV, SR); Skarpa Zapusty, 235-240 m (AS). Bark of trees, rotten wood.

Brachythecium salebrosus (Hoffm. ex F. Weber & D. Mohr) Schimp. – Agata, 598-604 m (AR, MW, MSK); Czarny Las, 310 m (BF, SR). Rotten wood.

Bryoerythrophyllum recurvirostrum (Hedw.) P.C. Chen – Skarpa Zapusty, soil, limestone outcrops, 235-240 m (AS, BF, MS, SR).

Bryum argenteum Hedw. – Skarpa Zapusty, limestone outcrops, 235-245 m (BF, GJW, GV, MW, SR).

Bryum caespiticium Hedw. – Skarpa Zapusty, mineral soil on slope, 235-240 m (AS).

Bryum dichotomum Hedw. – Skarpa Zapusty, mineral soil on slope, 245 m (BF).

Bucklandiella microcarpa (Hedw.) Bednarek-Ochyra & Ochyra – Agata, 598-608 m (AR, EF, MS, MW, SR);

Lysica, 545-605 m (AS, BF, DS, GJW, GV, TP). Insolated stones.

!! ●(V)*(E) *Buxbaumia viridis* (Moug. ex Lam. & DC) Brid. ex Moug. & Nestl. – Czarny Las, 290 m (MS). Rotten log of *Abies alba* in linden-oak-hornbeam forest. Three sporophytes were observed.

●(RT) *Callicladium haldanianum* (Grev.) H.A. Crum – Czarny Las, rotten wood, base of trunks of aspen and birch in mixed forest, 290-303 m (AS, BF, BP, GV, SR).

Calliergon cordifolium (Hedw.) Kindb. – Czarny Las, wetlands in the Czarna Woda stream valley, wet place in alder forest, 285 m (AS, BF, SR).

! *Calliergonella cuspidata* (Hedw.) Loeske – Czarny Las, moist soil in alder forest, 285 m (AS, BF, BP, SR, TP).

Campyliadelphus chrysophyllus (Brid.) R.S. Chopra – Skarpa Zapusty, mineral soil in thicket, 240-245 m (AR, BP, MS).

Campylophyllopsis calcarea (Crundwell & Nyholm) Ochyra – Skarpa Zapusty, mineral soil, 245 m (AR, BF, GJW, GV).

Ceratodon purpureus (Hedw.) Brid. – Czarny Las, 290 m (AR, AS); Łysica, 550-600 m (BF, AS, DS, TP); Skarpa Zapusty, 245 m (BF, GJW, SR). Soil, stones.

Cirriphyllum crassinervium (Taylor) Loeske & M. Fleisch. – Skarpa Zapusty, limestone outcrops, 240-245 m (AS, BF).

! *Climacium dendroides* (Hedw.) F. Weber & D. Mohr. – Czarny Las, moist soil in alder forest, 298 m (SR).

Ctenidium molluscum (Hedw.) Mitt. – Skarpa Zapusty, mineral soil in linden-oak-hornbeam forest, 245 m (BF, BP).

Cynodontium strumiferum (Hedw.) Lindb. – Agata, 582-608 m (AR, MS, MSK, MW, SR); Łysica, 570-600 m (AS, BF, DS, GJW, GV, TP). Humic soil among stones, bark of *Sorbus aucuparia* (Agata).

Dicranella heteromalla (Hedw.) Schimp. – Agata, 580-604 m (AR, MS); Czarny Las, 310 m (BF, BP, MS); Łysica, 590 m (BF); Skarpa Zapusty, 230-245 m (AS, BF, GV, MS, SR). Soil, rotten wood, loess ledges on slope.

Dicranella varia (Hedw.) Schimp. – Skarpa Zapusty, wet bare soil, 230-235 m (AS, MW, TP).

Dicranodontium denudatum (Brid.) E. Britton – Agata, 590-600 m (BP, EF, MS, MW, SR); Czarny Las, 302 m (SR); Łysica, 590-600 m (AS, BF, DS, TP, SR). Rotten wood in *Abies alba-Picea abies* forest.

! *Dicranum polysetum* Sw. ex anon. – Łysica, 570-600 m (AS, DS, RZ). Humic soil among stones.

