



## CONTRIBUTION TO THE BRYOFLORA OF THE WOLIN ISLAND (NW POLAND)

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**ABSTRACT.** Information on distribution and habitats of 176 bryophyte species revealed by a survey of the Wolin Island conducted during the 12<sup>th</sup> Bryological Workshop organised by the Bryological Section of the Polish Botanical Society is presented. The most interesting (rare, protected and threatened) are: *Ctenidium molluscum*, *Dicranum viride*, *Frullania tamarisci*, *Leiocolea badensis*, *Orthotrichum pulchellum*, *Syntrichia ruraliformis*, *Zygodon stirtonii*, *Z. viridissimus*.

**KEY WORDS:** mosses, liverworts, protected species, threatened species, distribution data, Wolin Island, Wolin National Park, Western Pomerania, Poland.

### INTRODUCTION

The Wolin Island is situated in the western part of the Polish Baltic Sea coast. According to the physico-geographical regionalization of Poland, it is located in mezoregion of Uznam and Wolin (KONDRACKI 2009), which is the most north-western part of Poland. That mezoregion is fairly geographically differentiated what resulted in its division into eight

microregions, including Pasma Wolińskie range and Pagórki Lubińsko-Wapnickie hills where the field investigations of the 12<sup>th</sup> Bryological Workshops were organised by the Bryological Section of the Polish Botanical Society. Results of the research are presented in the paper.

The island is known for its exceedingly diverse topography which includes such geomorphological formations as terminal moraines, kames and outwash

plains (BORÓWKA 2004, KONDRACKI 2009). The diverse topography has given rise to a great variety of habitats. Some of them are unique on the country-wide scale: steep cliff shores (with the Gosań Hill which, with its altitude of 93 m above the sea level is the highest elevation on Polish Baltic Sea coast), coastal sand dunes, wind blown sand-covered slanted beech tree trunks, saline meadows, coastal pine forests with *Empetrum nigrum* L., and coastal beech forests. Some of the habitats have been formed on the cliff naspas, i.e., lime-rich specific soils present in narrow strips (30–150 m) on cliff tops. The habitats referred to have been granted protection as components of the Wolin National Park or as components of the Wolin and Uznam NATURA 2000 area.

The first bryological observations from the Wolin Island were reported by LUCAS (1863) in the second half of the 19th century. He provided records of 66 bryophyte species, mainly the common taxa. A fundamental contribution to the knowledge of the Wolin Island's bryophytes came with the research, reports and herbarium materials of WINKELMANN (1888, 1893). In 1872–1907, he recorded 198 bryophyte species (28 liverworts and 170 mosses). Some new data were provided also by research conducted by WARNSTORF (1902/03, 1906). After the Second World War, the Wolin Island's bryophytes were thoroughly investigated by Polish researchers: Lisowski, Szweykowski and Koźlicka. Their own field work and their revision of Winkelmann's historical herbarium materials led them to the conclusion that the Wolin Island bryoflora is made up by 74 liverwort and 246 moss species (LISOWSKI 1957, 1958, 1960, 1961, SZWEYKOWSKI 1958, SZWEYKOWSKI & KOŹLICKA 1966). Some additional data concerning bryophyte occurrence on the Wolin Island are inserted in phytosociological papers (CZUBIŃSKI & URBAŃSKI 1951, PIOTROWSKA 1955, 2003, BOSIACKA 2005).

## STUDY AREA, MATERIAL AND METHODS

The surveys of some selected habitats typical of the Wolin Island (steep cliff shores, coastal sand dunes, coastal pine forests with *Empetrum nigrum* L., and limestone outcrops) were conducted in March (field reconnaissance) and September 2014.

Bryophyte nomenclature follows mainly KLAMA (2006b) and OCHYRA et al. (2003). Protected species in Poland are given after the Regulation of the Minister of the Environment (REGULATION... 2014), threatened species in Poland listed according to KLAMA (2006a) and ŻARNOWIEC et al. (2004), whereas threatened species in Europe according to SCHUMACKER & MARTINY (1995).

## LIST OF COLLECTION SITES

For each locality the following information is given: habitat, number of forest compartments or number of cadastral parcel in the Międzyzdroje and Wolin municipality GPS coordinates, ATMOS grid square. All sites are showed on the map (Fig. 1).

1. **The Łuniewo nature reserve** near village Warnowo: mire and alder forests (*Ribeso nigri-Alnetum*, *Sphagno squarrosi-Alnetum*); Międzyzdroje Forest Division, compartments: 54 g, h, i, j, k; GPS: 53°55'32"N, 14°31'59"E; ATMOS grid: Ba 23.
2. **Lake Turkusowe** near Wapnica village: former excavations of glacially displaced block of Cretaceous limestone, secondary forest communities with contribution of *Pinus sylvestris*, thickets, sandy grassland overgrown with pine, beech forest *Galio odorati-Fagetum* (comp. 128A d, 128A n).
  - **The prof. W. Szafer strictly protected area** (the so-called Lelowa Góra) near Wapnica village: beech forest *Galio odorati-Fagetum* (127 a, c, d, f, g), beech forest *Luzulo pilosae-Fagetum* (comp. 127 b); Wolin National Park: compartments 127 and 128A; GPS: 53°52'29"N, 14°26'30"E; ATMOS grid: Ba 33.
3. **The dr B. Dyakowski strictly protected area** near village Trzciagowo: gully, former excavations of glacially displaced block of Cretaceous limestone, secondary forest communities with contribution of *Pinus sylvestris*, beech forest *Galio odorati-Fagetum* (comp. 125 bx, j), thermophilous calciphilous slope (comp. 125 f), reed-rushes around limestone excavation; Wolin National Park, compartments: 125 bx, c, d, f, j, z; GPS: 53°52'56"N, 14°27'52"E; ATMOS grid: Ba 33.
4. **Lake Grodno**, 6 km NE of Międzyzdroje: lake-shore and beech forest *Luzulo pilosae-Fagetum*; Wolin National Park, compartments: 10A l, m; GPS: 53°57'49"N, 14°31'36"E; ATMOS grid: Ba 23.
5. **The Wiselka forests**, area in the N vicinity of the village of Wiselka: secondary forest communities with contribution of *Pinus sylvestris*, a mature and young coastal *Empetro nigri-Pinetum* pine forest (5 d, 5 f, 6 g, 7 k, 24 j); Wolin National Park, compartments: 5, 6, 7, 24, 25; GPS: 53°58'16"N, 14°33'33"E, ATMOS grid: Ba 23.
6. **The Wiselka dunes**, approx. 1.5 km N of the village of Wiselka: white dunes with *Elymo-Amphiletum arenariae* and grey dunes with *Helichryso-Jasionetum litoralis*; Wolin National Park, compartments: 5, 6, 7; GPS: 53°58'31"N, 14°33'15"E, ATMOS grid: Ba 23.
7. **Cliffs between Biała Góra and Gosań**, approx. 3.5 km NE of Międzyzdroje: living cliffs, cliffs topped with the *Luzulo pilosae-Fagetum* beech forest; Wolin National Park, compartments 14 and

