

The water clarity of Polish lakes with charophyte vegetation in the years 1953-1968

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Abstract. A total of 313 lakes with charophyte vegetation were identified based on the data presented in 1111 manuscripts under the shared title of “*Assumptions for the fisheries management project in Lake (lake name)*”, based on the results of an environmental inventory carried out by the Inland Fisheries Institute in 1953-1968. The lakes’ morphological characteristics were described, hydrophyte species that most frequently accompanied charophytes were identified, differences in summer water transparency were analyzed in 281 lakes with charophyte vegetation and the results were compared with the observations made in 657 other lakes, and the potential trophic state of lakes with charophyte vegetation was determined using Carlson’s trophic state index (1996). More than half (54%) of 171 dimictic lakes with charophyte vegetation were classified as mesotrophic and 31% as oligotrophic, whereas 50% of 110 polymictic lakes were classified as eutrophic, and 40% as mesotrophic. The frequency of taxa that contribute to the eutrophication (degradation) of water bodies, including *Ceratophyllum* spp. *Myriophyllum* spp. and *Elodea canadensis*, increased with a decrease in the percentage of charophytes in communities of submerged hydrophytes. Regardless of the proportion of charophytes in submerged hydrophyte communities, water in the lakes colonized by charophytes was more transparent than in the 659 lakes without charophytes. Water in many polymictic and dimictic lakes with charophyte vegetation, including lakes with a small contribution of charophytes, was more transparent than in lakes without charophytes, which suggests that charophytes are sensitive indicators of water quality and are components of ecological memory in aquatic ecosystems.

Key words: Chara-lake, submerged hydrophytes, distribution of lakes with charophytes, ecological memory

1. Introduction

Charophytes, in particular extensive charophyte meadows (habitat code 3140), are sensitive indicators of water quality (Piotrowicz 2004; Pełechaty & Pronin 2015; Pełechaty *et al.* 2016). Selected charophyte species, such as *C. polyacantha*, suggest the mesotrophic status of lakes (Dąmbska 1964; Pełechaty & Pronin 2015), whereas other species, such as *N. obtusa* and *C. globularis*, form dense benthic communities in moderately eutrophic and eutrophic lakes (Dąmbska 1964; Krause 1981, 1997; Pełechaty & Pukacz 2008; Kraska 2009, Pełechaty & Pronin 2015). According to the literature, phytoplankton biomass decreases and water transparency increases with a rise in the number of charophyte communities in lakes (Pukacz & Pełechaty 2006). Pursuant to the provisions of the Water Framework Directive (EC Directive 2000/60/E), Poland has introduced the Ecological State Macrophyte

Index (ESMI) for evaluating the ecological status of lakes based on macrophyte communities. This method is used to determine the severity of anthropogenic pressure that contributes to lake eutrophication (Ciecierska *et al.* 2013), and charophytes are considered an important indicator of water quality in this approach. Water bodies with satisfactory ESMI values, where charophyte meadows account for more than 20-30% of the phytolittoral, can be described as having very good ecological status (Ciecierska *et al.* 2013).

In Europe, historical data are available only in countries with a long tradition of biological monitoring, such as Germany (Ciecierska 2008; Kolada & Ciecierska 2008; Soszka 2009; Ciecierska *et al.* 2013). In Poland, research into charophytes has been conducted since the late 19th century (Caspary 1881, 1882), but biological databases that are consistent at the national level are still in short supply (Soszka 2009). In the mid-20th century, Professor Izabella Dąmbska authored several papers

describing charophyte communities in the regions of Poznań, Łąka Lakeland, Pomorze (Pomerania), Mikołajki, Sieraków and Międzychód. A series of 12 research bulletins describing the localities of various charophyte species in 50 lakes in the regions of Wielkopolska, Pomorze, Łąka Lakeland, Giżycko Lakeland, Lublin, Ziemia Lubuska and Białystok Upland was published in 1954-1960 under the shared title of "A collection of Polish charophytes". New charophyte localities in 75 lakes formed during the last glacial period were described in a publication entitled "Charophyte communities in Poland" (Dąbwska 1966). Information about lakes colonized by charophytes can also be found in numerous publications describing charophyte localities in different Polish regions (e.g. Bernatowicz 1960a, 1963; Karczmarz 1963, 1965). Charophyte communities have been most thoroughly explored in Polish lakelands (Krajewski *et al.* 2015).

In view of the above, unpublished data on the distribution of charophyte communities in Polish lakes could be useful for evaluating the ecological and trophic status of lakes (including transformations and water quality deterioration), in particular, during water quality assessments required under the Water Framework Directive (EC Directive 2000/60/E).

In 1949-1968, the Inland Fisheries Institute surveyed 1209 Polish lakes to develop a simplified method of fisheries management. The first assessments were carried out in Lake Tajty (Kocół 1953; Olszewski 1953; Sakowicz 1953) and in the area of Węgorzewo (Bernatowicz 1960a, 1960b; Patalas 1960; Zawisza & Patalas 1960). They involved analyses of lake basin morphology (bathymetric maps were developed), water temperature and oxygen saturation (distribution of temperature and dissolved oxygen in spring, early summer and at the peak of the summer stagnation period). Calcium, potassium, magnesium and sodium levels were determined, and electrolytic conductivity was measured in selected lakes (Korycka 1991). The results were used to map the location of emergent and submerged hydrophytes, and to identify the most and least abundant hydrophyte species. A total of 1111 manuscripts under the shared title of "Assumptions for the fisheries management project in Lake (lake name)" were prepared in 1953-1968. These manuscripts contained information about lakes colonized by charophytes, including lakes with a predominance of charophyte communities. However, charophytes were identified to the species level in very few cases.

