



A CONTRIBUTION TO THE LIVERWORT FLORA OF THE DRAWSKO LAKE DISTRICT
(WESTERN POMERANIA, POLAND)

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ABSTRACT. The article presents a list of 246 localities of 39 liverwort species and one hornwort species from the Drawsko Lake District, Poland. Investigations were conducted on an area administered by the State Forests National Forest Holding, thus the focus was also on the relation between the manner of utilization of different types of natural habitats and the preservation of their natural value, primarily from the point of view of liverwort protection. Under conditions of forest economy the flora of epiphytic liverworts is particularly poor, while that of epigeal species is relatively rich. Valuable objects for studies on processes of recreation of conditions for the return of rare epiphytes (including the so-called relicts of the primeval forest) are bird habitat protection zones, established around their nesting grounds. Natural habitats richest in liverworts are boggy pine forests and birch forests.

KEY WORDS: liverworts, Drawsko Lake District, Western Pomerania, protection of bryophytes

INTRODUCTION

To date Western Pomerania has been the site of numerous bryological studies (SZWEYKOWSKI 1958, SZWEYKOWSKI and KOZŁICKA 1969). Many papers concerning this region were published by German botanists in the 19th and early 20th centuries. In the second half of the 20th century certain regions of Western Pomerania were presented in monographs. This pertains e.g. to the island of Wolin (SZWEYKOWSKI and KOZŁICKA 1966), the Beech Primeval Forest [Puszcza Bukowa] (BALCERKIEWICZ 1970) or the Kartuzy Lake District (RUSIŃSKA 1981). Despite the large number of floristic studies Western Pomerania has not been thoroughly investigated over its entire area (RUSIŃSKA and URBAŃSKI 1989). An example of such a region may be the Drawsko Lake District. The last report concerning the flora of liverworts in that area comes from the early 20th century. Localities of bryophytes (including liverworts) from the area of Szczecinek were published by HINTZE and KOHLHOFF (1902, 1903), as well as KOPPE and KOPPE (1940). In the area of the present-day "Sośnica" nature reserve near the village of Otrzep (Świerczyna Forest Inspectorate) investigations were conducted by HINTZE (1905). A much bigger body of bryological data from the Drawsko Lake District concerns the flora of mosses. It was thoroughly inventoried by URBAŃSKI (1992). In this area numerous rare species were reported (URBAŃSKI 1989, RUSIŃSKA and URBAŃSKI 1989, 1993 a), as well as one of the first localities of moss neophytes in the flora of Poland (URBAŃSKI 1987, RUSIŃSKA and URBAŃSKI 1993 b).

The aim of this study was to present localities of 39 species of liverworts (as well as those of one hornwort) from the Drawsko Lake District. Since the survey was conducted in the area belonging to the State Forests National Forest Holding, special emphasis was placed on relations between management systems of different types of natural habitats and the preservation of their natural value, mainly from the point of view of liverwort protection. These data will supplement the results concerning bryophyte protection (e.g. KLAMA 2003, 2004, ŻARNOWIEC 2003, GÓRSKI and URBAŃSKI 2006).

AREA OF THE STUDY

Field investigations were conducted in the south-western part of the Drawsko Lake District. It comprised the area of three forest inspectorates, i.e. Czaplinek, Czarnobór and Świerczyna, being a part of the Regional Directorate of State Forests (Regionalna Dyrekcja Lasów Państwowych – RDLP) in Szczecinek (Fig. 1). A total of 2618 forest subcompartments from the Czaplinek Forest Inspectorate (1353 subcompartments), Świerczyna (834) and Czarnobór (431) were penetrated.

The Drawsko Lake District covers the area of approx. 1900 km² in the central part of the Western Pomeranian Lake District, in the north-western Poland (KONDRACKI 2000). It includes the upper basin of the Drawa River in the west and the headstream area of the Parsęta River in the east (JASNOWSKA and JASNOWSKI 1983). This region is characterised by a high variation in land sculpture and comprises three series of end moraines



FIG. 1. Area of investigation – part of the Drawskie Lake District (1 – Czaplinek Forest Inspectorate, 2 – Świerczyna Forest Inspectorate, 3 – Czarnoból Forest Inspectorate, R! – “Sośnica” nature reserve)

(KONDRACKI l.c.) and depressions between them, filled with a dense river network and numerous lakes. A unique characteristic of the area is connected with beech forests and bog communities, coniferous forests and bog birch forests. The fragment of the Lake District of greatest natural value is the Drawsko Landscape Park. It was established in 1979 between the towns of Czaplinek, Złocieniec and Połczyn Zdrój.