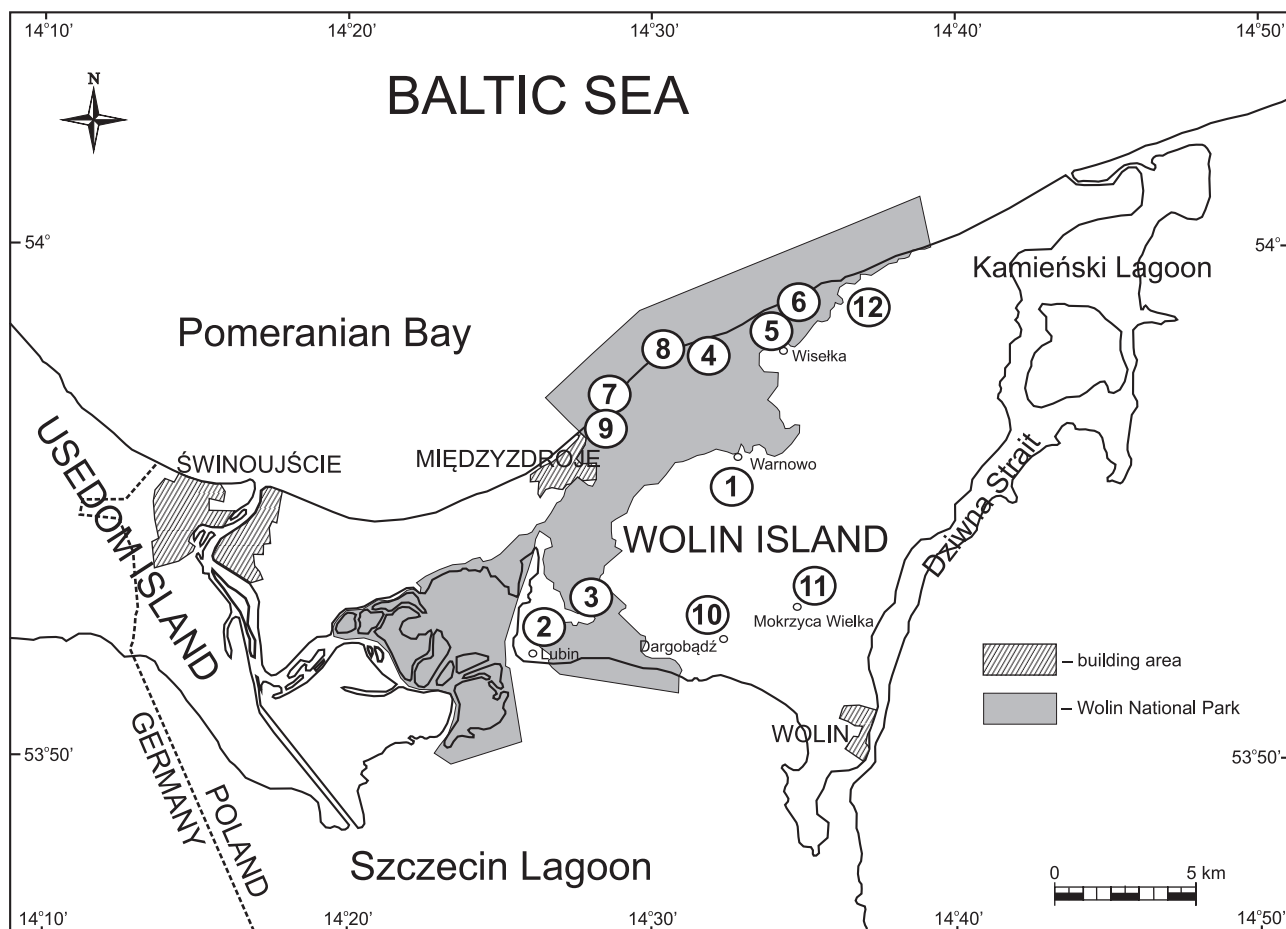


Fig. 1. Sites of investigations: 1 – Łuniewo nature reserve, 2 – Lake Turkusowe and prof. W. Szafer strictly protected area, 3 – B. Dyakowski strictly protected area, 4 – Lake Grodno, 5 – Wiselka forests, 6 – Wiselka dunes, 7 – cliffs between Biała Góra and Gosań, 8 – cliffs between Świdna Kępa and Gosań, 9 – Biała Góra, 10 – Dzicze Uroczysko special value ecological area, 11 – Mokrzyca Wielka, 12 – Lewińska Struga

- 15; GPS: 53°57'05"N, 14°28'50"E; ATMOS grid: Ba 23.
8. **Cliffs between Świdna Kępa and Gosań**, approx. 5 km NE of Międzyzdroje: living cliffs, cliffs topped with the *Luzulo pilosae-Fagetum* and *Cephalanthero rubrae-Fagetum* beech forests; Wolin National Park, compartments: 11 (**the prof. Z. Czubiński strictly protected area**), 12, 13; GPS: 53°57'42"N, 14°29'49"E; ATMOS grid: Ba 23.
  9. **Biała Góra**, approx. 2.5 km NE of Międzyzdroje: a former military area of anthropogenic habitats (buildings walls, roads, remains of concrete structures); Wolin National Park, compartments 400 and 842; GPS: 53°52'56"N, 14°27'52"E; ATMOS grid: Ba 23.
  10. **The Dzicze Uroczysko**, special value ecological area which covers an area of 3.5 ha, near village Dargobądz: peatbog with *Eriophorum vaginatum-Sphagnum fallax* community and birch thickets on the edge of bog; Międzyzdroje Forest Division, compartment 127 a; GPS: 53°52'38"N, 14°31'26"E; ATMOS grid: Ba 33.
  11. **Mokrzyca Wielka**, wet meadow and road-side afforestations E of the village of Mokrzyca Wielka; Wolin municipality, compartments: 3, 5, 70; GPS: 53°52'30"N, 14°35'03"E; ATMOS grid: Ba 33, 34.
  12. **Lewińska Struga**, wet meadows S of the watercourse, approx. 1.5 km NE of the village of Kołczewo (near golf course); Wolin municipality, compartments: 133, 134, 135, 136; GPS: 53°58'33"N, 14°37'24"E; ATMOS grid: Ba 24.

## RESULTS

The surveys revealed a total of 176 bryophyte species and four varieties of bryophyte (29 species of liverworts and 147 species and four varieties of mosses). Of them, 46 are protected and 12 threatened in Poland, as well as two (*Dicranum viride* and *Campyliadelphus elodes*) threatened in Europe. Sixteen species are new to the Wolin: *Plagiochila porelloides*, *Brachythecium rivulare*, *Campylopus introflexus*, *Didymodon rigidulus*, *Fissidens dubius*, *Orthodicranum tauricum*, *Orthodontium lineare*, *Orthotrichum pallens*, *O. pulchel-*



lum, *O. pumilum*, *O. stramineum*, *Plagiothecium curvifolium*, *Schistidium crassipilum*, *Sphagnum angustifolium*, *Syntrichia calcicola* and *S. ruraliformis*. Characteristic for the moss flora of the Wolin Island is a fairly high contribution of suboceanic and oceanic species (DÜLL 1984, 1985). These are: *Bucklandiella heterosticha*, *Campylophyllopsis calcarea*, *Campylopus introflexus*, *Dicranoweisia cirrata*, *Didymodon insulanus*, *Eurhynchium striatum*, *Hypnum jutlandicum*, *Orthodicranum tauricum*, *Orthodontium lineare*, *Orthotrichum pulchellum*, *Oxyrrhynchium schleicherii*, *Plagiothecium succulentum*, *Syntrichia ruraliformis*, *Zygodon stirtonii*, *Z. viridissimus*. The most interesting are the following rare species: *Ctenidium molluscum*, *Dicranum viride*, *Frullania tamarisci*, *Leiocolea badensis*, *Orthotrichum pulchellum*, *Syntrichia ruraliformis*, *Zygodon viridissimus* and *Z. stirtonii*. Short information about the occurrence of these bryophytes in Poland is presented below.

*Ctenidium molluscum* is a calciphilous moss occurring mainly in the south of Poland – in the mountains and the piedmont, extremely rare in the northern part of the country. At the end of the 19<sup>th</sup> century, Winkelmann collected the moss at two Wolin Island localities (OCHYRA et al. 1985): Mokrzyca and the Komańcza Hill. The record provided by LISOWSKI (1961) concerns most likely the latter site as well.

*Dicranum viride* is a moss species growing primarily in the Carpathians (STEBEL et al. 2011), reported from localities scattered throughout Poland. Prior to this study, the species had been recorded on the Wolin Island at a single – and different – locality, in the village of Łunowo on the Przytór Peninsula (LISOWSKI 1961).

*Frullania tamarisci* is a liverwort species distributed both in the north of Poland (mainly in Western Pomerania) and in southern regions of the country, in lower parts of the Sudetes and Western Carpathians (SZWEYKOWSKI & KOZŁICKA 1977). The species was reported from the Wolin Island nearly 65 years ago (CZUBIŃSKI & URBAŃSKI 1951). According to SZWEYKOWSKI (2006) *Frullania tamarisci* is very rare in lowlands and can be regarded as extinct. Recently, however, Jacob Koopman has found the species in Western Pomerania again, in the environs of the city of Koszalin (GÓRSKI 2013). Although the species is known to occur at a number of sites in the mountains (ZUBEL & STEBEL 2008, GÓRSKI & VÁŇA 2014), it has been observed to disappear there as well (SZWEYKOWSKI & BUCZKOWSKA 1996, SZWEYKOWSKI 2006).

*Leiocolea badensis* is a very rare liverwort occurring both in lowlands and in the mountains, calcareous rock habitats (SZWEYKOWSKI 2006). The species was reported from the Tatras (Western Tatras and Bélianske Tatras in Slovakia; SZWEYKOWSKI 1960, GÓRSKI & VÁŇA 2014) and from the Pieniny Mountains (SZWEYKOWSKI 1961). In the lowlands, uplands belt and lower mountain locations *L. badensis* was reported from several locations (e.g. KARCZMARZ 1967, 1968, SZWEYKOWSKI 2006), including some anthro-

pogenic habitats (STEBEL 1999, 2006, SZWEYKOWSKI 2006, ARMATA 2011). On the Wolin Island, the species was first recorded at the end of the 19<sup>th</sup> century by J. Winkelmann in a chalk mine near Wapnica (SZWEYKOWSKI 1958). The species was recorded at the same site again 70 years later (SZWEYKOWSKI & KOZŁICKA 1966) and in 2014 (in the B. Dyakowski Reserve), which evidences the species' persistence in poorly consolidated, unshadowed xerothermal meadows with loose, fine-grained limestone material. It is worth noting that the species proved absent from the nearest vicinity of the Szmardgowe Lake from where it had been reported by SZWEYKOWSKI & KOZŁICKA (1966); the absence has to be associated with a heavy growth of ruderal vegetation of the site.