The aim of this study was to characterize lakes that were colonized by charophytes in the mid-20th century. Based on a detailed analysis of water transparency in the evaluated water bodies, attempts were made to validate the role of charophytes as sensitive biological indicators of lakes' trophic status.

2. Materials and methods

The distribution of Polish lakes colonized by charophytes was analyzed based on the results of an environmental inventory carried out by the Inland Fisheries Institute in 1953-1968. Lake Ciechomickie, which was inventoried by the Institute in 1984, was also included in the analysis.

Lakes were arranged in 10 x 10 km squares of the ATPOL cartogram (Zajac 1978) based on their geographical location in bathymetric maps. The data were verified against an orthophotomap which is available on the website of the National Geodesy and Cartography Resource (PZGiK), as part of the Geoportal 2 project. The location of every lake was determined in its center based on automatic orthophotomap readouts. Submerged hydrophyte species were identified in each lake.

The analyzed lakes were divided into three groups:

- group I – lakes where charophytes were the predominant submerged hydrophytes,
- group II – lakes where charophytes were abundant and coexisted with other species,
- group III – lakes where charophytes were relatively abundant or less abundant and coexisted with other species.

It was assumed that in group III and, partly, group II lakes, the presence of charophytes was limited to shallow zones and that large and slowly growing species occurred individually in the area of other hydrophyte communities.

The number of lakes and the proportion of lakes in each depth and size (surface area) category were determined. Due to the absence of detailed information about the structure of aquatic vegetation in the evaluated lakes, the identified species of submerged plants, plants rooted in or anchored to the bottom, and their contribution (%) were presented in tabular format only.

In summer (from the last ten days of July to the first ten days of September), water transparency was determined in the Secchi disk visibility test in polymictic and dimictic lakes with charophyte vegetation, and separately in each identified lake group. The potential trophic status of lakes with charophyte vegetation was determined on the basis of the values of Carlson's (Carlson & Simpson 1996) Secchi disk index (TSI_{SD}). Water transparency in the analyzed lakes was compared against the data from 198 other polymictic lakes and 459 other dimictic lakes that were inventoried by the Inland Fisheries Institute in 1953-1968.

The homogeneity of variance was determined by two-way ANOVA and Tukey's test at a significance level of 0.01. The data were processed statistically in the Statistica program.

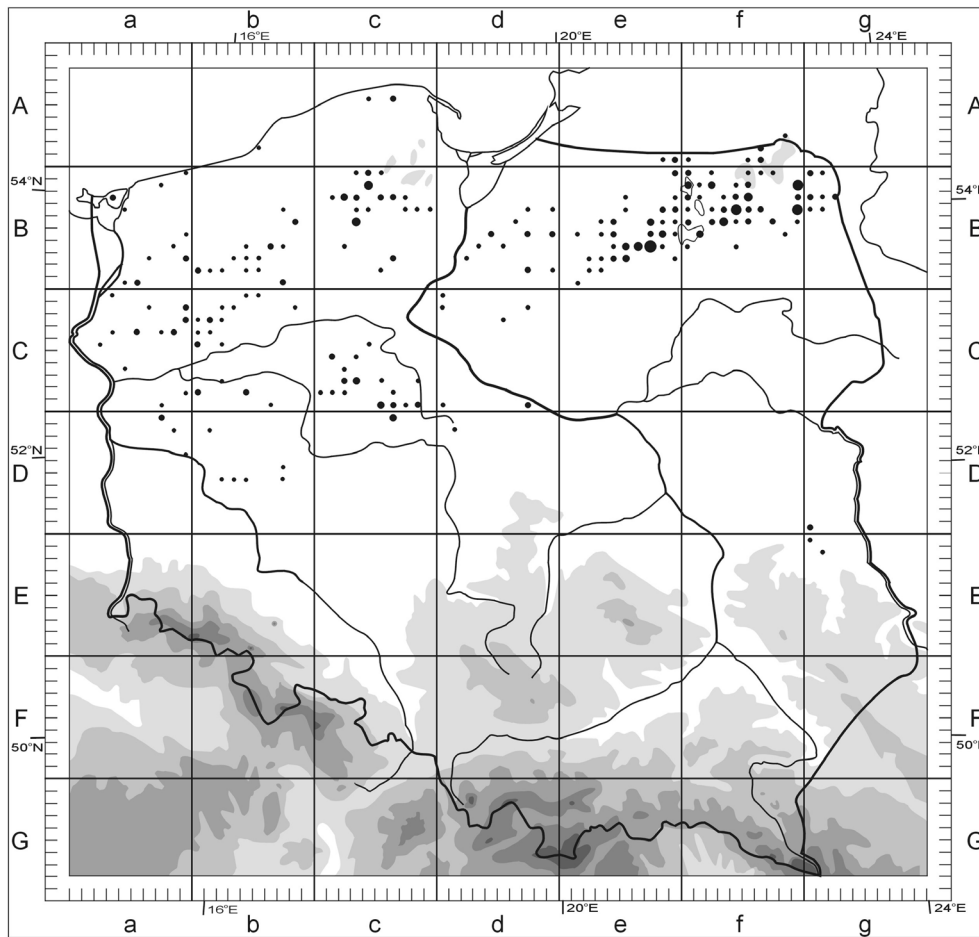


Fig. 1. Distribution of 313 Polish lakes where charophytes were identified in 1953-1968 (ATPOL grid)
 Explanations: • - 1 lake, • - 2 lakes, • - 3, • - 4, • - 5, • - 6