METHODS

Liverwort localities are presented in the ATMOS grid system (OCHYRA and SZMAJDA 1983). Moreover, the actual location of species was given on a survey map. The locations were determined based on a 1 : 50 000 map, calculating the distance from the locality of a given species to the central part of the nearest town/village. The list of plants was also supplemented with data from the division into compartments of the State Forests National Forest Holding, i.e. the name of a forest division and forest district as well as the number of the subcompartment. One record of a species in a forest subcompartment was assumed to constitute a locality. The spatial system of forest subcompartments was consistent with that binding in the Forest Division Management Plan for Czaplinek for the years 2000-2009, for Czarnoból – for the years 2005-2014 and Świerczyna

– for 1999-2008. The list did not include the most common species, (e.g. *Lophocolea heterophylla*, *L. bidentata*, *Cephalozia bicuspidata*, *Ptilidium pulcherrimum* or *Lepidozia reptans*). In the area of the above mentioned forest divisions mainly Natura 2000 sites were surveyed. Apart from certain economic management forest types (oak-hornbeam forests, beech forests, ash-alder riparian forest and alder swamp forest) there were primarily the so-called wasteland and swaps, i.e. different types of bogs, birch forests and bog coniferous forests, as well as natural dystrophic reservoirs.

The concept of a Natura 2000 habitat is consistent with that presented in the Habitat directive of the European Economic Community Council no. 92/43/EEC of 21 May 1992 (Appendix I). Habitat classification after BRZEG and WOJTERSKA (2001) was adopted for types of phytocenoses not included in that legal act. The nomenclature of liverworts and hornworts was adopted after SZWEYKOWSKI (2006), while that of mosses after OCHYRA et AL. (2003).

RESULTS

List of species

Abbreviations:

NCza – Czaplinek Forest Inspectorate

NCzb – Czarnoból Forest Inspectorate

NSw – Świerczyna Forest Inspectorate
f. – forestry
f. Kaczory, 350b – Kaczory forestry, subcompartment
350b
Bb 74 – ATMOS grid square.

Aneura pinguis (L.) Dumort.

NSw: **Bb 84** (2 km S of the village of Byszkowo, Kaczory, 350b)

Anthoceros agrestis Paton

NCza: **Bb 74** (near the village of Niwka), **Bb 75** (4 km W of the village of Łubowo, f. Łubowo, 94k)

Bazzania trilobata (L.) Gray

NCza: **Bb 56** (2 km SEE of the village of Chwalimki, f. Nowy Chwalim, 79g), **Bb 65** (2.5 km SE of the village of Sikory, f. Łubowo, 35a)

Blasia pusilla L.

NCza: **Bb 55** (2 km SWW of the village of Kiełpino, f. Kiełpino, 166b, 166i), **Bb 63** (2 km W of the village of Piaseczno, f. Piaseczno, 152a), **Bb 64** (at W shore of Lake Dołgie Wielkie, f. Sikory, 58h), **Bb 65** (1 km N of the village of Karsno, f. Sikory, 81d), **Bb 74** (2 km SEE of the village of Piaseczno, Rękawica peninsula on Lake Drawsko, f. Piaseczno, 170b)

NCzb: **Bb 68** (1 km SE of the village of Omulna, f. Turów, 61b)

NSw: **Bb 73** (2.5 km SW of the village of Siemczyno, f. Wilczkowo, 17d)

Blepharostoma trichophyllum (L.) Dumort.

NCzb: **Bb 77** (5 km NE of the village of Kłomino, f. Wrzosiec, 431g, 432b)

Calypogeia muelleriana (Schiffn.) Müll. Frib.

NSw: **Bb 84** (2 km NE of the village of Nowe Laski, f. Dąbrowa, 25a)

Calypogeia neesiana (C. Massal. & Carestia) Müll. Frib.

NSw: **Bb 73** (2.5 km SW of the village of Siemczyno, f. Wilczkowo, 26i, 26j)

Calypogeia sphagnicola (Parnell & J. Perss.) Warnst. & Loeske

NCza: **Bb 63** (1.5 km NW of the village of Rzepowo, f. Worowo, 128m), **Bb 64** (1.5 km SEE of the village of Sikory, f. Sikory, 27d),

NCzb: **Bb 68** (2.5 km SW of the village of Omulna, f. Turów, 73f)

Cephalozia connivens (Dicks.) Lindb.

NCza: **Bb 56** (2 km NEE of the village of Chwalimki, f. Nowy Chwalim 72d, 72f; 2 km SEE of the village of Chwalimki, f. Nowy Chwalim, 79a, 81c; 1.5 km W of the village of Kiełpino, f. Kiełpino, 159x, 160b, 162i; 3 km SWW of the village of Kiełpino, f. Kiełpino, 169g; 2 km N of the village of Juchowo, f. Juchowo, 125c), **Bb 63** (2.5 km S of the village of Chlebowo, at E shore of Lake Siecino, f. Worowo, 120b; 1.5 km NW of the village of Rzepowo, f. Worowo, 128m), **Bb 64** (1.5 km SEE of the village of Sikory, f. Sikory, 27d), **Bb 65** (in the

environs of Lake Sierakowo, f. Polne, 173h; 1 km N of the village of Międzyzlesie, f. Międzyzlesie 337f, 339b; 1 km NNW of the village of Strzeszyn, f. Międzyzlesie, 358r; 1.5 km SSW of the village of Międzyzlesie, f. Międzyzlesie, 380h), **Bb 66** (3 km W of the village of Juchowo, f. Juchowo, 199f), **Bb 75** (2 km E of the village of Karsno, f. Łubowo, 91f)