! *Dicranum scoparium* Hedw. – Agata, 575-608 m (AR, BP, EF, MS, MSK, MW, SR); Czarny Las, 285-303 m (AR, AS, BF, GV, SR); Łysica, 545-600 m (AS, BF, DS, GJW, RZ, TP); Skarpa Zapusty, 240 m (MS). Humic soil, rotten wood, bark of trees, stones.

!! ●(V)*(R) *Dicranum viride* (Sull. & Lesq.) Lindb. – Czarny Las, rotten wood of *Abies alba* on the border of linden-oak-hornbeam forest and valley, 290 m (SR).

Didymodon acutus (Brid.) K. Saito – Skarpa Zapusty, soil, 235-240 m (AS).

Didymodon fallax (Hedw.) R.H. Zander – Skarpa Zapusty, mineral soil, limestone outcrops in grasslands and thicket, 235-245 m (AR, AS, BF, MS, SR).

Didymodon rigidulus Hedw. – Skarpa Zapusty, limestone outcrops in grasslands and thicket, 235-245 m (AR, AS, BF, MS, SR).

Didymodon tophaceus (Brid.) Lisa – Skarpa Zapusty, soil, 245 m (BP, MS).

Dryptodon pulvinatus (Hedw.) Brid. – Skarpa Zapusty, insolated limestone outcrops, 235 m (RZ).

Ecalypta streptocarpa Hedw. – Skarpa Zapusty, limestone outcrops in thicket and grasslands, 235-240 m (AP, AR, AS, BF, MW, RZ, SR).

Ecalypta vulgaris Hedw. – Skarpa Zapusty, mineral soil, 245 m (BF, GJW, GV).

! *Eurhynchium angustirete* (Broth.) T.J. Kop. – Agata, 580-600 m (EF, MS, MW); Czarny Las, 290-303 m (AP, AR, AS, BF, BP, GV, MS, SR); Łysica, 590-595 m (AS, DS, TP); Skarpa Zapusty, 230 m (GV); Święta Katarzyna, 360-370 m (AS, DS). Soil in forest and thicket communities.

Fissidens dubius P. Beauv. var. *mucronatus* (Breidl. ex Limpr.) Karttunen, Hedenäs & Söderström – Skarpa Zapusty, mineral soil, 240 m (GV).

Fissidens taxifolius Hedw. – Skarpa Zapusty, mineral soil in thicket and forest, 230-240 m (AS, BF, GV, SR).

Fissidens viridulus (Sw. ex anon.) Wahlenb. – Skarpa Zapusty, mineral soil, 235-245 m (AS, BF).

Hedwigia ciliata (Hedw.) P. Beauv. – Agata, 570-600 m (EF, MW); Łysica, 570-605 m (GJW, RZ). Stones.

Herzogiella seligeri (Brid.) Z. Iwats. – Agata, 575-608 m (AR, EF, MW, MSK, SR); Czarny Las, 285-303 m (AR, AS, BF, BP, GV, MS, MW, SR); Łysica, 540-612 m (BF, GJW). Rotten wood, bark of trees, humic soil.

!! *Homalia trichomanoides* (Hedw.) Schimp. – Agata, 580-608 m (MW); Czarny Las, 300-303 m (AR, AS, BF, BP). Bark of deciduous trees.

Homalothecium lutescens (Hedw.) H. Rob. – Skarpa Zapusty, insolated limestone outcrops, xerothermic grasslands, 230-240 m (AR, AS, BP, GV, MS, RZ).

Homalothecium sericeum (Hedw.) Schimp. – Agata, 598-600 m (BP, MS, MSK, SR); Skarpa Zapusty, 235-240 m (AR, AS, GJW, GV, MS, RZ, SR). Limestone outcrops, bark of trees.

Homomallium incurvatum (Schrad. ex Brid.) Loeske – Skarpa Zapusty, limestone outcrops, 240-245 m (AR, AS, BF, SR).

! *Hylocomiadelphus triquetrus* (Hedw.) Ochyra & Stebel – Agata, rotten log on edge of forest, 570 m (EF).

! *Hylocomium splendens* (Hedw.) Schimp. – Agata, 580-608 m (AR, BP, EF, MS, MW); Łysica, 570-600 m (AS, BF, DS, RZ). Humic soil in *Abies alba-Picea abies* forest.