3. Results and discussion

The results of botanical analyses revealed the presence of charophytes in 311¹ (Appendix 1) out of the 1209 lakes that were inventoried in 1953-1968 (Fig. 1). Most of these lakes were characterized by an average depth

of 5-10 m. Shallow lakes with an average depth of up to 5 m were also well represented, whereas lakes deeper than 15 m were least numerous (Table 1). In most cases, lake size increased with lake depth. Around 32% of shallow lakes (with an average depth of up to 5 m) had an area of less than 50 ha. Only 17% of deeper lakes

Table 1. The characteristic parameters of 311 lakes where charophytes were identified in 1953-1968

Mean depth [m]	Number of lakes	Contribution [%]	Lake area [ha]	Maximum depth [m]
< 5	114	41	144.3 (9.2-1747.4)	7.7 (1.6-23.0)
5-10	134	48	384.2 (9.8-11340.4)	22.6 (6.7-52.0)
10-15	55	20	424.2 (24.8-3030.0)	36.8 (22.9-60.0)
15-20	5	2	1361.6 (58.3-3527.0)	55.4 (33.5-73.0)
20-25	3	1	173.5 (117.6-250.4)	52.7 (45.0-65.0)

Explanation: the presented values of lake areas and maximum depths are averages with the corresponding range in parentheses

¹ Lake Ciechomiczkie and Lake Górskie, which were surveyed in 1984, were included in the analysis as the 312th lakes.

(5-10 m) fell into this size category, and all deep lakes (average depth >10 m) were larger than 50 ha.

Table 2. Frequency of occurrence of dominant, codominant and less abundant species of submerged plants (rooted in or anchored to the bottom) in lakes with a predominance of charophytes – group I (N=120); lakes where charophytes were the codominant species – group II (N=82); and lakes where charophytes coexisted with other submerged hydrophytes – group III (N=111)

Species	Contribution [%]		
	Group I	Group II	Group III
	N=120	N=82	N=111
<i>Elodea canadensis</i> L.	61	68	72
<i>Myriophyllum spicatum</i> L. + <i>M.</i> sp. ¹	48	54	72
<i>Ceratophyllum demersum</i> L. + <i>C.</i> sp. ²	36	63	79
<i>Potamogeton perfoliatus</i> L.	33	37	45
<i>Potamogeton lucens</i> L.	40	27	44
<i>Fontinalis antypiretica</i>	36	20	31
<i>Batrachium circinatum</i> (Sibth.) Fr.	27	21	34
<i>Potamogeton</i> sp.	8	17	17
<i>Potamogeton compressus</i> L.	8	2	4
<i>Potamogeton crispus</i> L.	6	13	8
<i>Potamogeton pectinatus</i> L.	3		2
<i>Potamogeton gramineus</i> L.	3	1	1
<i>Najas</i> sp.	3		2

Explanations: ¹ only 22% of the identified taxa were described with the full name of *Myriophyllum spicatum* L., ² 79% of the identified taxa were described as *Ceratophyllum* spp.

Charophytes were the predominant submerged hydrophytes in 120 lakes, the codominant species in 82 lakes, and coexisted with other species of submerged hydrophytes in various proportions in 111 lakes.

Lakes with a predominance of charophytes in submerged hydrophyte communities were often colonized by *Elodea canadensis* Michx., *Ceratophyllum* spp. (79% of the species identified in the “Assumptions for fisheries management projects in Lake...”), *Myriophyllum* sp. (only 22% of the identified species were described with the full name of *Myriophyllum spicatum* L.), *Potamogeton perfoliatus* L., *P. lucens* L., *Fontinalis antypiretica* L. and *Batrachium circinatum* (Sibth.) Fr. (Table 2). In 19 lakes (16%), charophytes were the only abundant group of submerged hydrophytes. In 26 lakes, charophytes were accompanied by

a single abundant species, mostly *Elodea canadensis* (12 lakes), and, less frequently, *Potamogeton* (6 lakes) and *Ceratophyllum* species (4 lakes). *Elodea canadensis*, *Myriophyllum spicatum*, *Ceratophyllum demersum* L. and *Potamogeton perfoliatus* were more frequently observed in lakes that were less abundantly colonized by charophytes (subdominant and coexisting species) (Table 2). The first three species are characteristic of eutrophic water bodies, pointing to the degradation of clean water habitats (Mróz 2012; Ciecierska *et al.* 2013). The frequency of occurrence of three other relatively common species (20-44%) as well as *Potamogeton* spp. and *Najas* spp. which were rarely (several percent) noted in the “Assumptions for fisheries management projects in Lake...” did not differ significantly between the three groups of lakes.

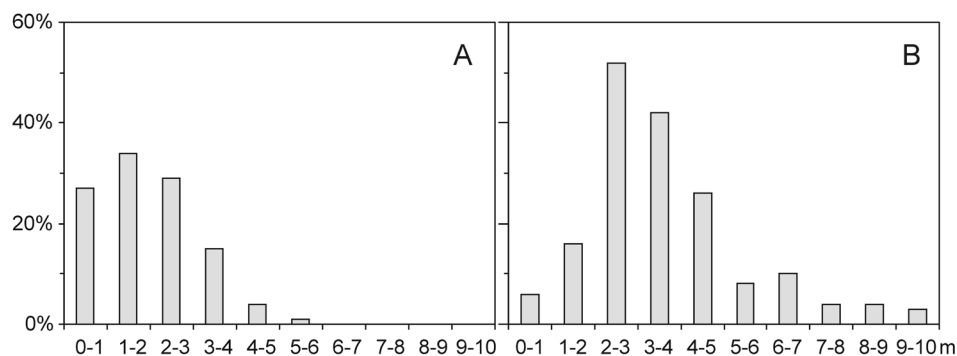


Fig. 2. Summer Secchi depth (m) in polymictic (A) and seasonally stratified lakes (B) where charophytes were identified in 1953-1968