NCzb: **Bb 57** (eastern outskirts of the town of Szczecinek, f. Czarnobór, 46b), **Bb 58** (1.5 km SW of the village of Czarnobór, f. Czarnobór, 40h, 40i; 2 km SSW of the village of Czarnobór, f. Czarnobór, 48b), **Bb 68** (2.5 km SW of the village of Omulna, f. Turów, 73f), **Bb 77** (3 km E of Lake Kniewo, f. Płytnica, 312d)

NSw: **Bb 73** (2.5 km SW of the village of Siemczyno, f. Wilczkowo, 18g; 3 km SW of the village of Siemczyno, f. Wilczkowo, 27n; 2.5 km SE of the village of Siemczyno, f. Wilczkowo, 37d, 38h; 1.5 km NE of the village of Wąsosz, f. Wąsosz, 82g; 1.5 km E of the village of Wąsosz, f. Wąsosz, 94a), **Bb 74** (1 km SW of the village of Łąka, f. Krzemno, 50c, 50f, 51c; 2 km E of the village of Nowe Kaleńsko, f. Krzemno, 59l; 1.5 km S of the village of Nowe Kaleńsko, f. Krzemno, 102b), **Bb 84** (3 km SEE of the village of Wierzchowo, f. Nowy Dwór, 239c)

Cephaloziella divaricata (Sm.) Schiffn.

NSw: **Bb 84** (1 km NW of the village of Garbowo, f. Dąbrowa, 9l)

Chiloscyphus pallescens (Ehrh. ex Hoffm.) Dumort.

NSw: **Bb 84** (1 km NE of the village of Sońnica, f. Dębosz, 387l)

Cladopodiella fluitans (Nees) H. Buch

NCza: **Bb 55** (dystrophic reservoir 3 km SWW of the village of Kiełpino, f. Kiełpino, 169g), **Bb 63** (1.5 km NW of the village of Rzepowo, f. Worowo, 128m), **Bb 64** (1.5 km SEE of the village of Sikory, f. Sikory, 27d), **Bb 75** (2 km E of the village of Karsno, f. Łubowo, 91f)
NSw: **Bb 73** (1.5 km NE of the village of Wąsosz, f. Wąsosz, 82g, 94a)

Conocephalum salebrosum Szweyk. et al.

NCza: **Bb 46** (1 km S of the village of Iwin, f. Nowy Chwalim 10c, 10i, 23j), **Bb 56** (2 km SE of the village of Jeziorki, f. Juchowo, 114h)

NSw: **Bb 83** (1.5 km NE of the village of Wierzchowo, f. Nowy Dwór, 193b)

Diplophyllum albicans (L.) Dumort.

NCza: **Bb 65** (2.5 km E of the village of Sikory, f. Łubowo, 24d, 34b)

Fossombronion wondraczekii (Corda) Lindb.

NCza: **Bb 56** (1.5 km S of the village of Chwalimki, f. Nowy Chwalim, 96f; 2 km NE of the village of Juchowo, f. Juchowo, 123o), **Bb 64** (at W shore of Lake Dołgie Wielkie, f. Sikory, 58a), **Bb 75** (1 km NW of the village of Karsno, f. Sikory, 82a; 2 km SE of the village of Karsno, f. Łubowo, 94k)

NCzb: **Bb 68** (2.5 km SE of the village of Omulna, f. Turów, 76h), **Bb 77** (1.5 km SSE of southern shore of Lake Kniewo, f. Kniewo, 346a, 346d)

Frullania dilatata (L.) Dumort.

NSw: **Bb 84** (1 km NNE of the village of Nowe Laski, f. Dąbrowa, 27c)

Gymnocolea inflata (Huds.) Dumort.

NCzb: **Bb 77** (5 km NE of the village of Kłomino, f. Wrzosiec, 431g)

Jungermannia gracillima Sm.

NCza: **Bb 64** (at W shore of Lake Dołgie Wielkie, f. Sikory, 58a), **Bb 75** (1 km NW of the village of Karsno, f. Sikory, 82a)

NCzb: **Bb 77** (5 km NE of the village of Kłomino, f. Wrzosiec, 431g)

NSw: **Bb 74** (1 km S of the village of Nowe Kaleńsko, f. Laski, 87g)

Lejeunea cavifolia (Ehrh.) Lindb.