*Orthotrichum pulchellum* is an epiphytic oceanic moss known from its wide distribution in western Europe. In the present territory of Poland, it was first reported from a single site near Mieszkowice (RUTHE 1867), and has been recently found again at a few sites in Western Pomerania (PLAŠEK et al. 2013, SMOCZYK & WIADERNY 2015). Authors regarded the species as extending its range eastwards, therefore new records can be anticipated from Poland.

*Syntrichia ruraliformis* is a suboceanic-Mediterranean species (DÜLL 1984). Some authors regard it as a variety *Syntrichia ruralis* var. *ruraliformis* (Besch.) Delogne and report the species as occurring in the Mediterranean region on gypsum-rich soils and on the sea coast (GALLEGO et al. 2002). In Poland, the species has been reported from the Lublin region (KUC 1962) and from the Nida Valley (WACŁAWSKA 1964). OCHYRA (1988) regarded the species as common on the Hel Peninsula where it grows on sand dunes. This is a habitat the species occurs in all along the Polish coast; it was collected from, i.a., the Bukowo Spit and near Ustronie Morskie and Łazy (herbarium of POZG – Rusińska, personal communication). It was also found in the herbarium materials from the Wolin Island, identified as *Syntrichia ruralis* rather than as a separate species or a variety. (leg. J. Winkelmann 1885; leg. S. Lisowski 1995).

*Zygodon viridissimus* is an epiphytic moss very rare in Poland, occurring mainly in the north-western part of the country. Overall, compared to other *Zygodon* species in Poland, its distribution is poorly known and requires detailed studies.

*Zygodon stirtonii* is a species known so far in Poland from a single site near the village of Wisefka on the Wolin Island where it was collected by Lisowski in 1957 (STEBEL et al. 2007).

#### LIST OF SPECIES

Abbreviations: **initials of authors**: AR – Anna Rusińska, AS – Adam Stebel, ASa – Anna Salachna, BF – Barbara Fojcik, EF – Ewa Fudali, GV – Grzegorz Vončina, MW – Marcin Wilhelm, PG – Piotr Gór-

ski, RZ – Robert Zubel, SR – Stanisław Rosadziński; **comp.** – forest compartment, **DyakSPA** – dr B. Dyakowski strictly protected area, **ŁunNR** – Łuniewo nature reserve, **SzaferSPA** – prof. W. Szafer strictly protected area, **sec. for. comm.** – secondary forest communities with contribution of *Pinus sylvestris*, ! – species partly protected in Poland, !! – species strictly protected in Poland, \* – species threatened in Poland (**E** – endangered, **I** – indeterminate, **R** – rare, **V** – vulnerable), • – species threatened in Europe. Taxa are listed in alphabetical order.

## LIVERWORTS MARCHANTIOPHYTA

*Aneura pinguis* (L.) Dumort. – DyakSPA, gully (RZ); cliffs between Biała Góra and Gosań (PG); Świdna Kępa (RZ). Calcareous soil and sand.

*Barbilophozia barbata* (Schmidel ex Scherb.) Loeske – Wiselka forests, comp. 7, log and humic soil in *Empetro nigri-Pinetum* (AS, ASa, GV, MW, PG).

\***(I)** *Calypogeia fissa* (L.) Raddi – ŁunNR, peat in willow thickets and open mire (AR, GV, PG, SR).

*Calypogeia integristipula* Steph. – Grodno Lake, sand and humus layer in *Luzulo pilosae-Fagetum* (GV, MW, PG, RZ).

*Calypogeia muelleriana* (Schiffn.) Müll. – Grodno Lake, humic soil in *Luzulo pilosae-Fagetum* (ASa, MW).

*Calypogeia neesiana* (C. Massal. & Carestia) Müll. Frib. – Wiselka forests, comp. 7, soil in *Empetro nigri-Pinetum* (PG, RZ).

*Cephalozia bicuspida* (L.) Dumort. – DyakSPA, former excavations (PG); Grodno Lake beech forest (PG); ŁunNR, open mire (PG); Wiselka forests, sec. for. comm. (ASa). Rotten wood.

*Cephalozia connivens* (Dicks.) Lindb. – ŁunNR, peat and rotten wood on open mire (AR, AS, MW, PG, SR); Wiselka forests, *Empetro nigri-Pinetum*, rotten wood (RZ).

*Cephaloziella divaricata* (Sm.) Schiffn. – Grodno Lake, *Luzulo pilosae-Fagetum* (PG); Wiselka dunes, grey dunes (PG); Wiselka forests, *Empetro nigri-Pinetum* (AR, AS, ASa, PG, RZ). Mineral soil.

*Chiloscyphus polyanthos* (L.) Corda – ŁunNR, water hollows on the border between lake and mire (GV).

! *Frullania dilatata* (L.) Dumort. – cliffs between Świdna Kępa and Gosań (AS, GV, SR); Grodno Lake (AR, AS, ASa, GV, MW, PG, SR, RZ). Bark of beech trees.

\***(E)** !! *Frullania tamarisci* (L.) Dumort. – Grodno Lake, bark of beech tree in *Luzulo pilosae-Fagetum* (SR).

*Leiocolea badensis* (Gottsche) Schiffn. – DyakSPA, comp. 125 f, sunny slope, calcareous soil (PG, RZ, SR).

*Lepidozia reptans* (L.) Dumort. – DyakSPA (ASa, MW, PG, RZ, SR); cliffs between Biała Góra and Świdna Kępa, mineral soil, humic soil and logs in beech forest *Luzulo pilosae-Fagetum* (BF, SR); Grodno Lake, beech forest (ASa, BF, EF, GV, MW, PG, RZ);

Wiselka forests, sec. for. comm. (BF), coastal pine forest *Empetro nigri-Pinetum*, rotten wood (AR, AS, ASa, PG, RZ).

*Lophocolea bidentata* (L.) Dumort. – DyakSPA former excavations and beech forest *Galio odorati-Fagetum* with addition of Scotch pine, humic and calcareous soil (AR, ASa, PG, SR); cliffs between Świdna Kępa and Gosań, sand and ground cover in *Luzulo pilosae-Fagetum* (EF, GV, MW); Turkusowe Lake, mineral soil, bark and rotten poplar wood in sec. for. comm., thicket and overgrown dune (AS, BF, GV); Wiselka dunes (AS); Wiselka forests, soil (AR, RZ).

*Lophocolea heterophylla* (Schrad.) Dumort. – DyakSPA (ASa, EF, MW, PG, RZ, SR); cliffs between Biała Góra and Świdna Kępa (AR, PG, SR, RZ); Grodno Lake (AR, ASa, GV, PG, RZ); ŁunNR (AR, MW, PG, SR); SzaferSPA (BF, MW); Turkusowe Lake (AS, BF, GV, MW); Wiselka forests (AR, AS, ASa, BF, GV, MW, PG, RZ). Rotten wood.

*Lophocolea minor* Nees – cliffs between Biała Góra and Gosań (PG); Świdna Kępa (SR). Humic soil and sand.

*Lophozia excisa* (Dicks.) Dumort. – Świdna Kępa, sand on the cliff (RZ); Wiselka dunes and initial stage of *Empetro nigri-Pinetum* (AS, ASa, GV, PG, RZ, SR).

*Marchantia polymorpha* L. subsp. *ruderalis* – Biała Góra comp. 400 (AS, BF). Mineral soil.

*Metzgeria furcata* (L.) Dumort. – DyakSPA (AR, ASa, EF, MW, PG, RZ, SR); cliffs between Biała Góra and Gosań (AR); Grodno Lake (AR, AS, ASa, BF, EF, GV, MW, PG, SR, RZ); SzaferSPA (AS, BF, GV, MW); Świdna Kępa (AS, GV, MW, RZ, SR); Turkusowe Lake (AS, BF, GV, MW); Wiselka forests comp. 24 (AR, AS, MW, RZ). Bark of trees.

\***(V)** ! *Nowellia curvifolia* (Dicks.) Mitt. – DyakSPA, *Galio odorati-Fagetum* (ASa, MW, PG, RZ); Grodno Lake (GV, PG, RZ); Wiselka forests, comp. 7 and 25 (AR, AS, ASa, MW, RZ, SR). Rotten wood.

*Pellia endiviifolia* (Dicks.) Dumort. – DyakSPA, beech forest *Galio odorati-Fagetum* with Scotch pine addition, calcareous soil and rotten wood (AR, ASa, EF, MW, PG, RZ, SR); Turkusowe Lake lakeshore, soil (AS, BF).

*Plagiochila porelloides* (Torrey ex Nees) Lindenb. – DyakSPA, gully and *Galio odorati-Fagetum* (MW, PG, SR); cliffs between Biała Góra and Gosań (AR, MW, PG); SzaferSPA (GV); Świdna Kępa (AS, GV, MW, RZ, SR). Mineral soil.