Hypnum cupressiforme Hedw. var. *cupressiforme* – Agata, 560-604 m (AR, BP, EF, MS, MW, SR); Czarny Las, 285-303 m (AP, AR, AS, BF, GV, MW, SR, TP); Łysica, 545-612 m (BF, GJW); Skarpa Zapusty, 240-245 m (GV, RZ). Bark of trees, rotten wood, soil.

var. *filiforme* Brid. – Agata, 608 m (MSK); Czarny Las, 290-303 m (BF, GV). Bark of trees.

var. *lacunosum* Brid. – Skarpa Zapusty, grasslands on limestone, 230-240 m (AR, GJW, SR).

Hypnum pallescens (Hedw.) P. Beauv. – Agata, 575-608 m (MS, MSK, MW, SR); Czarny Las, 290-300 m (AS); Łysica, 540-600 m (AP, AS, BF, DS, TP); Święta Katarzyna, 360-370 m (AS, DS). Bark of trees, rotten wood.

Isoetecium alopecuroides (Lam. ex Dubois) Isov. – Agata, 560-600 m (MS, MSK); Czarny Las, 295-303 m

(AR, AS, BF, BP, GV); Łysica, 590-595 m (AS, DS); Święta Katarzyna, 360-370 m (AS, DS). Bark of trees, stones.

Leskea polycarpa Hedw. – Skarpa Zapusty, bark of *Acer platanoides*, 230 m (GV).

! *Leucobryum glaucum* (Hedw.) Ångstr. – Łysica, 545-600 m (GJW); Święta Katarzyna, 360-370 m (AS, DS). Soil in forest and thicket.

Leucodon sciuroides (Hedw.) Schwägr. – Skarpa Zapusty, 235-245 m (BF, BP, GJW, GV, MS, MW, RZ, SR). Limestone outcrops.

Mnium hornum Hedw. – Czarny Las, 285-303 m (AR, AS, BF, BP, GV, MS, SR); Święta Katarzyna, 360-370 m (AS, DS). Base of trees, soil.

Mnium marginatum (Dicks.) P. Beauv. – Skarpa Zapusty, soil, 245 m (TP).

Mnium stellare Reichard ex Hedw. – Skarpa Zapusty, slope in linden-oak-hornbeam forest, 240 m (BF, BP, GV).

Orthodicranum flagellare (Hedw.) Loeske – Czarny Las, logs and stumps, 290-303 m (BF, BP, MS, MW, SR).

Orthodicranum montanum (Hedw.) Loeske – Agata, 575-608 m (AR, EF, MS, MSK, SR); Czarny Las, 285-303 m (AP, AR, AS, BF, GV, MS, MW, SR, TP); Łysica, 545-612 m (AS, BF, DS, GJW, GV, SR, TP). Bark of trees, rotten wood.

Orthodicranum tauricum (Sapjegin) Smirnova – Agata, bark of *Sorbus aucuparia* and lower part of *Abies alba*, rotten wood, 598-608 m (AR, MS, MSK, SR).

Orthodontium lineare Schwägr. – Łysica, rotten wood, 580-600 m (GJW, GV, TP).

Orthotrichum anomalum Hedw. – Skarpa Zapusty, limestone outcrops, 245 m (BF, GV).

Orthotrichum cupulatum Hoffm. ex Brid. – Skarpa Zapusty, limestone outcrops, 240-245 m (GV, MW).

Orthotrichum speciosum Nees – Agata, bark of *Acer pseudoplatanus*, 598 m (MSK).

Oxyrrhynchium hians (Hedw.) Loeske var. *hians* – Czarny Las, 290 m (GV, TP); Skarpa Zapusty, 230-245 m (AR, AS, BF, BP, GJW, MW, SR). Soil.

var. *rigidum* (Boulay) Ochyra & Żarnowiec – Skarpa Zapusty, 240 m (AR, BF, GV). Soil.

Paraleucobryum longifolium (Ehrh. ex Hedw.) Loeske – Agata, 575-608 m (AR, BP, EF, MS, MSK, MW, SR); Łysica, 540-610 m (AS, BF, BP, DS, SR). Stones, bark of deciduous trees.

Plagiomnium affine (Blandow ex Funck) T.J. Kop. – Czarny Las, 285-303 m (AR, AS, BF, GV, MW, SR); Łysica, 590-595 m (AS, DS). Humic soil.