NCza: **Bb 55** (2.5 km W of the village of Jezioroki, f. Juchowo, 141l)

Lophozia barbata (Schmidel ex Schreb.) Dumort. [syn. *Barbilophozia barbata* (Schmidel ex Schreb.) Loeske]

NCza: **Bb 55** (2.5 km W of the village of Jezioroki, f. Juchowo, 141l)

Lophozia bicrenata (Schmidel ex Hoffm.) Dumort.

NCza: **Bb 64** (1.5 km S of the village of Sikory, f. Sikory, 30a)

NCzb: **Bb 67** (3 km S of the village of Jelonek, f. Krągi, 157d)

Lophozia excisa (Dicks.) Dumort.

NCza: **Bb 65** (2.5 km W of the village of Międzyzlesie, f. Międzyzlesie, 359b)

Lophozia ventricosa (Dicks.) Dumort. emend. H. Buch

NCza: **Bb 56** (2 km NE of the village of Juchowo, f. Juchowo, 123o), **Bb 64** (2 km S of the village of Sikory, at western shore of Lake Dołgie Wielkie, f. Sikory, 43c)

NCzb: **Bb 77** (5 km NE of the village of Kłomino, f. Wrzosiec, 431g)

Mylia anomala (Hook.) Gray

NCza: **Bb 65** (1.5 km SSW of the village of Międzyzlesie, f. Międzyzlesie, 380h), **Bb 66** (3 km W of the village of Juchowo, f. Juchowo, 199f)

NSw: **Bb 74** (1 km SW of the village of Łąka, f. Krzemno, 50c, 51c)

Nowellia curvifolia (Dicks.) Mitt.

NCza: **Bb 55** (3 km W of the village of Jezioroki, f. Juchowo, 142g), **Bb 56** (2 km SEE of the village of Chwalimki, f. Nowy Chwalim, 79a, 81a; 1.5 km W of the village of Kiełpino, f. Kiełpino, 159x, 160b, 162i), **Bb 63** (1 km W of the village of Warnięg, f. Worowo, 122i; 1.5 km NNE of the village of Cieszyno, f. Worowo, 130c; 1.5 km W of the village of Piaseczno, f. Piaseczno, 151a), **Bb 64** (1.5 km SE of the village of Sikory, f. Sikory, 39b), **Bb 65** (1.5 km SSW of the village of Trzemienko, f. Polne, 174g; 2.5 km NNW of the village of Strzeszyn, f. Międzyzlesie, 325g; 1 km N of the village of Międzyzlesie, f. Międzyzlesie 337f; 1.5 km SSW of the

village of Międzyzlesie, f. Międzyzlesie, 380h; 3 km NE of the village of Rakowo, f. Rakowo, 329b), **Bb 73** (1.5 km E of the village of Budów, f. Piaseczno, 203c), **Bb 75** (1 km SE of the village of Łubowo, f. Łubowo, 45j; 2 km S of the village of Łubowo, f. Łubowo, 49b)

NCzb: **Bb 58** (2 km SSW of the village of Czarnobór, f. Czarnobór, 48b), **Bb 66** (1.5 km NE of the village of Krągi, f. Jeleń, 113i), **Bb 68** (1.5 km E of the village of Drawień, f. Czarnobór, 18i; 2.5 km NE of the village of Wilcze Laski, f. Turowo, 75k), **Bb 77** (at southern shore of Lake Przełęg, f. Płytnica, 235a, 258d; at southern shore of Lake Kniewo, f. Płytnica, 292f; 6 km NE of the village of Kłomino, f. Wrzosiec, 404g; 5 and 6 km NEE of the village of Kłomino, f. Wrzosiec, 458b, 477m)

NSw: **Bb 73** (2 and 2.5 km SW of the village of Siemczyno, f. Wilczkowo, 16g, 18g; 2.5 km SSW of the village of Siemczyno, f. Wilczkowo, 26a, 27n; 2.5 km of the village of Bobrowo, f. Wilczkowo, 20b; 2 km NNE of the village of Wąsosz, f. Wąsosz, 44a; 2.5 km NW of the village of Wąsosz, f. Wąsosz, 67f, 68a, 80c), **Bb 74** (1.5 km NWW of the village of Nowe Kaleńsko, f. Wilczkowo, 39b, 39c, 38k; 1 km SW of the village of Łąka, f. Krzemno, 50c, 50k, 50l, 51a; 2 km SEE of the village of Nowe Kaleńsko, f. Krzemno, 59f; 2 km SE of the village of Nowe Kaleńsko, f. Krzemno, 115c; 2 km SW of the village of Pławno, f. Dzikowo, 160b), **Bb 84** (3 km SEE of the village of Wierzchowo, f. Nowy Dwór, 239c)

Odontoschisma denudatum (Mart.) Dumort.