\***(E)** !! *Porella platyphylla* (L.) Pfeiff. – cliffs between Świdna Kępa and Gosań, bark and log of beech (AS, GV, RZ, SR).

! *Ptilidium ciliare* (L.) Hampe – cliffs between Świdna Kępa and Gosań, trunk of oak (EF); Wiselka forests, pine trunk base and ground cover (AS, ASa, EF, GV, MW, PG, SR).

*Ptilidium pulcherimum* (Weber) Vain. – ŁunNR, bark of wood (PG); Wiselka forests in *Empetro nigri-Pinetum* bark of birch (SR).

*Radula complanata* (L.) Dumort. – DyakSPA, beech forest *Galio odorati-Fagetum* with addition of Scotch pine and termophilous slope (AR, ASa, MW, PG, RZ); cliffs between Świdna Kępa and Gosań (EF, MW, SR); Grodno Lake (ASa, EF, SR); Turkusowe Lake (AS, BF); Wiselka forests (AS). Bark of trees.

*Riccardia latifrons* (Lindb.) Lindb. – ŁunNR, rotten wood on the open mire (PG).

*Riccia fluitans* L. emend. Lorb. – ŁunNR, hollows in alder forest (PG).

#### MOSESSES BRYOPHYTA

! *Abietinella abietina* (Hedw.) M. Fleisch. – DyakSPA, sunny slope of southern exposition, calcareous soil (EF).

*Amblystegium serpens* (Hedw.) Schimp. – DyakSPA (AR, SR); Biała Góra comp. 400 (AS, BF); cliffs between Biała Góra and Gosań (AR, BF); cliffs between Gosań and Świdna Kępa (AS, GV, RZ, SR); Grodno Lake (BF, GV); Turkusowe Lake (AS, BF, GV). Humic soil, bark of trees, rotten wood, peaty soil, concrete.

! *Anomodon viticulosus* (Hedw.) Hook. & Taylor – cliffs between Świdna Kępa and Gosań in *Cephalanthero rubrae-Fagetum*, logs of oak and beech (AS, GV, RZ, SR).

*Atrichum undulatum* (Hedw.) P.Beauv. – DyakSPA (EF, MW, RZ, SR); cliffs between Biała Góra and Gosań (AR, BF, MW); SzaferSPA (AS, BF, GV, MW); Świdna Kępa (EF, GV, MW, RZ, SR); Turkusowe Lake, sec. for. comm. (BF); Wiselka forests, sec. for. comm. (AS, BF, GV). Mineral soil.

*Aulacomnium androgynum* (Hedw.) Schwägr. – DyakSPA (EF, MW, RZ, SR); cliffs between Biała Góra and Gosań (AR, BF, MW); Dzicze Uroczysko, birch thickets (AR, MW, SR); Grodno Lake (AR, BF, GV, MW); Świdna Kępa (SR); Wiselka forests, sec. for. comm. (BF). Humic soil and pine logs.

! *Aulacomnium palustre* (Hedw.) Schwägr. – Dzicze Uroczysko (AR, MW, SR); ŁunNR (AR, AS, GV, MW, SR). Peat.

*Barbula convoluta* Hedw. – Biała Góra, lawn and soil between plates of pavement (BF, SR); cliffs between Biała Góra and Gosań (AR); Świdna Kępa (SR); Turkusowe Lake, thicket and overgrown dune (BF, GV). Soil, concrete.

*Barbula unguiculata* Hedw. – Biała Góra, lawn (AS, BF); cliffs between Biała Góra and Gosań (AR); Świdna Kępa (GV, SR). Mineral soil.

*Bartramia pomiformis* Hedw. – cliffs between Biała Góra and Gosań, soil in *Luzulo pilosae-Fagetum* (BF).

*Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen – DyakSPA, beech forest *Galio odorati-Fagetum* with Scotch pine addition, slope (AR, EF); cliffs between Biała Góra and Gosań (AR, BF, MW); Grodno Lake (AR, BF, EF); SzaferSPA (AS, BF, GV); Świd-

na Kępa (AS, GV, MW, SR); Turkusowe Lake (AS, BF, GV). Bark, logs, roots of beech, rarely soil and concrete rubble.

*Brachythecium albicans* (Hedw.) Schimp. – Biała Góra (AS, BF, SR); cliffs between Świdna Kępa and Gosań (GV, MW); Turkusowe Lake (BF, GV, MW); Wiselka dunes (AR, AS, EF, GV, MW, RZ, SR). Mineral soil, sand.

*Brachythecium glareosum* (Bruch ex Spruce) Schimp. – DyakSPA, sec. for. comm. and lime slope (AR, EF, MW, SR); cliffs between Biała Góra and Gosań (AR, MW, SR); Świdna Kępa (EF); Turkusowe Lake (BF, GV). Soil, sand, logs of beech.

*Brachythecium rivulare* Schimp. – DyakSPA, edge of former excavations (SR); Lewińska Struga (AR, SR). Peaty soil.

*Brachythecium rutabulum* (Hedw.) Schimp. – DyakSPA, beech forest *Galio odorati-Fagetum* with Scotch pine addition (AR, EF, MW, RZ, SR); Biała Góra comp. 400 roadside (BF); cliffs between Biała Góra and Gosań (AR, BF); Grodno Lake (AS, BF, GV, SR); Lewińska Struga (AR, MW, SR); Mokrzyca Wielka, wet meadow (AR, MW, SR); ŁunNR, alder forest (AR, AS, MW, SR); SzaferSPA (AS, BF, GV, MW); Świdna Kępa (EF, GV, RZ, SR); Turkusowe Lake (AS, BF, GV, MW); Wiselka dunes (GV); Wiselka forests (AR, AS, BF, GV, SR). Bark of trees, logs, mineral soil, concrete, peat.

*Brachythecium salebrosum* (Hoffm. ex F. Weber & D. Mohr) Schimp. – DyakSPA, slope at former excavations (MW, SR); cliffs between Świdna Kępa and Gosań (AS, RZ, SR); Grodno Lake (EF, GV); ŁunNR, alder forest (GV); Turkusowe Lake, sec. for. comm. (BF); Wiselka forests, *Empetro nigri-Pinetum* (EF) and sec. for. comm. (AS, GV). Rotten wood.

*Bryoerythrophyllum recurvirostrum* (Hedw.) P.C. Chen – DyakSPA (AR, MW, SR); cliffs between Biała Góra and Gosań (AR, SR); Świdna Kępa (AS, EF, GV, MW); Turkusowe Lake (BF, GV). Soil.

*Bryum argenteum* Hedw. – Biała Góra, lawn and roadside, concrete ledge (AS, BF, SR); cliffs between Biała Góra and Gosań, soil (AR); Wiselka forests (AS).

*Bryum caespiticium* Hedw. – Biała Góra, lawn (BF); cliffs between Świdna Kępa and Gosań (SR); Wiselka dunes (AR, MW, SR); Wiselka forests (GV). Soil, concrete ledge.

*Bucklandiella heterosticha* (Hedw.) Bednarek-Ochyra & Ochyra – cliffs between Biała Góra and Gosań, stone on the top (AR).

*Calliargon cordifolium* (Hedw.) Kindb. – DyakSPA, former excavation filled with water (MW); ŁunNR, water in hollows between clumps of *Carex paniculata* (GV, MW); Mokrzyca Wielka, wet meadow, peat (AR, MW, SR).

! *Calliargonella cuspidata* (Hedw.) Loeske – DyakSPA, edge of former excavation filled with water, calcareous soil (AR, EF, MW, RZ, SR); ŁunNR, alder



forest and *Caricetum paniculatae* (AR, AS, GV, MW, SR); Grodno Lake shore (BF, GV, SR); Lewińska Struga (AR, MW, SR); Mokrzyca Wielka, wet meadow (AR, MW, SR); Turkusowe Lake shore (AS, BF, GV, MW). Peat, wet soil, water.

*Campyliadelphus chrysophyllus* (Brid.) R.S. Chopra – DyakSPA, sunny slope and beech forest *Galio odorati-Fagetum* with addition of Scotch pine (AR, SR). Calcareous soil.

\***(R)** • *Campyliadelphus elodes* (Lindb.) Kanda – DyakSPA sunny slope comp. 125 f, dried branch and lime soil (AR).

*Campylophyllopsis calcarea* (Crundwell & Nyholm) Ochrya – DyakSPA gully (AR, MW, SR); cliffs between Biała Góra and Gosań (AR, SR); Turkusowe Lake, sec. for. comm. (AS, BF, GV). Soil, sand, rarely limestone boulder, rotten poplar wood, birch roots.

*Campylopus introflexus* (Hedw.) Brid. – Grodno Lake (AS, BF, GV, MW, RZ). Humic and wet soil.