Table 3. The number of polymictic and seasonally stratified lakes in each lake group where charophytes were identified in 1953-1968 based on their trophic state, Secchi depth and TSI_{SD} in summer

	Attributes proposed by Carlson & Simpson (1996)	SD [m] (TSI _{SD})	Number and percentage (%) of the analyzed lakes	
			polymictic	seasonally stratified
Oligotrophic	Clear water, oxygen throughout the year in the hypolimnion	>8 (<30)	-	7 (4%)
	Hypolimnia of shallower lakes may become anoxic	8-4 (30-40)	5 (5%)	48 (28%)
Mesotrophic	Water moderately clear; increasing probability of hypolimnetic anoxia during summer	4-2 (40-50)	44 (40%)	94 (55%)
Eutrophic	Water moderately clear; increasing probability of hypolimnetic anoxia during summer	2-1 (50-60)	34 (31%)	16 (9%)
	Blue-green algae dominate, algal scums and macrophyte problems	0.5-1 (60-70)	21 (19%)	5 (3%)
Hypereutrophic	Productivity limited by light. Dense algae and macrophytes	0.25-0.5 (70-80)	5 (5%)	1 (1%)
	Algal scums, few macrophytes	<0.25 (>80)	1 (1%)	-

Explanation: the boundary values of the Secchi depth and TSI_{SD} for denomination of the trophic state after Carlson & Simpson (1996)

The frequency of occurrence of *Ceratophyllum* spp. was 75% higher in lakes where charophytes were less abundant in the phytolittoral (codominant species, lake group II). In lakes characterized by a predominance of charophytes, the frequency of occurrence of *Ceratophyllum* spp. was twice lower than in water bodies where charophytes coexisted with other plant species (group III) (Table 2).

In summer, water transparency was measured in 281 lakes colonized by charophytes, including 110 polymictic lakes and 171 dimictic lakes. Secchi depth (SD) ranged from 20 cm to 9.5 m. Surprisingly, SD was less than 3 m in 58% of the lakes with charophyte vegetation, and less than 1 m in 12% of the lakes. In 29% of the evaluated lakes, SD depth ranged from 3 to 4 m. Only 11 lakes were characterized by supreme water transparency (SD greater than 7 m) relative to Polish standards (in 1961-1969, the maximum water transparency in 1211 Polish lakes was determined at 9.5 m by Korycka (1991).

Water transparency was lower in polymictic lakes in summer (Fig. 2). In 90 polymictic lakes (82%), SD was less than 3 m, and the maximum SD reached 5.2 m. The analyzed parameter was generally higher in dimictic lakes. In summer, Secchi depth was determined at 2-5 m in 120 (70%) dimictic lakes, and it exceeded 5 m in 29 lakes (17%)

The trophic state of lakes was evaluated with the use of the Carlson's Secchi disk index (Carlson & Simpson 1996) (Table 3). The results of the evaluation revealed that 55 dimictic lakes (32% of the examined lakes) and

only 5 (5%) polymictic lakes were probably oligotrophic, 94 (54%) dimictic lakes and 44 (40%) polymictic lakes were mesotrophic, whereas 55 (50%) polymictic lakes and 21 (12%) dimictic lakes were eutrophic. The values of the Carlson's trophic state index suggest that 6 polymictic lakes and 1 dimictic lake could be classified as hypereutrophic (Table 3).

Water transparency was compared in the three groups of lakes: lakes with a predominance of charophytes (group I), lakes where charophytes were the codominant species (group II), and lakes where charophytes coexisted with other species of submerged hydrophytes (group III). A separate comparison was performed in polymictic and dimictic lakes. In polymictic lakes, water transparency decreased with a drop in charophyte abundance in the communities of submerged plants (Table 4). However, only minor differences in SD were noted across the three groups of lakes (25 cm between group I and group II lakes; 48 cm between group I and group III lakes). Water transparency differed in seasonally stratified lakes. The average SD was identical in lakes where charophytes were the codominant species (group II) and in lakes where charophytes coexisted with other macrophytes (group III). Lakes with a predominance of charophytes (group I) were characterized by significantly more transparent water (SD was nearly 90 cm greater than in the remaining two groups).

The parameters measured in polymictic and seasonally stratified lakes were processed by two-way ANOVA, which revealed significant differences between polymictic and dimictic lakes and between lakes

Table 4. Secchi depth in lakes with a predominance of charophytes (group I), lakes where charophytes were the codominant species (group II), and lakes where charophytes coexisted with other submerged hydrophytes (group III)

Lake group	Polymictic		Dimictic	
	N	Secchi depth [m]	N	Secchi depth [m]
I	38	2.18±1.01 0.60-4.20	66	4.08±1.83 0.75-9.50
II	32	1.93±1.35 0.20-5.20	44	3.20±1.73 1.15-9.00
III	40	1.45±0.80 0.40-2.90	61	3.20±1.69 0.40-8.50

Explanation: means ± standard deviations (first line) are followed by minimum and maximum values (second line)

Table 5. The results of ANOVA for Secchi depth data in polymictic and dimictic lakes with a predominance of charophytes (group I), lakes where charophytes were the codominant species (group II), and lakes where charophytes coexisted with other submerged hydrophytes (group III)