NCza: **Bb 56** (2 km SEE of the village of Chwalimki, f. Nowy Chwalim, 79a; 1.5 km W of the village of Kiełpino, f. Kiełpino, 162i), **Bb 65** (1.5 km SSW of the village of Międzyzlesie, f. Międzyzlesie, 380h)

NSw: **Bb 73** (1.5 km NE of the village of Wąsosz, f. Wąsosz 70i, 82b; 2 km S of the village of Siemczyno, f. Wilczkowo 25g, 26a)

Metzgeria furcata (L.) Dumort.

NCza: **Bb 55** (2 km NNE of the village of Kiełpino, f. Juchowo 149m), **Bb 63** (2 km NW of the village of Warnięg, f. Worowo, 108ax), **Bb 64** (1.5 km W of the village of Kluczewo, f. Worowo, 107A-a, 107A-g)

NCzb: **Bb 58** (1.5 km NEE of the village of Czarnobór, f. Czarnobór 25h; 1 km W of the village of Czarnobór, f. Czarnobór 29n; 1 km SEE of the village of Czarnobór, f. Czarnobór 30b; 1.5 km S of the village of Czarnobór, f. Czarnobór 38a, 39b; 2.5 km SSW of the village of Czarnobór, f. Czarnobór 48a)

NSw: **Bb 73** (2-3 km SW of the village of Siemczyno, f. Wilczkowo 15i, 15o, 16g, 16l, 18m; 2 km NE of the village of Wąsosz, f. Wąsosz, 68c, 80n), **Bb 84** (1 km NNE of the village of Nowe Laski, f. Dąbrowa, 27d; 2.5 km NE of the village of Nowe Laski, f. Dąbrowa, 37d; 3 km NEE of the village of Nowe Laski, f. Dąbrowa, 46g; 1.5 km E of the village of Nowe Laski, f. Dąbrowa, 50f; 2.5 km SWW of the village of Otrzep, f. Buczyzna, 34b, 45a; 2 km SW of the village of Otrzep, f. Buczyzna, 84i, 85b)

Pellia epiphylla (L.) Corda

NSw: **Bb 84** (2 km NE of the village of Wierzchowo, f. Nowy Dwór, 175n)

Plagiochila asplenioides (L. emend. Taylor) Dumort.
NCzb: **Bb 58** (1.5 km NEE of the village of Czarnobór, f. Czarnobór 25h)

Plagiochila porelloides (Torrey ex Nees) Lindenb.
NCza: **Bb 55** (2.5 km W of the village of Jeziorki, f. Juchowo, 141l)

Ptilidium ciliare (L.) Hampe
NCza: **Bb 46** (1.5 km SSW of the village of Storkowo, north of the Parsęta River, f. Nowy Chwalim, 18a, 18j)

Radula complanata (L.) Dumort.
NCza: **Bb 56** (2 km NE of the village of Juchowo, f. Juchowo, 123t), **Bb 63** (2 km S of the village of Chlebowo, f. Worowo, 118b), **Bb 64** (2 km N of the village of Sikory, f. Sikory, 100A-c)
NCzb: **Bb 58** (1 km SEE of the village of Czarnobór, f. Czarnobór, 30b), **Bb 67** (at eastern shore of Lake Przełęg, f. Płynica, 194f)
NSw: **Bb 73** (1.5-3 km S of the village of Siemczyno, f. Wilczkowo, 15i, 15o 16g, 16l, 18m, 26d), **Bb 84** (1 km NNE of the village of Nowe Laski, f. Dąbrowa, 27a, 27c; 2.5 km SWW of the village of Otrzep, f. Buczyzna, 34b; 2 km SW of the village of Otrzep, f. Buczyzna, 84i, 85b)

Riccardia latifrons (Lindb.) Lindb.
NCza: **Bb 56** (1.5 km W of the village of Kiełpino, f. Kiełpino, 162i), **Bb 65** (1.5 km SSW of the village of Międzyzylesie, f. Międzyzylesie, 380h)
NSw: **Bb 85** (2.5 km NEE from the village of Świerczyna, f. Kaczory, 442d)

Riccardia palmata (Hedw.) Carruth.
NCza: **Bb 55** (3 km W of the village of Jeziorki, f. Juchowo, 142g)

Riccia cavernosa Hoffm.
NSw: **Bb 84** (1.5 km NNE of the village of Sońnica, f. Dębosz, 366c)