Plagiomnium elatum (Bruch & Schimp.) T.J. Kop. – Czarny Las, wetlands in the Czarna Woda stream valley, 288 m (SR).

Plagiomnium ellipticum (Brid.) T.J. Kop. – Czarny Las, humic soil in alder swamp forest, 285-300 m (BF).

Plagiomnium rostratum (Schrad.) T.J. Kop. – Skarpa Zapusty, mineral soil, 230-240 m (AS, BF, MW).

Plagiomnium undulatum (Hedw.) T.J. Kop. – Agata, 570 m (EF); Czarny Las, 285-300 m (AP, AS, BF, GV, SR, TP); Skarpa Zapusty, 230-235 m (AS). Wet soil.

Plagiothecium cavifolium (Brid.) Z. Iwats. – Skarpa Zapusty, clayey slopes in forest and thicket, 230-240 m (BF, BP, MW, SR).

Plagiothecium curvifolium Schlieph. ex Limpr. – Agata, 575-608 m (AR, BP, EF, MW, SR); Czarny Las,

285-303 m (AR, AS, BF); Łysica, 540-612 m (AS, BF, DS, GJW, SR). Humic soil, rotten wood.

Plagiothecium denticulatum (Hedw.) Schimp. – Agata, 590-608 m (MSK); Czarny Las, 295-303 m (AR, BF, MS, SR). Bark of trees, rotten wood.

Plagiothecium laetum Schimp. – Agata, 582-608 m (AR, MSK); Czarny Las, 290-303 m (AR, BF, BP, GV, SR); Łysica, 540-600 m (AS, BF, DS, GJW, GV, RZ). Bark of trees, rotten wood, stones.

Plagiothecium nemorale (Mitt.) A. Jaeger – Agata, 575-608 m (EF); Czarny Las, 290-303 m (AS, BF, GV, MW, SR); Skarpa Zapusty, 230-235 m (AS, GV); Święta Katarzyna, 360-370 m (AS, DS). Soil, rotten wood.

Plagiothecium ruthei Limpr. – Czarny Las, humic soil in alder swamp forest, wet rotten wood, 285-290 m (BF, GV, MW).

Platygyrium repens (Brid.) Schimp. – Agata, 590 m (MS); Czarny Las, 290-303 m (AS, BF, BP, SR); Łysica, 540-610 m (BF, GJW, RZ). Bark of deciduous trees.

! *Pleurozium schreberi* (Willd. ex Brid.) Mitt. – Agata, 575-608 m (AR, EF, MS, MSK, MW); Czarny Las, 290-303 m (AP, AR, AS, BF, GV, SR, TP); Łysica, 540-612 m (AS, BF, DS, GJW, RZ). Humic soil, rotten wood.

Pohlia nutans (Hedw.) Lindb. – Agata, 598-608 m (AR, BP, EF, MS, MW, SR); Czarny Las, 285-300 m (AR, AS, BF, SR); Łysica, 545-605 m (AP, AS, BF, DS, GJW, GV, RZ, SR, TP); Skarpa Zapusty, 240 m (BF); Święta Katarzyna, 360-370 m (AS, DS). Soil, rotten wood.

Polytrichastrum formosum (Hedw.) G.L. Sm. – Agata, 575-608 m (AR, EF, MS, MSK, MW); Czarny Las, 290-303 m (AR, AS, BF, GV, MS, SR); Łysica, 540-612 m (AS, BF, DS, GJW, GV); Skarpa Zapusty, 245 m (BF); Święta Katarzyna, 360-370 m (AS, DS). Soil, rotten wood.

Polytrichastrum pallidisetum (Funck) G.L. Sm. – Łysica, 580-600 m (AS, BF, DS, GJW, GV, RZ, SR). Humic soil among stones.

! *Polytrichum commune* Hedw. – Agata, 595-600 m (MS, MW); Czarny Las, 285-290 m (AS, BF, BP, GV, MS, MW, SR). Wet places among stones, wetlands.

Polytrichum juniperinum Hedw. – Agata, 600-608 m (AR, EF, MSK, SR); Łysica, 545-600 m (GJW, RZ, SR). Humic soil among stones.