*Ceratodon purpureus* (Hedw.) Brid. – Biała Góra: lawn, roadside, wreck car body, bark of *Pseudotsuga*, concrete ledge, soil (AS, BF, MW, SR); cliffs between Biała Góra and Gosań (AR, BF); cliffs between Świdna Kępa and Gosań (AS, GV, MW, SR); Grodno Lake, *Luzulo pilosae-Fagetum* (GV), lakeshore, logs (BF); SzaferSPA (BF); Wiśłka dunes, mineral soil: white dunes (EF, GV, MW), grey dunes (AR, AS, MW, RZ, SR); Wiśłka forests, mineral soil (GV).

*Cirriphyllum piliferum* (Hedw.) Grout – DyakSPA, lime slope (EF); Turkusowe Lake, sec. for. comm. and edge of reed-rushes, mineral soil (AS, BF, GV).

! *Climacium dendroides* (Hedw.) F. Weber & D. Mohr – DyakSPA, reed-rushes near former excavations filled with water (MW); Biała Góra roadside (AS); Lewińska Struga (AR, MW, SR); ŁunNR, marginal part of bog (AR, MW, SR); Turkusowe Lake shore (AS, BF, MW). Mineral wet soil, peat.

*Cratoneuron filicinum* (Hedw.) Spruce – DyakSPA, grassy slope (AR, EF, MW, SR); Turkusowe Lake, lakeshore and overgrown dune (AS, BF, GV). Mineral wet soil.

! *Ctenidium molluscum* (Hedw.) Mitt. – DyakSPA, sunny slope, comp. 125 f (AR, MW, SR).

*Dicranella heteromalla* (Hedw.) Schimp. – DyakSPA, *Galio odorati-Fagetum* (EF, MW); cliffs between Biała Góra and Gosań (AR, BF); Grodno Lake (AR, AS, BF, GV, SR); SzaferSPA (AS, BF, GV, MW); Świdna Kępa (GV, SR); Wiśłka forests, sec. for. comm. (AS, BF), *Empetro nigri-Pinetum* (AR, BF, SR). Mineral soil.

*Dicranella varia* (Hedw.) Schimp. – cliffs between Biała Góra and Gosań, soil on the top (AR); Turkusowe Lake, overgrown dune (AS, BF, GV). Mineral soil.

*Dicranodontium denudatum* (Brid.) E. Britton – cliffs between Gosań and Świdna Kępa, logs and bark of beech (SR).

*Dicranoweisia cirrata* (Hedw.) Lindb. – DyakSPA, *Galio odorati-Fagetum* (AR, MW, SR); Biała Góra roadside (AS); cliffs between Biała Góra and Gosań (BF);

Grodno Lake (BF); ŁunNR, alder and pine forest (AR, AS, GV, SR); Mokrzyca Wielka, roadside afforestation (AR, SR); Świdna Kępa (SR). Bark of trees.

*Dicranum majus* Sm. – Grodno Lake, *Luzulo pilosae-Fagetum* (AR, EF, MW, SR). Mineral soil.

! *Dicranum polysetum* Sm. ex anon. – Turkusowe Lake, soil in thicket (BF); Wiśłka forests, *Empetro nigri-Pinetum*, ground layer (AR, AS, BF, EF, GV, MW, RZ, SR).

! *Dicranum scoparium* Hedw. – DyakSPA (AR, EF, MW, RZ, SR); Biała Góra, roadside slope (BF); cliffs between Biała Góra and Gosań (AR, BF, MW, SR); Grodno Lake (AR, AS, BF, EF, GV, MW, RZ, SR); ŁunNR, alder thicket on the mire (AS, GV); Mokrzyca Wielka, roadside afforestation (AR, SR); Świdna Kępa (AS, MW, RZ, SR); Turkusowe Lake, thicket and sec. for. comm. (AS, BF, GV); Wiśłka dunes (AR, MW, RZ, SR); Wiśłka forests, sec. for. comm. (AS, BF, GV) and *Empetro nigri-Pinetum* (AR, AS, BF, EF, MW, RZ, SR). Logs, stumps and bark of trees, calcareous soil, humic soil, mineral soil, sand.

\***(R)** !! • *Dicranum viride* (Sull. & Lesq.) Lindb. – Świdna Kępa comp. 11, bark of fallen trunk of beech tree (SR).

*Didymodon fallax* (Hedw.) R.H. Zander – DyakSPA, sunny slope (AR, SR); Świdna Kępa, comp. 11 cliff (AS, GV); Turkusowe Lake, overgrown dune (AS, BF, GV). Mineral soil.

*Didymodon insulanus* (De Not.) M.O. Hill – DyakSPA sunny slope, soil (AR).

*Didymodon rigidulus* Hedw. – Biała Góra roadside (AS, BF); Wiśłka forests, *Empetro nigri-Pinetum* (AS, GV). Concrete ledge.

*Distichium capillaceum* (Hedw.) Bruch & Schimp. – cliffs between Biała Góra and Gosań (AR, BF, MW, SR). Sand.

*Drepanocladus aduncus* (Hedw.) Warnst. – Grodno Lake, water of lake (BF, GV).

*Drepanocladus polycarpus* (Blandow ex Voit) Warnst. – Lewińska Struga, peaty soil (AR, MW, SR).

*Dryptodon pulvinatus* (Hedw.) Brid. – Biała Góra, roadside, concrete ledge (AS, BF, SR); Świdna Kępa comp. 11, bark of beech (AS, GV, RZ).

*Ecalypta streptocarpa* Hedw. – DyakSPA, sunny slope and beech forest *Galio odorati-Fagetum* with addition of Scotch pine (AR, SR); Świdna Kępa, comp. 11 cliff (AS, GV, MW, RZ, SR); Turkusowe Lake, thicket (AS, BF, MW). Soil.

*Ecalypta vulgaris* Hedw. – Świdna Kępa comp. 11 cliff (GV, MW, SR). Mineral soil.

! *Eurhynchium angustirete* (Broth.) T.J. Kop. – DyakSPA, former excavations and sec. for. comm. (MW, SR). Calcareous and humic soil.

! *Eurhynchium striatum* (Schreb. ex Hedw.) Schimp. – DyakSPA, beech forest with addition of Scotch pine and edge of former excavations filled with water (AR, EF, MW, SR); cliffs between Biała Góra and Gosań (AR, BF); Świdna Kępa (AS, GV, MW, RZ, SR); Grod-

no Lake, *Luzulo pilosae-Fagetum* (EF); Turkusowe Lake, sec. for. comm. and overgrown dune (AS, BF, GV, MW). Mineral soil.

*Fissidens adianthoides* Hedw. – DyakSPA, slope near former excavation, wet soil (AR).

*Fissidens dubius* P. Beauv. – DyakSPA, lime slope (AR, EF, MW, RZ, SR).

*Fissidens taxifolius* Hedw. – DyakSPA (AR, EF, MW, RZ, SR); Grodno Lake (EF); Turkusowe Lake (AS, BF, GV, MW). Mineral and calcareous soil.

*Fontinalis antipyretica* Hedw. – Grodno Lake, in water (AR, AS, BF, GV, MW, SR).

*Herzogiella seligeri* (Brid.) Z. Iwats. – DyakSPA (AR, EF, MW, RZ); cliffs between Biała Góra and Gosań (AR, BF); Świdna Kępa (AS, GV, RZ, SR); Grodno Lake (AS, BF, EF, GV, RZ, SR); ŁunNR alder forest (AR, MW, SR); Szafer SPA (AS); Turkusowe Lake (AS, BF, GV); Wiselka dunes (AR), Wiselka forests, sec. for. comm. (AR, AS, BF, MW) and *Empetro nigri-Pinetum* (RZ). Rotten wood, soil.

! *Homalia trichomanoides* (Hedw.) Schimp – DyakSPA, beech forest *Galio odorati-Fagetum* with addition of Scotch pine, roots of beech (AR, SR).

*Homalothecium lutescens* (Hedw.) H. Rob. – Świdna Kępa comp. 11 (AS, GV, RZ, SR); Turkusowe Lake, thicket (AS, BF, GV, MW); Wiselka dunes (RZ). Mineral soil.

*Homalothecium sericeum* (Hedw.) Schimp. – DyakSPA, sunny slope (AR, MW); cliffs between Biała Góra and Gosań (BF); Świdna Kępa (GV, RZ, SR); Grodno Lake (BF, GV, PG, SR); Turkusowe Lake, sec. for. comm. (BF, GV). Bark of trees, rotten wood.

! *Hylocomium splendens* (Hedw.) Schimp. – DyakSPA, near former excavations filled with water (EF, MW, SR); cliffs between Biała Góra and Gosań (BF, MW); Grodno Lake, slope (AS, MW); Turkusowe Lake (AS, BF, GV); Wiselka forests, *Empetro nigri-Pinetum* (AR, AS, BF, EF, GV, MW, RZ, SR). Soil, ground layer.