Riccia fluitans L. emend. Lorb.
NCza: **Bb 55** (2 km W of the village of Jeziorki, f. Juchowo 140i; 2 km SWW of the village of Kiełpino, f. Kiełpino, 166b), **Bb 56** (2 km SE of the village of Jeziorki, f. Juchowo, 114m; 2 km NE of the village of Juchowo, f. Juchowo, 123w, 123j; 2.5 km NW of the village of Juchowo, f. Juchowo, 136j), **Bb 63** (2 km NW of the village of Rzepowo, f. Worowo, 127j, 127m, 127r, 128l), **Bb 64** (2 km S of the village of Sikory, f. Sikory, 44a; 2 km N of the village of Sikory, f. Sikory, 100A-f), **Bb 65** (1 km SEE of the village of Rakowo, f. Rakowo, 333c, 333j; 1.5 km N of the village of Rakowo, f. Rakowo, 351f; 1.5 km N of the village of Łubowo, f. Rakowo, 399d), **Bb 73** (2 km NW of the village of Siemczyno, f. Piaseczno, 187b, 187f)
NCzb: **Bb 58** (0.5 km of the village of Czarnobór, f. Czarnobór, 27d; 1 km SEE of the village of Czarnobór, f. Czarnobór, 30h; 1.5 SSW of the village of Czarnobór, 40b); **Bb 66** (2 km NE of the village of Krągi, f. Jeleń, 111h), **Bb 67** (3.5 km SE of the village of Krągi, f. Krągi, 203f)
NSw: **Bb 73** (2 km NE of the village of Bobrowo, f. Wilczkowo, 21d; 2 km S of the village of Siemczyno, f. Wilczkowo, 23d; 2.5 km E of the village of Bobrowo, f. Wąsosz, 30r; 2 km SE of the village of Bobrowo, f. Wąsosz, 48r),

Bb 74 (1 km SW of the village of Żeliszawie, f. Wilczkowo, 34a; 1.5 km W of the village of Nowe Kaleńsko, f. Wilczkowo, 65m), **Bb 84** (1.5 km W of the village of Otrzep, f. Buczyzna, 32b)

Ricciocarpos natans (L.) Corda
NCza: **Bb 55** (2 km W of the village of Jeziorki, f. Juchowo, 140i), **Bb 63** (2 km NW of the village of Rzepowo, f. Worowo, 127m, 127r), **Bb 64** (2 km N of the village of Sikory, f. Sikory, 100A-f), **Bb 65** (1.5 km N of the village of Międzyzylesie, f. Międzyzylesie, 335g), **Bb 73** (2 km NW of the village of Siemczyno, f. Piaseczno, 186c 187b, 187f)
NCzb: **Bb 67** (3.5 km SE of the village of Krągi, f. Krągi, 203f)
NSw: **Bb 84** (2 km S of the village of Będolino, f. Nowy Dwór, 347C j; 2 km NNE of the village of Nowe Laski, f. Dąbrowa, 17a)

Scapania curta (Mart.) Dumort.
NCza: **Bb 75** (1 km NW of the village of Karsno, f. Sikory, 82a)

Scapania irrigua (Nees) Nees
NCzb: **Bb 77** (4.5 km NE of the village of Kłomino, f. Wrzosiec, 409a)

Scapania nemorea (L.) Grolle
NCza: **Bb 65** (2.5 km E of the village of Sikory, f. Łubowo, 34b, 34f)

Liverworts in view of habitat diversity

In the investigated area the presence of liverworts was recorded in almost 15 different types of natural habitats (Table 1). The most numerous group comprised

TABLE 1. Richness of liverwort species in selected natural habitats of Drawsko Lake District

Type of habitat/plant association	Number of species
Bog woodland – <i>Vaccinio uliginosi</i> - <i>Betuletum pubescentis</i>	10
<i>Stellario holostea</i> - <i>Carpinetum</i>	8
Bog woodland – <i>Vaccinio uliginosi</i> - <i>Pinetum</i>	8
Transition mires and quaking bogs	4
Wet heaths	4
Natural eu- and mesotrophic lakes	4
Natural dystrophic lakes	3
Active raised bogs	3
Degraded raised bogs still capable of natural regeneration	3
<i>Luzulo-Fagetum</i> beech forests	3
<i>Sphagno squarrosi</i> - <i>Alnetum</i>	1
<i>Salicetum pentandro-cinerea</i>	1
Alluvial forests – <i>Fraxino-Alnetum</i>	1
Substitute forest communities with pine	1

species found in phytocenoses of bog birch forest *Vaccinio uliginosi-Betuletum pubescentis* (10), followed by bog coniferous forests *Vaccinio uliginosi-Pinetum* and sub-Atlantic oak-hornbeam forests *Stellario-Carpinetum* with a high proportion of beech (eight each), as well as heaths, transition mires and small, eutrophic water bodies (four each).

Oak-hornbeam forests are characterised by the occurrence of a high number of liverwort taxa recorded only once or twice. These include *Lejeunea cavifolia*, *Lophozia barbata* (overgrowing forest erratics partly submerged in water) or *Diplophyllum albicans* and *Scapania nemorea* connected with shaded escarpments on forest edges. On secondary sites within the forest, i.e. dirt roads and strip roads, they form rarely found in Poland communities from the *Radiolion linoidis* alliance (Rivas-Goday 1961) Pietsch 1973 (class *Isoeto-Nanojunctetea*) with *Juncus bufonius* and *Hypericum humifusum*, in which *Fossombronia wondraczekii*, *Blasia pusilla* and *Anthoceros agrestis* are components of the moss layer. They may form spatial complexes with phytocenoses of *Jungermannietum gracillimae* Neum. 1971 (with predominating *Jungermannia gracillima* and *Scapania curta*), overgrowing vertical sides of wheel tracks in dirt roads.