Polytrichum piliferum Hedw. – Łysica, among stones, 545-600 m (GJW, RZ).

! *Polytrichum strictum* Menzies ex Brid. – Agata, 598-608 m (AR, BP, MS, MW); Łysica, 545-600 m (AS, BF, DS, GJW, GV, TP). Wet humic soil among stones.

!! *(E) *Pseudobryum cinclidioides* (Huebener) T.J. Kop. – Czarny Las, wet hollow in swamp alder forest, 285 m (AS, BF).

! *Pseudoscleropodium purum* (Hedw.) M. Fleisch. ex Broth. – Czarny Las, 285-300 m (AP, AS, BF, GV, TP); Skarpa Zapusty, 240 m (RZ). Soil.

Pterigynandrum filiforme Hedw. – Agata, 600 m (BP, MS); Czarny Las, 303 m (TP); Łysica, 540-600 m (AP, AS, BF, DS, GJW, SR, TP). Bark of deciduous trees.

*(I) *Pterygoneurum subsessile* (Brid.) Jur. – Skarpa Zapusty, mineral soil, 240 m (GV).

Racomitrium lanuginosum (Hedw.) Brid. – Agata, 590-600 m (EF, MS, MW); Łysica, 550-600 m (AS, BF, DS, GV, RZ, TP). Stones.

Rhizomnium punctatum (Hedw.) T.J. Kop. – Czarny Las, 285-300 m (AR, AS, BF, BP, GV, SR); Święta Katarzyna, 360-370 m (AS, DS). Rotten wood.

Rhodobryum ontariense (Kindb.) Kindb. – Skarpa Zapusty, soil on edge of thicket, 235-245 m (MW).

Rhodobryum roseum (Hedw.) Limpr. – Czarny Las, moist soil in alder forest, 288 m (SR).

Rhynchostegium murale (Hedw.) Schimp. – Skarpa Zapusty, limestone, soil, 230-240 m (AS, MW); Święta Katarzyna, concrete, 360-370 m (AS, DS).

! *Rhytidadelphus squarrosus* (Hedw.) Warnst. – Czarny Las, grassy place, 285 m (AP, BF, TP).

Rosulabryum capillare (Hedw.) J.R. Spence – Skarpa Zapusty, mineral soil, 235-240 m (AS, GV, MW).

Rosulabryum moravicum (Podp.) Ochyra & Stebel – Agata, 598 m (MSK); Czarny Las, 290-303 m (AS). Bark of trees.

Sanionia uncinata (Hedw.) Loeske – Agata, 575-608 m (AR, BP, MS, MSK, MS, MW, SR); Czarny Las, 290-295 m (BP, AR, SR); Łysica, 545-600 m (AS, BF, DS, GJW, RZ, SR, TP). Rotten wood, bark of trees.

Schistidium crassipilum H.H. Blom – Skarpa Zapusty, grasslands on limestone, 235-240 m (AR, GV, SR).

Sciuro-hypnum oedipodium (Mitt.) Ignatov & Huttunen – Agata, 604 m (AR); Czarny Las, 303 m (BF); Łysica, 570-600 m (AS, DS); Święta Katarzyna, 360-370 m (AS, DS). Rotten wood, humic soil.

Sciuro-hypnum reflexum (Starke) Ignatov & Huttunen – Agata, 590-608 m (BP, EF, MSK); Łysica, 540-600 m (AS, BF, DS, GJW, TP). Humic soil, bark of trees, stones, rotten wood.

!! *Sphagnum capillifolium* (Ehrh.) Hedw. – Agata, 595-608 m (AR, BP, EF, MS, MW, SR); Czarny Las, 285 m (MS, MW); Łysica, 545-600 m (AS, DS, GJW, RZ). Wet humic soil among stones, wetlands.

!! *Sphagnum denticulatum* Brid. – Czarny Las, wetlands, 285-290 m (AR, GV).

! *Sphagnum fallax* (H. Klinggr.) H. Klinggr. – Agata, 595 m (AR, BP, MW); Czarny Las, 290 m (BF, MW, SR). Wet humic soil among stones, wetlands.

!! *Sphagnum flexuosum* Dozy & Molk. – Czarny Las, wetlands, 285 m (AS); Święta Katarzyna, bank of stream, 360-370 m (AS, DS).