Source	SS	Degrees of freedom	MS	F _{-ratio}	p
Absolute value	1880.504	1	1880.504	814.0728	0.000000
Water mixing (polymictic, dimictic lakes)	176.742	1	176.742	76.5121	0.000000
Lake group (I, II, III)	32.597	2	16.298	7.0556	0.001028
Water mixing × Lake group	4.516	2	2.258	0.9775	0.377564
Error	635.248	275	2.310		

characterized by differences in charophyte abundance. The values of the F-ratio indicate that the dataset is non-homogeneous at a significance level of $p < 1\%$ (Table 5). Attempts were made to identify lake groups which were responsible for the observed non-homogeneity. Multiple comparisons were conducted independently for polymictic and dimictic lakes with the use of Tukey's test. Significant differences in water transparency were noted only between lakes with a predominance of charophytes (group I) and lakes where charophytes coexisted with other submerged hydrophytes (group III; Tables 6 and 7). The above could also be attributed to the fact that water transparency was high (up to around 9 m) in lakes where charophytes were not the predominant type of vegetation. For example, in the seasonally stratified Lake Lubikowskie, where Secchi depth was determined at 9 m in the pelagic zone in August 1966, submerged

vegetation did not form extensive meadows despite the fact that it was observed to a depth of 7 m. In the above lake, submerged plants were represented mainly by *Groenlandia densa* (L.) Four. and charophytes.

Charophytes are regarded as highly sensitive biological indicators of both qualitative and quantitative changes in aquatic ecosystems (Pelechaty & Pronin 2015). They can be used to identify selected phenomena in water habitats and to describe their intensity (Ciecierska & Dynowska 2013). However, the absence of significant differences in water transparency between the lakes where charophytes were the codominant species and the lakes where charophytes coexisted with other hydrophytes (Table 4) could suggest that charophytes are less effective bioindicators when they are less abundant. This hypothesis was tested by comparing Secchi depth in lakes with and without charophytes. Water transparency

Table 6. The results of Tukey's test for polymictic lakes where charophytes were identified in 1953-1968

Lake group	Lake group		
	I	II	III
	{2.1767}	{1.9323}	{1.4528}
I		0.623754	0.009542
II	0.623754		0.167592
III	0.009542	0.167592	

Table 7. The results of Tukey's test for dimictic lakes where charophytes were identified in 1953-1968

Lake group	Lake group		
	I	II	III
	{4.0827}	{3.1978}	{3.1991}
I		0.047113	0.014915
II	0.047113		0.999993
III	0.014915	0.999993	

Table 8. The results of ANOVA for Secchi depth data in polymictic and dimictic lakes colonized by charophytes and other polymictic (198) and dimictic (459) lakes that were inventoried by the Inland Fisheries Institute in 1953-1968

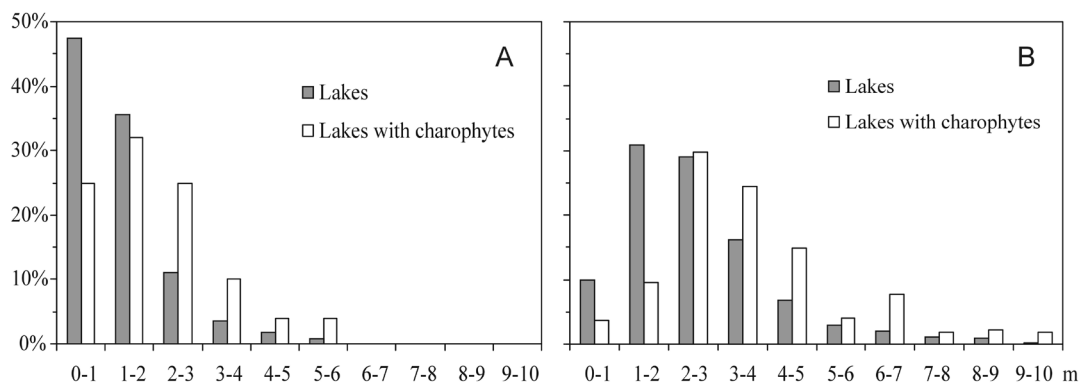
SS	Degrees of freedom	MS	F-ratio	p
Polymictic lakes				
Absolute value	1	936.1956	971.0730	0.00000
Polymictic lakes	1	50.6407	52.5273	0.00000
Error	418	0.9641		
Dimictic lakes				
Absolute value	1	6385.504	2568.413	0.00
Dimictic lakes	1	219.930	88.461	0.00
Error	1050	2.486		

Table 9. Mode values and skewness of Secchi depth data in polymictic and dimictic lakes with charophytes (n=110 and n=171, respectively) and without charophytes (N=198 and N=459, respectively) that were inventoried by the Inland Fisheries Institute in 1953-1968

	Polymictic			Dimictic		
	Without charophytes	With charophytes		Without charophytes	With charophytes	
		I + II + III	II + III		I + II + III	II + III
Mode	0.5	2.0	2.0	2.0	2.5	2.5
Skewness	1.64	0.63	0.93	1.44	1.29	1.33

in the lakes colonized by charophytes (regardless of their abundance) was significantly higher (Table 8) than in the lakes without charophytes (Fig. 3A). The above conclusions can be drawn based on the asymmetry of distribution curves and higher mode values in the lakes colonized by charophytes (Table 9). Those differences were particularly pronounced in polymictic lakes. Despite the above, many polymictic and dimictic lakes colonized by charophytes, including lakes where charophytes were not the predominant types of vegetation (groups II and III), were characterized by higher water transparency than lakes where charophytes were

not identified (Fig. 3B). The above could be attributed to ecosystem memory which is defined as “the capacity of past states or experiences to influence present or future responses of the community” (Skowroński 2004). Peterson (2002) defined ecosystem memory as “the degree to which an ecological process is shaped by its past modifications of a landscape”. According to Skowroński (2004), information encoded in the internal structure of a system can be transformed to minimize the uncertainty of selected events under the influence of external stimuli (Skowroński 2004). In the analyzed charophyte lakes, eutrophication, a process that exerts

**Fig. 3.** Summer Secchi depth (m) in polymictic (A) and seasonally stratified lakes (B) where charophytes were identified in 1953-1968, and in 198 other polymictic lakes and 459 other dimictic lakes that were simultaneously surveyed by the Inland Fisheries Institute

the greatest influence on Polish lakes (Ciecierska *et al.* 2013), was probably the most powerful external stimulus. According to the literature, the number of polluted lakes in Poland doubled at the turn of the 1960s and 1970s (Korycka 1991). The mineral composition of lake water changed in response to diffuse source and point source pollution, including municipal sewage, industrial sewage and surface runoffs from fertilized farmland. This process was particularly pronounced in the Masurian Lakeland, on the Baltic coast and in the Lubusko-Leszczyński Lakeland (Korycka 1991).