In the Drawsko Lake District liverworts of meso- and eutrophic water bodies, i.e. *Riccia fluitans* and *Ricciocarpos natans*, are common. They are frequently found in the complex of mesotrophic broad-leaved forests, transition mires, bog birch forests or peat alder forests.

Nowellia curvifolia is a frequent species, at the same time exhibiting a wide phytocenotic spectrum. It was recorded in 43 localities, in nine natural habitat types (Table 2). This species is found most frequently in birch forests and in boggy coniferous forests (also those considerably degraded) and it covers pine stems on transition mires. In forests, in which commercial forest economy is implemented, it occurs rarely. It was recorded once in a forest substitute community with pine on the site of acidophilous beech forest *Luzulo-Fagetum*. It needs to be added that this plant was reported on a pine stump on the upper, flat kerf surface.

TABLE 2. Occurrence of *Nowellia curvifolia* in different natural habitats in the Drawsko Lake District

Type of habitat/plant association	Number of localities
Bog woodland – <i>Vaccinio-Betuletum pubescentis</i>	22
Bog woodland – <i>Vaccinio uliginosi-Pinetum</i>	7
Transition mires	3
<i>Sphagno squarrosi-Alnetum</i>	3
Degraded raised bogs	2
Alluvial forests – <i>Fraxino-Alnetum</i>	2
Substitute forest communities with pine	2
Natural dystrophic lakes	1
<i>Salicetum pentandro-cinereae</i>	1

Liverwort protection under conditions of forest economy

In commercial forests protection of epiphytic liverworts is particularly difficult. This problem has been repeatedly reported (KLAMA 2003, 2004, GÓRSKI and URBAŃSKI 2006). In the Drawsko Lake District the group of typical epiphytes is represented only by *Metzgeria furcata* and *Radula complanata*. In this region *Frullania dilatata* is a very rare liverwort. For almost 1600 surveyed forest subcompartments this plant was found in one locality. Its absence is particularly disturbing in forests excluded from commercial forest economy management, e.g. on lake islands, reserves or fragments of forests being refuges of rare birds. The disappearance of this formerly common plant in forest was mentioned by KLAMA et AL. (1999) and STEBEL (2006). Observations recorded by the author of this study conducted in the Wielkopolska region confirm the rare occurrence of this species in forest reserves in that region. In commercial forests of the Drawsko Lake District less common epixylic liverworts are also lacking. The presence of dead wood stipulated for commercial stands (on the power of the ordinance of the General Director of the State Forests no. 11a of 11 May 1999), is not a sufficient factor resulting the development of rich epixylic phytocenoses of bryophytes. Without actions ensuring an increase in moisture content in forest interior, dead tree stems will be habitats only for species with an extensive ecological scale (e.g. *Hypnum cupressiforme*). Most epixylic liverworts, i.e. *Nowellia curvifolia*, *Odontoschisma denudatum* and even commonly found in Poland *Lepidozia reptans*, are recorded in the analysed area mainly in birch forests and boggy coniferous forests.

In commercial forests, i.e. oak-hornbeam or beech forests, a good level of protection (passive or unintentional) is observed for epigeal liverworts connected with seminatural habitats, i.e. shaded escarpments at forest edges or occasionally used forest roads. Although individual phytocenoses undergo succession changes towards dense communities of vascular plants (thus eliminating rare liverworts), as a type of habitat they will continue to function (i.e. form again) in the landscape of commercial forests. *Fossombronia wondraczekii* – a dying out species, critically endangered in Poland, constitutes an element of the habitats described above (category E; KLAMA 2006). In the analysed area this species was recorded in eight localities, on each sporulating specimens were found. It may be assumed that this species is not locally endangered in that area.

Liverworts in forest sites, which are usually excluded from commercial forest economy, are relatively well-protected. They are birch forests and boggy coniferous forests, as well as related dynamically and successively developing transition mires and raised bogs. A threat to these sites, apart from the regulation of water relations and peat excavation, is the promotion or planting of spruce. In forests sites in which this species is already found or is spreading spontaneously, it would be justified to maintain max. 20% proportion of this tree species (HERBICHOVA et AL. 2004). In the Świerczyna Forest Inspectorate bog birch forests with spruce were observed after mass gradations of insects. On spruce stems rich epixylic biocenoses were formed, among liverworts with abundantly occurring *Odontoschisma*

denudatum, *Nowellia curvifolia*, *Riccardia latifrons* or *R. palmata*. Unfortunately, we may relatively frequently see birch forests or boggy coniferous forests drained with a network of parallel ditches and an established spruce culture. Apart from the degradation of peat, depletion of the floristic composition and structure of these phytocenoses, the presence of neophytic mosses was also observed, i.e. *Campylopus introflexus* or *Orthodontium lineare* (these localities were published in a study by FUDALI et AL. 2009). An evident indicator of birch forest and boggy coniferous forest degeneration are naked, i.e. not covered by bryophytes, pine or spruce stems.