*Hypnum cupressiforme* var. *cupressiforme* Hedw. – DyakSPA (AR, EF, MW, RZ, SR); Biała Góra, lawn, roadside (BF, MW, SR); cliffs between Biała Góra and Gosań (AR, BF, MW); Świdna Kępa (AS, GV, MW, RZ, SR); Dzicze Uroczysko, birch thickets (AR, MW, SR); Grodno Lake (AR, AS, BF, EF, GV, MW, RZ, SR); ŁunNR, alder thicket on the mire (AS, GV); Mokrzyca Wielka roadside afforestation (AR, SR); Szafer SPA (AS, BF, GV, MW); Turkusowe Lake (AS, BF, GV, MW); Wiselka forests, sec. for. comm. (AS, GV, MW, SR) and *Empetro nigri-Pinetum* (AR, AS, BF, MW, RZ). Bark of trees, rotten wood, soil, concrete ledge.

var. *filiforme* Brid. – DyakSPA (EF); cliffs between Biała Góra and Gosań (AR); Świdna Kępa (SR); Grodno Lake (AR, AS, BF, EF, GV, MW, RZ, SR); Szafer SPA (BF); Turkusowe Lake, thicket (GV); Wiselka forests, sec. for. comm. forest (BF, GV). Bark of trees.

var. *lacunosum* Brid. – Biała Góra (SR); cliffs between Biała Góra and Gosań (AR, SR); Turkusowe Lake, thicket (BF, GV); Wiselka dunes (AR, BF, MW,

RZ); Wiselka forests, *Empetro nigri-Pinetum* (AR). Mineral soil.

*Hypnum jutlandicum* Holmen & E. Warncke – DyakSPA, beech forest *Galio odorati-Fagetum* with addition of Scotch pine (EF); Grodno Lake, shore (AS, BF, EF, GV, RZ, SR); Świdna Kępa comp. 11 (SR); Wiselka dunes (AR, MW); Wiselka forests, sec. for. comm. (BF, GV) and *Empetro nigri-Pinetum* (AR, AS, BF, EF, GV, MW, SR). Soil, ground layer.

*Isoetecium alopecuroides* (Lam. ex Dubois) Isov. – DyakSPA, boulders in gully (AR); cliffs between Biała Góra and Gosań (AR, BF, MW); Grodno Lake (AR, BF, GV, SR); Szafer SPA (BF, GV); Świdna Kępa (AS, GV, MW, SR). Bark of trees.

*Kindbergia praelonga* (Hedw.) Ochyra – DyakSPA, beech forest *Galio odorati-Fagetum* with addition of Scotch pine (EF); cliffs between Biała Góra and Gosań (BF); Grodno Lake (AR); Lewińska Struga (AR, SR); Świdna Kępa (SR); Turkusowe Lake, *Galio odorati-Fagetum* (GV); Wiselka forests, sec. for. comm. (AR, AS, BF, GV, SR) and *Empetro nigri-Pinetum* (BF, GV). Humic, mineral and peaty soil.

! *Leptodictyum humile* (P.Beauv.) Ochyra – Lewińska Struga (AR, SR); Mokrzyca Wielka wet meadow, peat (AR, SR).

*Leptodictyum riparium* (Hedw.) Warnst. – Mokrzyca Wielka wet meadow, peat (AR, MW, SR).

! *Leucobryum glaucum* (Hedw.) Ångstr. – cliffs between Biała Góra and Gosań (BF); Grodno Lake (AR, AS, BF, EF, GV, MW, SR); Świdna Kępa (SR); Wiselka forests, sec. for. comm. (AR, BF, GV) and *Empetro nigri-Pinetum* (AR, AS, BF, EF, GV, MW, RZ, SR). Soil, ground layer.

*Leucodon sciuroides* (Hedw.) Schwägr. – Świdna Kępa, comp. 11, bark of oak (GV).

*Mnium hornum* Hedw. – DyakSPA (AR, EF, MW, SR); cliffs between Biała Góra and Gosań (AR, BF, MW); Grodno Lake (AR, BF, EF, GV, MW, RZ, SR); ŁunNR, alder thicket on the mire (AR, AS, GV, MW, SR), Szafer SPA (AS, BF, GV, MW); Świdna Kępa (AS, EF, GV, MW, RZ, SR); Turkusowe Lake sec. for. comm. (BF); Wiselka forests, sec. for. comm. (AR, AS, BF, GV, SR) and *Empetro nigri-Pinetum* (BF). Bark and logs of trees, trunks, humic and mineral soil.

*Mnium marginatum* (Dicks.) P. Beauv. – DyakSPA, gully and *Galio odorati-Fagetum* (AR, MW, SR); Turkusowe Lake (AS, BF, GV). Soil.

*Mnium stellare* Reichard ex Hedw. – DyakSPA, *Galio odorati-Fagetum* (SR); cliffs between Biała Góra and Gosań (BF); Świdna Kępa (AS, GV); Turkusowe Lake (BF). Soil.

! *Neckera complanata* (Hedw.) Huebener – DyakSPA, comp. 125 f sunny slope, roots of birch (MW); cliffs between Biała Góra and Gosań (BF); Świdna Kępa (AS, GV, MW, RZ, SR); Turkusowe Lake (BF, GV). Bark of beech and oak trees.



*Niphotrichum canescens* (Hedw.) Bednarek-Ochyra & Ochyra – Turkusowe Lake overgrown dune (AS, BF, GV); Wiselka dunes (AR, SR). Sand.

*Orthodicranum montanum* (Hedw.) Loeske – DyakSPA (EF, RZ); Biała Góra, roadside (BF); cliffs between Biała Góra and Gosań (AR); Grodno Lake (AR, AS, BF, EF, GV, MW, SR); ŁunNR, alder thicket on the mire (AR, AS, GV, SR); SzaferSPA (BF, GV); Świdna Kępa (AS, MW, SR); Turkusowe Lake, thicket and sec. for. comm. (AS, GV); Wiselka forests, sec. for. comm. (AR, AS, BF, GV, SR) and *Empetro nigri-Pinetum* (AR, BF, MW). Bark of beeches, rarely others trees, rotten wood.

*Orthodicranum tauricum* (Sapjegin) Smirnova – Świdna Kępa comp. 11, bark of beech (SR).

*Orthodontium lineare* Schwägr. – cliffs between Biała Góra and Gosań (AR, BF); Dzicze Uroczyso, birch thickets (AR, MW, SR); Grodno Lake (AS, BF, GV, RZ, SR); Wiselka forests sec. for. comm. (BF) and *Empetro nigri-Pinetum* (AR, AS, EF, MW). Humic soil (especially in base of pines), rotten wood.

*Orthotrichum affine* Schrad. ex Brid. – DyakSPA, *Galio odorati-Fagetum* (SR); Biała Góra, roadside (BF); Grodno Lake (SR); SzaferSPA (BF, MW); Turkusowe Lake (BF); Wiselka forests, sec. for. comm. (AR, AS). Bark of trees.

*Orthotrichum anomalum* Hedw. – Biała Góra, roadside, concrete ledge (AS, BF); Mokrzyca Wielka roadside afforestation, bark of willow (AR).

*Orthotrichum diaphanum* Schrad. ex Brid. – Biała Góra, roadside, concrete ledge and bark of *Acer platanoides* (AS); Świdna Kępa comp. 11, bark of beech (GV, RZ).

*Orthotrichum pallens* Bruch ex Brid. – Grodno Lake, *Luzulo pilosae-Fagetum*, logs of beech (BF, SR).

*Orthotrichum pulchellum* Brunt. – Mokrzyca Wielka, roadside afforestation, bark of willow (AR, SR).

*Orthotrichum pumilum* Sw. ex anon. – DyakSPA, *Galio odorati-Fagetum* (SR); Świdna Kępa comp. 11 (GV, SR); Grodno Lake, *Luzulo pilosae-Fagetum* (BF, GV, MW). Bark of beech trees.

*Orthotrichum speciosum* Nees – Biała Góra roadside (AS); Grodno Lake, *Luzulo pilosae-Fagetum* (AR); Mokrzyca Wielka, roadside afforestation (AR, SR); Świdna Kępa comp. 11 (GV); Turkusowe Lake (AS, GV). Bark of beech trees.

\***(V)** *Orthotrichum stramineum* Hornsch. ex Brid. – DyakSPA, slope (AR); Biała Góra roadside (BF); cliffs between Biała Góra and Gosań (AR); Grodno Lake, *Luzulo pilosae-Fagetum* (AR, AS, EF); SzaferSPA (AS); Świdna Kępa (AS, EF). Bark of trees.

*Oxyrrhynchium hians* (Hedw.) Loeske – DyakSPA (AR, EF, MW, RZ, SR); Biała Góra, lawn, thicket (AS, BF); Grodno Lake (EF); Turkusowe Lake (AS, BF, GV); Wiselka forests, sec. for. comm. (AS). Calcareous soil, mineral soil.

var. *rigidum* (Boulay) Ochyra & Żarnowiec – DyakSPA, sunny slope (AR); Grodno Lake, concrete ledge

(BF); Turkusowe Lake, sec. for. comm., limestone boulder, mineral soil, rotten wood (AS, BF, GV).