The mechanisms responsible for the maintenance of high water transparency in lakes with disappearing charophyte communities cannot be explained based on the presented data. The correlations between abiotic events and biotic responses to environmental stimuli and their mutual interactions remain poorly understood (Ogle *et al.* 2015). The composition of plant communities and ecosystems is influenced by the local habitat conditions, the presence of spores, seeds, stem fragments, species, populations and other residues (Schaefer 2009), but also by lake basin morphology, hydrological conditions in catchments and nutrient loads in lakes. Significant changes in the structure and function of ecosystems would require considerable time and vast abiotic resources. A mathematical model describing the possibility of alternative stable states in lakes (Schaeffer 2009) would be difficult to develop even with the use of the most advanced computing techniques. According to Ogle *et al.* (2015), ecological processes should be

studied by considering antecedent conditions, including: (1) the length of ecological memory (time during which antecedent conditions influence the present ecological dynamics), (2) temporal pattern (variations in the relative significance of antecedent conditions), and (3) strength of memory with respect to the influence of antecedent conditions on current ecological dynamics. These factors could be used to explain the relatively small differences in water transparency (Fig. 3) between polymictic and dimictic lakes with a predominance of charophytes (Fig. 3A) and lakes where charophytes were the codominant species or coexisted with other types of vegetation (groups II and III; Fig. 3B). The frequency distribution curves in the analyzed lake groups have a highly similar shape, which suggests that light availability did not differ significantly between lakes with a predominance of charophytes and lakes where charophytes were abundant or coexisted with other species. These observations indicate that charophytes are highly sensitive biological indicators (which probably respond to relatively minor differences in water transparency) and that ecosystem memory plays an important role in ecological assessments. The frequency distribution curves in polymictic and dimictic lakes have a different shape, which suggests that the length of ecological memory, namely, the time during which antecedent conditions influence the current ecological dynamics, is much shorter in polymictic than in dimictic lakes.

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Appendix 1. A list of lakes colonized by charophytes, developed based on the environmental inventory carried out by the Inland Fisheries Institute in 1953-1968, with ATPOL grid coordinates and the identified species of submerged hydrophytes

Explanations: (d) – dominant, codominant; (a) – abundant; (la) – locally abundant; (lum) – lush underwater meadows; (sr) – sparse; (sp) – sporadic; (ip) – individual plants; (c) – clusters; (sq) – in smaller quantities; FLS – floating-leaved species

Aldrovanda vesiculosa = *A. vesiculosa*; *Batrachium circinatum* = *B. circinatum*; *Ceratophyllum demersum* = *C. demersum*; *Ceratophyllum submersum* = *C. submersum*; *Ceratophyllum* sp. = *C. sp.*; *Elodea canadensis* = *E. canadensis*; *Fontinalis antipyretica* = *F. antipyretica*; *Hippuris vulgaris* = *H. vulgaris*; *Lemna trisulca* = *L. trisulca*; *Myriophyllum spicatum* = *M. spicatum*; *Myriophyllum* sp. = *M. sp.*; *Nuphar lutea* = *N. lutea*; *Nymphaea alba* = *N. alba*; *Polygonum amphibium* = *P. amphibium*; *Potamogeton compressus* = *P. compressus*; *Potamogeton perfoliatus* = *P. perfoliatus*; *Potamogeton lucens* = *P. lucens*; *Potamogeton crispus* = *P. crispus*; *Potamogeton natans* = *P. natans*; *Potamogeton pectinatus* = *P. pectinatus*; *Potamogeton* sp. = *P. sp.*; *Stratiotes aloides* = *S. aloides*; *Utricularia vulgaris* = *U. vulgaris*