!! *Sphagnum girgensohnii* Russow – Agata, 590-600 m (MS); Czarny Las, 285-290 m (AR, AS, BF, GV, MS, MW, SR). Wet humic soil among stones, wetlands, thicket.

!! *Sphagnum inundatum* Russow – Czarny Las, wetlands, 285 m (AS, SR).

!! *Sphagnum obtusum* Warnst. – Czarny Las, wetlands, 290 m (BF).

!! *Sphagnum palustre* L. – Czarny Las, 285-290 m (AR, AS, BF, GV, MS, MW, SR); Święta Katarzyna, 360-370 m (AS, DS). Wetlands, bank of stream, alder swamp forest.

!! *Sphagnum quinquefarium* (Braithw.) Warnst. – Agata, 595 m (MW, SR); Łysica, 580-590 m (AS, BF, DS). Wet humic soil among stones.

!! *Sphagnum russowii* Warnst. – Agata, 595-600 m (AR, BP, MS, MW, SR); Czarny Las, 290 m (BF). Wet humic soil among stones, wetlands.

! *Sphagnum squarrosum* Crome – Czarny Las, alder swamp forest, 290 m (BF, SR).

!! *Sphagnum subsecundum* Nees – Czarny Las, wetlands, 285-290 m (AS, BF).

!! *Sphagnum warnstorffii* Russow – Czarny Las, wetlands, 285 m (AS, GV).

Straminergon stramineum (Dicks. ex Brid.) Hedenäs – Czarny Las, wetlands, 285-290 m (AS, BF, GV, MW, SR).

Syntrichia calcicola J.J. Amann – Skarpa Zapusty, grasslands in limestone outcrop, 245 m (BF, SR).

Syntrichia ruralis (Hedw.) F. Weber & D. Mohr – Skarpa Zapusty, limestone outcrops, 230-240 m (AR, AS, BP, GV, MW, RZ).

Taxiphyllum wissgrillii (Garov.) Wijk. & Margad. – Skarpa Zapusty, limestone outcrops, 235-240 m (AS, GV).

Tetraphis pellucida Hedw. – Agata, 590-608 m (AR, EF, MS, MSK, MW, SR); Czarny Las, 285-303 m (AR, AS, BF, BP, GV, MS, MW); Łysica, 540-612 m (BF, GJW, SR, TP); Święta Katarzyna, 360-370 m (AS, DS). Rotten wood.

Tetraplodon angustatus (Hedw.) Bruch & Schimp. – Agata, 590-608 m (AR, BP, EF, MS, MSK, MW, SR); Łysica, 570-600 m (AS, BF, DS, GJW, GV, RZ, TP). Humic soil among stones.

! *Thuidium assimile* (Mitt.) A. Jaeger – Skarpa Zapusty, grassland and thicket, 240-245 m (RZ, SR).

! *Thuidium tamariscinum* (Hedw.) Schimp. – Agata, 595-608 m (AR, MS, MSK); Czarny Las, 285-303 m (AR, AS, BF, BP, GV, MW, SR); Łysica, 540-595 m (AS, BF, DS); Święta Katarzyna, 360-370 m (AS, DS). Soil in forest and thicket.

Tortella tortuosa (Hedw.) Limpr. – Skarpa Zapusty, 235-245 m (AR, BF, BP, GJW, GV, MS, MW, RZ, SR). Limestone outcrops, soil.

Tortula muralis Hedw. – Skarpa Zapusty, limestone outcrop, 235 m (GV).

Tortula subulata Hedw. – Skarpa Zapusty, mineral soil, rotten stump, 230-245 m (AS, BF, BP, GV, MS, MW, SR).

Tortula truncata (Hedw.) Mitt. – Skarpa Zapusty, wet bare soil, 230-235 m (AS, MW).

!! *(V) *Ulota bruchii* Hornsch. ex Brid. – Agata, bark of *Sorbus aucuparia*, 590 m (MS).

Weissia brachycarpa (Nees & Hornsch.) Jur. – Skarpa Zapusty, mineral soil, 245 m (BF, BP, GJW, MS, SR).

Weissia controversa Hedw. – Skarpa Zapusty, mineral soil, 235 m (GJW, GV).

Weissia longifolia Mitt. – Skarpa Zapusty, mineral soil, 240-245 m (MS).

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