*Oxyrrhynchium schleicheri* (R. Hedw.) Röhl – DyakSPA lime outcrop (EF). Soil.

*Physcomitrium pyriforme* (Hedw.) Bruch & Schimp. – Lewińska Struga (AR, SR); Mokrzyca Wielka, wet meadow (AR, MW, SR). Peat.

*Plagiomnium affine* (Blandow ex Funck) T.J. Kop. – DyakSPA, beech forest *Galio odorati-Fagetum* with addition of Scotch pine and edge of former excavation (AR, EF, MW); Biała Góra lawn (BF, MW); cliffs between Biała Góra and Gosań (AR, BF); Turkusowe Lake, sec. for. comm., thicket (AS, BF); Wiselka dunes (AR, GV, SR); Wiselka forests, sec. for. comm. (AR, AS, BF, GV) and *Empetro nigri-Pinetum* (BF, GV, RZ). Mineral soil, rotten wood.

*Plagiomnium cuspidatum* (Hedw.) T.J. Kop. – DyakSPA (EF, SR); Biała Góra roadside (BF); cliffs between Biała Góra and Gosań (AR, BF); Świdna Kępa (AS, EF, GV, MW, RZ, SR); Grodno Lake (BF, EF, GV, RZ); Mokrzyca Wielka, road-side afforestations (AR, MW, SR); SzaferSPA (AS, BF, GV); Turkusowe Lake (AS, BF, GV); Wiselka forests, *Empetro nigri-Pinetum* (AS, GV). Bark of trees, concrete ledge, humic soil, mineral soil, rotten wood.

*Plagiomnium elatum* (Bruch & Schimp.) T.J. Kop. – Lewińska Struga, peaty soil (AR, MW, SR).

*Plagiomnium ellipticum* (Brid.) T.J. Kop. – DyakSPA, edge of former pit, lime soil (SR); Mokrzyca Wielka, wet meadow, peat (AR, MW).

*Plagiomnium rostratum* (Schrad.) T.J. Kop. – DyakSPA (AR, EF, MW, SR); Świdna Kępa, comp. 11 cliff (RZ); Turkusowe Lake (AS, BF, GV, MW); Wiselka dunes, grey dunes (RZ). Humic and mineral soil, sand.

*Plagiomnium undulatum* (Hedw.) T.J. Kop. – DyakSPA (AR, EF, MW, RZ, SR); Biała Góra, lawn, thicket (AS, BF, MW); cliffs between Biała Góra and Gosań (AR, BF, MW); Grodno Lake (GV, MW); SzaferSPA (BF, GV); Świdna Kępa (AS, GV, MW, SR); Turkusowe Lake (AS, BF, GV, MW); Wiselka forests, sec. for. comm. (AS, BF, GV, SR) and *Empetro nigri-Pinetum* (AS). Mineral soil, rotten wood, sand.

*Plagiothecium cavifolium* (Brid.) Z. Iwats. – DyakSPA, *Galio odorati-Fagetum* with addition of Scotch pine (EF, MW); Grodno Lake (AR, AS); SzaferSPA (AS, BF). Mineral soil.

*Plagiothecium curvifolium* Schleiph. ex Limpr. – DyakSPA, beech forest *Galio odorati-Fagetum* with addition of Scotch pine (EF); cliffs between Biała Góra and Gosań (AR, BF); Dzicze Uroczyso, birch thicket (AR); Grodno Lake, *Luzulo pilosae-Fagetum* (BF, SR); SzaferSPA (GV); Wiselka forests, sec. for. comm. (AR, BF, GV) and *Empetro nigri-Pinetum* (AR, AS, MW). Humic and mineral soil, rotten wood.

*Plagiothecium denticulatum* (Hedw.) Schimp. – DyakSPA, *Galio odorati-Fagetum* and sec. for. comm.,

humic soil (AR, SR); Wiselka forests, sec. for. comm., pine logs (SR).

*Plagiothecium laetum* Schimp. – DyakSPA, beech forest *Galio odorati-Fagetum* with addition of Scotch pine, humic soil (SR); Grodno Lake, *Luzulo pilosae-Fagetum*, rotten wood (GV); Wiselka forests, sec. for. comm., bark of trees (AS, GV).

*Plagiothecium nemorale* (Mitt.) A. Jaeger – DyakSPA, *Galio odorati-Fagetum* (AR, SR); cliffs between Świdna Kępa and Gosań, humic soil (SR); Wiselka forests, sec. for. comm. (AS); SzaferSPA (AS, BF, GV, MW). Bark of trees, mineral soil.

*Plagiothecium ruthei* Limpr. – ŁunNR, rotten wood in alder forest (AR, SR).

*Plagiothecium succulentum* (Wilson) Lindb. – DyakSPA, *Galio odorati-Fagetum* (SR); Cliffs between Biała Góra and Gosań (AR); Grodno Lake, *Luzulo pilosae-Fagetum* (GV). Mineral soil.

*Platygyrium repens* (Brid.) Schimp. – DyakSPA, *Galio odorati-Fagetum* (SR); cliffs between Świdna Kępa and Gosań (AS, SR); Grodno Lake (AR, AS, BF, EF, GV, MW, RZ, SR); ŁunNR, alder forest (AS). Bark of trees.

! *Pleurozium schreberi* (Willd. ex Brid.) Mitt. – cliffs between Biała Góra and Gosań (BF, MW); Dzicze Uroczyisko, birch thicket (AR, MW, SR); Grodno Lake (BF, GV); Świdna Kępa (SR); Turkusowe Lake (AS, BF, GV); Wiselka dunes (BF, MW, RZ); Wiselka forests, sec. for. comm. (AS, BF) and in *Empetro nigri-Pinetum* (AR, AS, BF, EF, GV, MW, RZ, SR). Soil, ground layer in forests.

*Pohlia melanodon* (Brid.) A.J. Shaw – Turkusowe Lake thicket, soil (BF).

*Pohlia nutans* (Hedw.) Lindb. – DyakSPA, *Galio odorati-Fagetum* (SR); cliffs between Biała Góra and Gosań (AR, BF); Grodno Lake (AS, BF, GV, MW, SR); ŁunNR, alder forest and marginal part of bog (AR, AS, MW, SR); SzaferSPA (AS, BF, GV, MW); Świdna Kępa (AS, GV, SR); Turkusowe Lake (BF, GV); Wiselka dunes (AR); Wiselka forests in sec. for. comm. (AS, BF) and *Empetro nigri-Pinetum* (SR). Soil.

*Pohlia wahlenbergii* (F. Weber & D. Mohr) A.L. Andrews – DyakSPA, slope near former excavations, logs of pear, soil (AR, MW, SR); Turkusowe Lake – overgrown dune, mineral soil (AS, GV).

*Polytrichastrum formosum* (Hedw.) G.L. Sm. – DyakSPA (EF, MW, RZ, SR); Biała Góra roadside (BF); cliffs between Biała Góra and Gosań (AR, BF, MW); Grodno Lake (AR, AS, BF, EF, GV, MW, RZ, SR); ŁunNR (AS, GV); SzaferSPA (AS, BF, GV, MW); Świdna Kępa (AS, EF, GV, MW, RZ, SR); Turkusowe Lake, thicket (AS, BF, GV); Wiselka forests sec. for. comm. (AS, BF, GV, SR) and in *Empetro nigri-Pinetum* (BF, EF, MW, RZ, SR). Humic soil, mineral soil, rotten wood, peat.

! *Polytrichum commune* Hedw. – Grodno Lake shore (SR); ŁunNR, alder forest (AS, MW). Humic soil.

*Polytrichum juniperinum* Hedw. – cliffs between Biała Góra and Gosań, *Luzulo pilosae-Fagetum* (BF, MW); Turkusowe Lake sec. for. comm. (GV); Wiselka dunes (GV). Sand.

*Polytrichum piliferum* Hedw. – Wiselka white dunes, sand (EF).

! *Polytrichum strictum* Menzies ex Brid. – ŁunNR open mire, peat (AR, AS, MW, SR).

! *Pseudoscleropodium purum* (Hedw.) M. Fleisch. ex Broth. – DyakSPA sunny slope (AR, EF, MW, RZ, SR); Biała Góra roadside (AS, MW); cliffs between Biała Góra and Gosań (AR, BF); Świdna Kępa (AS, GV, MW, RZ, SR); Turkusowe Lake (AS, BF, GV); Wiselka dunes (BF, MW, SR); Wiselka forests sec. for. comm. (AS, BF, GV) and in *Empetro nigri-Pinetum* (AR, AS, BF, EF, GV, RZ, SR). Mineral soil, humic soil, forest cover.