[AB-09] 1. Resko Przymorskie, N 54° 8' 33" E 15° 22' 26"; *E. canadensis*, *P. perfoliatus*, *C. demersum*, Charales, *S. aloides*, *M. spicatum*, *P. crispus*. [AB-17] 2. Liwia Łuża (Niechorze), N 54° 5' 19" E 15° 5' 47"; (a): Charales, *S. aloides*, (sq:) *P. perfoliatus*, *E. canadensis*, *C. demersum*, *P. natans*, *L. trisulca*, *M. sp.*, *B. circinatum*. [AB-23] 3. Domysłowskie, N 53° 56' 14" E 14° 34' 12"; *M. sp.*, *C. demersum*, *N. lutea*, *N. alba*, *P. perfoliatus*, *P. lucens*, *P. natans*, Charales. 4. Warnowo, N 53° 56' 8" E 14° 32' 57"; *C. sp.*, *M. sp.*, Charales, *N. alba*, *N. lutea*, *P. perfoliatus*, *P. crispus*, *P. lucens*, *P. natans*. [AB-34] 5. Ostrowo (Mierzęcin), N 53° 49' 32" E 14° 41' 56"; *M. spicatum*, Charales, *E. canadensis*, *B. circinatum*, *C. demersum*, *P. lucens*, *P. perfoliatus*, *N. lutea*, *N. alba*, *S. aloides*, *P. crispus*, *P. amphibium*, *P. natans*, *F. antipyretica*, *U. vulgaris*. [AB-59] 6. Głębokie, N 53° 40' 10" E 15° 30' 10"; Charales, *E. canadensis*, *C. demersum*, *L. trisulca*, *B. circinatum*, *U. vulgaris*, *F. antipyretica*, *P. crispus*, *N. alba*, *S. aloides*. [AB-68] 7. Skwiernie (Okrzeja), N 53° 36' 51" E 15° 21' 28"; *C. sp.*, Charales, *M. sp.*, *P. perfoliatus*, *P. lucens*, *N. lutea*, *N. alba*, *P. natans*, *P. crispus*. [AB-76] 8. Lechickie (Pogrzymie), N 53° 32' 35" E 15° 0' 19"; *C. sp.*, Charales, *M. sp.*, *N. lutea*, *N. alba*, *P. perfoliatus*, *P. crispus*, *P. natans*. [AB-79] 9. Woświn, N 53° 32' 33" E 15° 24' 19"; (lum:) Charales, *E. canadensis*, *P. lucens*, *C. demersum*, *M. spicatum*, *P. perfoliatus*, FLS: *P. amphibium*, *S. aloides*, *L. trisulca*, *N. lutea*, *N. alba*. 10. Mielno, N 53° 33' 36" E 15° 24' 54"; *C. demersum*, *M. spicatum*, *N. lutea*, *N. alba*, *P. perfoliatus*, *P. crispus*, *P. natans*, Charales. [AB-94] 11. Glinno, N 53° 17' 29" E 14° 40' 52"; Charales, *E. canadensis*, *C. sp.*, *M. sp.*, *P. lucens*, *P. crispus*, *N. lutea*. [AB-95] 12. Miedwie, N 53° 17' 8" E 14° 53' 11"; Charales (90%), *P. perfoliatus*, *P. lucens*, *L. trisulca*, *N. lutea*. 13. Żelewko, N 53° 17' 3" E 14° 50' 46"; Charales, (sq:) *C. sp.*, *M. sp.*, *P. lucens*, *P. perfoliatus*, *N. lutea*.

[AC-03] 14. Weltyń, N 53° 14' 18" E 14° 34' 53"; *M. sp.*, *C. sp.*, Charales, *E. canadensis*, *N. lutea*, *N. alba*, *P. perfoliatus*, *P. lucens*, *P. crispus*. [AC-16] 15. Płoń, N 53° 8' 49" E 15° 5' 5"; *M. sp.*, *N. lutea*, Charales, *C. demersum*, *F. antipyretica*, *P. lucens*, *P. perfoliatus*. [AC-19] 16. Kluki (Klukom), N 53° 9' 35" E 15° 25' 23"; *C. demersum*, Charales, *M. spicatum*, (sq:) *N. lutea*, *N. alba*, *P. natans*. 17. Raduń, N 53° 8' 8" E 15° 28' 21"; *C. demersum*, Charales, *M. spicatum*, (sq:) *P. lucens*, *N. lutea*, *N. alba*. [AC-29] 18. Chłop, N 53° 2' 54,99" E 15° 31' 57,89"; (c:) *C. sp.*, Charales, *F. antipyretica*, *E. canadensis*, *M. sp.*, *P. sp.*, *B. circinatum*. 19. Chłopowo, N 53° 2' 55" E 15° 31' 57"; *C. demersum*, Charales, *M. spicatum*, *B. circinatum*. [AC-33] 20. Strzeszowskie, N 52° 59' 36,89" E 14° 36' 46,95"; Charales, *C. sp.*, *M. sp.*, *N. lutea*, *H. vulgaris*. [AC-35] 21. Chłop, N 52° 59' 52,07" E 14° 53' 59,02"; (a:) Charales, *F. antipyretica*, *C. sp.*, *M. sp.*, *P. perfoliatus*, *P. lucens*, (sp:) *E. canadensis*, *S. aloides*, *N. lutea*, *Najas* sp., *N. alba*, *Aldrovanda* sp. [AC-35] 22. Myśliborskie, N 52° 57' 13,10" E 14° 51' 36,16"; *F. antipyretica* – (d in the S part of the lake), Charales – (d in the N part of the lake), *E. canadensis*, *P. perfoliatus*, *P. lucens*, *N. lutea*, *B. circinatum*. [AC-37] 23. Okunino, N 52° 56' 14,98" E 15° 14' 34,02"; Charales, *E. canadensis*, *M. sp.*, *C. sp.*, *E. canadensis*, *N. lutea*. [AC-38] 24. Wielkie Polcko (Pełcz, Pełcz Duży), N 53° 0' 36" E 15° 20' 22"; Charales, *E. canadensis*, *M. spicatum*, *C. demersum*, (sq:) *P. lucens*, *P. perfoliatus*, *B. circinatum*, *L. trisulca*, *F. antipyretica*. 25. Dankowskie (Wielgie), N 52° 56' 34,10" E 15° 21' 48,56"; (lum:) Charales, *C. demersum*, *N. lutea*, *M. spicatum*, *S. aloides*, *P. lucens*, *P. natans*, *F. antipyretica*. [AC-42] 26. Morzycko (Moryńskie) N 52° 51' 50,00" E 14° 24' 33,01"; Charales (70%), *F. antipyretica*, *E. canadensis*, *P. lucens*, *P. perfoliatus*, *N. lutea*, *C. demersum*, *M. spicatum*, *S. aloides*, *B. circinatum*, *P. natans*, *Aldrovanda* sp. [AC-64] 27. Wielkie Jezioro (Mosine), N 52° 42' 42,02" E 14° 49' 19,13"; *E. canadensis*, Charales, *C. sp.*, *M. sp.*, sporadycznie: *F. antipyretica*, *N. lutea*. [AC-89] 28. Głębokie, N 52° 29' 38,86" E 15° 32' 25,66"; Charales, *B. circinatum*, *P. lucens*, *M. sp.* [AC-97] 29. Buszno; N 52° 24' 13,53" E 15° 18' 23,66"; *E. canadensis*, *C. sp.*, *Potamogeton* sp., Charales, *F. antipyretica* (sp).