A very good model for studies on the effect of forest economy on forest ecosystems is connected with the areas of zone bird protection. They are established around nesting sites of endangered species. Complete exclusion of fragments of forest complexes from forest economy relatively soon triggers regeneration processes, restoring the natural character of the forest. In the investigated area this is manifested in e.g. the “return” of rare epiphytes, including the so-called relics of primeval forests (as presented by CIEŚLIŃSKI et AL. 1996). An example of such a plant may be a moss species *Homalia trichomanoides*. In the Drawsko Lake District it was observed only in the bird protection zones and in forests on lake islands. Another example is liverwort *Bazzania trilobata*, which was recorded in the forest transition mire in such a zone. Under conditions found in the commercial forest economy these locations are usually deformed, e.g. by branches left after tending interventions or tree extraction.

Areas of unique natural value from the point of view of bryoflora

In the investigated area of the Drawsko Lake District we may indicate many locations worthy of area protection. The slight proportion of reserves in that area is surprising. Below two areas are shown, which preservation is important from the point of view of bryoflora resources. However, it needs to be stressed that the list given below does not present all locations of high natural value in terms of the presence of valuable natural habitats and vascular plants.

1. Raised bog in the Czaplonek Forest Division, Forest District Sikory, compartment 27d (11-04-4-08-27-d), ATMOS grid square – Bb 64 (1.5 km SEE of the village of Sikory), area of 3.29 ha.

A very well-preserved raised bog with phytocenoses of *Eriophoro-Sphagnetum* in the central part, in the complex with little valleys of *Caricetum limosae*. At the edges of the subcompartment a transition mire *Sphagno-Caricetum rostratae* is formed. An aspect of considerable interest in that area is the mass occurrence of *Cladodiella fluitans*, which overgrows the central part of the peatbog, on naked peat exposed by wild boars. The other peatbog species growing there include *Calypogeia sphagnicola*, *Sphagnum magellanicum*, *Polytrichum strictum*, *Scheuchzeria palustris*, *Drosera rotundifolia*, *Ledum palustre*, *Menyanthes trifoliata* and *Oxycoccus palustris*. The object deserves to be covered by reserve protection.

2. Boulder cluster in a beech forest, Czaplonek Forest Division, Forest District Juchowo, compartment 1411 (11-04-3-03-141-1), ATMOS grid square – Bb 55 (2.5 km W of the village of Jeziorki), area of the whole subcompartment 11.45 ha.

It is a cluster of around a dozen boulders in a shallow, forest water body. This area is located in a depression and is completely shaded by a beech stand. The location is a refuge of a specific, cool microclimate. A unique feature is a rich epilythic flora of bryophytes. One of the rarest is a mountain moss – *Rhytidiadelphus loreus*. Some rare bryophytes worthy mentioning here include *Homalia trichomanoides*, *Isothecium alopecuroides*, *Lophozia barbata* and *Lejeunea cavifolia*. Protection recommendations concerns the preservation of the specific characters of the cool microclimate in this site. This pertains particularly to the maintenance of the stand in the belt of 70-100 m around the reservoir, preservation of current water relations and protection of boulders against potential removal.

Localities of selected mosses in the analysed area

Homalia trichomanoides (Hedw.) Schimp.

NCza: **Bb 55** (2.5 km W of the village of Jeziorki, f. Juchowo, 1411), **Bb 56** (1.5 km NW of the village of Radacz, f. Juchowo, 98m), **Bb 64** (1.5 km W of the village of Kluczewo, f. Worowo, 107A-a), **Bb 65** (1.5 km SSW of the village of Strzeszyn, an island “Wyspa Łubicka” on Lake Łubicko Wielkie, f. Międzyzlesie, 391c; 3.5 km NWW of the village of Rakowo, at SE shore of Lake Komorze, f. Łubowo, 15c)

NCzb: **Bb 58** (1.5 km S of the village of Czarnobór, f. Czarnobór, 38d)

NSw: **Bb 84** (2.5 km SWW of the village of Otrzep, f. Buczyna, 34b, 34g, 35d; 2 km SW of the village of Otrzep, f. Buczyna, 85b)

Paraleucobryum longifolium (Ehrh. ex Hedw.) Loeske

NCza: **Bb 74** (4 km NE of the village of Siemczyno, at Lake Drawsko, f. Piaseczno, 162b)

Rhytidiadelphus loreus (Hedw.) Warnst.

NCza: **Bb 55** (2.5 km W of the village of Jeziorki, f. Juchowo, 1411)

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