*Pterigynandrum filiforme* Hedw. – Turkusowe Lake grey dunes, single stems among turf other mosses on mineral soil (GV).

! *Ptilium crista-castrensis* (Hedw.) De Not. – Wiselka forests, *Empetro nigri-Pinetum*, soil (BF, RZ).

*Pylaisia polyantha* (Hedw.) Schimp. – Mokrzyca Wielka, roadside afforestation, bark of willow (AR, SR).

*Rhizomnium punctatum* (Hedw.) T.J. Kop. – DyakSPA (AR, EF, MW, SR); Grodno Lake, shore (SR); SzaferSPA (BF); Turkusowe Lake, sec. for. comm. (BF); Wiselka forests, sec. for. comm. (BF). Wet soil.

*Rhodobryum roseum* (Hedw.) Limpr. – Turkusowe Lake, thicket (AS, BF, GV, MW). Humic and mineral soil.

*Rhynchostegium murale* (Hedw.) Schimp. – Biała Góra, concrete ledge (AS, SR).

! *Rhytidiadelphus squarrosus* (Hedw.) Warnst. – DyakSPA sunny slope (EF); Biała Góra, lawn (AS, BF, SR); Turkusowe Lake thicket (BF); Wiselka forests, sec. for. comm. (BF) and *Empetro nigri-Pinetum* (AS). Soil.

! *Rhytidiadelphus triquetrus* (Hedw.) Warnst. – DyakSPA, sunny slope (AR, EF, MW, SR); cliffs between Biała Góra and Gosań (AR, BF, MW); Świdna Kępa (AS, EF, GV, MW, RZ, SR); Turkusowe Lake, thicket and sec. for. comm. (AS, BF, GV); Wiselka dunes (BF); Wiselka forests, sec. for. comm. (SR) and *Empetro nigri-Pinetum* (GV). Mineral soil.

*Rosulabryum capillare* (Hedw.) J.R. Spence – DyakSPA (AR, EF, RZ); Biała Góra roadside (BF); cliffs between Biała Góra and Gosań (AR, BF, MW); Świdna Kępa (GV, MW); Turkusowe Lake (BF, GV); Wiselka dunes, white (EF) and grey dunes (AR, BF, SR); Wiselka forests, in initial stage of *Empetro nigri-Pinetum* (AS, GV). Mineral soil, concrete ledge, rotten wood, sand.

*Rosulabryum moravicum* (Podp.) Ochyra & Stebel – DyakSPA, *Galio odorati-Fagetum* (SR); cliffs between Biała Góra and Gosań (BF); cliffs between Świdna Kępa and Gosań (SR); Grodno Lake (BF); Lewińska

Struga (AR, SR); Mokrzyca Wielka, roadside afforestation (AR); SzaferSPA (AS); Turkusowe Lake, overgrown dune, thicket and sec. for. comm. (BF, GV). Bark of trees, humic soil, concrete.

*Sanionia uncinata* (Hedw.) Loeske – DyakSPA, sunny slope, roots of *Populus tremula* (MW).

*Schistidium crassipilum* H.H. Blom – Biała Góra roadside, concrete ledge (AS, SR); DyakSPA, boulder in beech forest (SR); Turkusowe Lake, thicket, limestone boulders (AS, GV).

*Sciuro-hypnum oedipodium* (Mitt.) Ignatov & Huttunen – Turkusowe Lake, thicket, soil (BF); Wisełka forests sec. for. comm., base of trunk of spruce and rotten wood (BF).

*Sciuro-hypnum populeum* (Hedw.) Ignatov & Huttunen – Turkusowe Lake, *Luzulo pilosae-Fagetum*, rotten wood (GV).

! *Sphagnum angustifolium* (C.E.O. Jensen ex Rusow) C.E.O. Jensen – ŁunNR, the open mire, peat (AR, AS, MW, SR).

! *Sphagnum capillifolium* (Ehrh.) Hedw. – Wisełka forests, *Empetro nigri-Pinetum*, comp. 7, ground layer (AR, EF, MW, RZ).

! *Sphagnum cuspidatum* Ehrh. ex Hoffm. – ŁunNR, the quacking bog, peat (AR, MW, SR).

! *Sphagnum fallax* (H. Klinggr.) H. Klinggr. – Dzikie Uroczyisko, the open mire (AR, MW, SR); ŁunNR, alder thicket on the mire, peat (AS, GV, MW).

! *Sphagnum fimbriatum* Wilson – Grodno Lake shore (SR); ŁunNR, peaty soil in alder forest (AR, AS, MW, SR).

! *Sphagnum flexuosum* Dozy & Molk. – Dzikie Uroczyisko, the open mire, peat (AR, MW, SR).

! *Sphagnum palustre* L. – Dzikie Uroczyisko, the open mire, peat (MW); ŁunNR, peat (AR, AS, GV, MW, SR); Grodno Lake, shore, wet soil (AS, BF); Wisełka forests in *Empetro nigri-Pinetum*, ground layer (RZ).

! *Sphagnum squarrosum* Crome – ŁunNR, peat (AR, AS, GV, MW, SR).

! *Sphagnum teres* (Schimp.) Ångstr. – ŁunNR, the open mire, peat (AR, MW, SR).

*Straminergon stramineum* (Dicks. ex Brid.) Hedenäs – Dzikie Uroczyisko, the open mire (AR, MW, SR); ŁunNR, peat (AR, GV, MW, SR).

*Syntrichia calcicola* J.J. Amann – cliffs between Świdna Kępa and Gosań, sand (SR).

\*(R) ! *Syntrichia papillosa* (Wilson) Jur. – Mokrzyca Wielka roadside afforestation, bark of ash tree (AR, SR).

*Syntrichia ruraliformis* (Besch.) Cardot – Biała Góra, roadside (AR, AS, BF, SR); Turkusowe Lake, overgrown dune (AS, BF, GV, MW); Wisełka dunes, white (EF) and grey dunes (AR, AS, BF, MW, RZ, SR); Wisełka forests, initial stage of *Empetro nigri-Pinetum* (GV). Concrete ledge, mineral soil, sand.

\*(R) ! *Syntrichia virescens* (De Not.) Ochyra – Biała Góra (AR, SR); Mokrzyca Wielka roadside afforestation (AR, SR). Bark of trees.

*Tetraphis pellucida* Hedw. – DyakSPA, slope (EF); cliffs between Biała Góra and Gosań (BF); Dzikie Uroczyisko, birch thickets (AR, MW, SR); Grodno Lake (AR, AS, BF, EF, GV, MW, RZ, SR); Świdna Kępa (SR); Wisełka forests, sec. for. comm. (AS, BF, SR) and *Empetro nigri-Pinetum* (AR, AS, RZ). Rotten wood.

! *Thuidium delicatulum* (Hedw.) Schimp. – cliffs between Świdna Kępa and Gosań, the cliff tops (EF); Wisełka dunes (AS); Wisełka forests, the initial stage of *Empetro nigri-Pinetum* (GV). Mineral soil, sand.

! *Thuidium philiberti* Limpr. – DyakSPA, edge of the former excavation (AR, EF, MW, SR); Turkusowe Lake, overgrown dune (AS, BF, GV). Soil.

! *Thuidium tamariscinum* (Hedw.) Schimp. – cliffs between Świdna Kępa and Gosań on the cliff tops (SR); Grodno Lake (AR, AS, BF, EF, GV, SR); Turkusowe Lake shore (AS, BF, GV, MW). Soil.

*Tortula muralis* Hedw. – Biała Góra roadside (AS, BF, SR); Wisełka forests, initial stage of *Empetro nigri-Pinetum* (AS, GV). Concrete ledge.

*Tortula subulata* Hedw. – DyakSPA, gully (MW); Biała Góra, roadside (BF); cliffs between Biała Góra and Gosań (AR, MW, SR); Świdna Kępa, cliff (GV); Turkusowe Lake (BF). Soil, sand.

\*(V) ! *Ulota bruchii* Hornsch. ex Brid. – Grodno Lake, *Luzulo pilosae-Fagetum* (BF, SR); SzaferSPA (BF). Bark of beech trees.

\*(V) ! *Ulota crispa* (Hedw.) Brid. – DyakSPA, slope (AR), Grodno Lake, *Luzulo pilosae-Fagetum* (AR, AS, GV); Świdna Kępa comp. 11 (GV, MW, SR). Bark of beeches.

*Warnstorfia fluitans* (Hedw.) Loeske – Dzikie Uroczyisko, open mire (AR, MW, SR). Peat.

!! *Zygodon stirtonii* Schimp. ex Stirt. – Grodno Lake, *Luzulo pilosae-Fagetum*, bark of beech (ASa); Świdna Kępa, comp. 11 (AS, RZ), bark of *Quercus petraea*.

\*(E) !! *Zygodon viridissimus* (Dicks.) Brid. – Świdna Kępa, comp. 11 (AS, GV, MW, SR). Bark of beeches and oaks.

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