[AD-07] 30. Ciecz (Trześniowskie), N 52° 21' 22,08" E 15° 17' 55,26"; *F. antipyretica*, *P. lucens*, *P. perfoliatus*, *C. demersum*, *E. canadensis*, *M. spicatum*, *B. circinatum*, Charales, *P. crispus*. 31. Łagowskie, N 52° 19' 16,34" E 15° 17' 12,81"; *E. canadensis*, *Potamogeton* sp., *M. sp.*, *F. antipyretica*, Charales, *N. lutea*, *B. circinatum*. [AD-18] 32. Niesłysz (Niesulickie), N 52° 13' 52,00" E 15° 23' 10,26"; Charales, *E. canadensis*, *M. sp.*, *C. sp.*, *P. perfoliatus*, *N. lutea*, *F. antipyretica*, *B. circinatum*, w zaciśnionych zatokach: *S. aloides*. [AD-39] 33. Bukowie (Bukowskie, Objezierze Wielkie), N 53° 5' 16,00" E 15° 33' 19,01"; (c:) Charales, *E. canadensis*, *C. sp.*, *B. circinatum*, *N. lutea*, *S. aloides*, *L. trisulca*.

[BA-85] 34. Bukowo, N 54° 20' 34,99" E 16° 16' 43,01"; *Potamogeton* sp., *E. canadensis*, Charales, *M. sp.*, *S. aloides*.

[BB-37] 35. Wierzcho, N 53° 51' 44,98" E 16° 39' 50,33"; *E. canadensis*, *C. sp.*, *M. sp.*, *Potamogeton* sp., Charales. [BB-48] 36. Dolgie, N 53° 46' 43,08" E 16° 48' 26,73"; *E. canadensis*, Charales, *M. sp.*, *C. sp.*, FLS: *S. aloides*, *N. alba*, *N. lutea*. 37. Stępieńskie, N 53° 49' 45,47" E 16° 44' 41,15"; Charales, *E. canadensis*. [BB-64] 38. Dolgie Wielkie, N 53° 35' 20,43" E 16° 15' 48,41"; *M. sp.*, Charales, (sq:) *E. canadensis*, *P. perfoliatus*, *P. lucens*, FLS: *N. lutea*, *N. alba*, *S. aloides*. [BB-66] 39. Pile, N 53° 35' 50,12" E 16° 30' 3,99"; *E. canadensis*, *C. sp.*, *M. sp.*, Charales, *S. aloides*, *F. antipyretica*, FLS: *N. alba*, *N. lutea*. 40. Ciemino, N 53° 38' 30,04" E 16° 33' 48,06"; *E. canadensis*, *M. sp.*, (sq:) *P. lucens*, *P. perfoliatus*, *C. sp.*, Charales. [BB-67] 41. Kopiel, N 53° 38' 30,70" E 16° 40' 25,71"; Charales. [BB-73] 42. Wilczkowo, N 53° 32' 42,19" E 16° 5' 24,46"; *E. canadensis*, *Potamogeton* sp., *C. sp.*, *M. sp.*, Charales, *F. antipyretica*. [BB-74] 43. Czaplino, N 53° 33' 16,27" E 16° 14' 55,25"; *E. canadensis*, *C. sp.*, *M. sp.*, (sq:) *B. circinatum*, *Potamogeton* sp., Charales. [BB-75] 44. Niewlino, N 53° 33' 0,25" E 16° 24' 31,04"; *E. canadensis*, Charales, and: *C. sp.*, *P. perfoliatus*, *B. circinatum*, ROLP: *S. aloides*, *N. alba*, *N. lutea*. [BB-80] 45. Ińsko, N 53° 26' 40,20" E 15° 32' 36,71"; (a:) Charales, *E. canadensis*, *M. spicatum*, *C. demersum*, *F. antipyretica*, (often but in small clusters:) *P. lucens*, *P. perfoliatus*, *B. circinatum*, *Potamogeton compressus*, *P. natans*, *N. lutea*, *P. amphibium*. 46. Stubnica, N 53° 24' 46,98" E 15° 32' 49,00"; Charales, *C. sp.*, *E. canadensis*, *M. sp.*, *F. antipyretica*, *B. circinatum*, *P. lucens*, *P. perfoliatus*, *N. lutea*, *P. natans*, *P. amphibium*, *S. aloides* (p). [BB-81] 47. Bucierz (Bucierz), N 53° 27' 52,98" E 15° 45' 57,98"; Charales, *E. canadensis*, *C. sp.*, *P. perfoliatus*. [BB-82] 48. Lubie (Lubieszewo, Lebieszewskie), N 53° 27' 22,26" E 15° 54' 13,91"; *E. canadensis*, *M. sp.*, *C. sp.*, (sq:) *B. circinatum*, *P. perfoliatus*, *P. lucens*, Charales. [BB-84] 49. Studnica, N 53° 28' 52,98" E 16° 15' 0,02"; Charales, *C. sp.*, *Potamogeton*

sp. div., FLS: *N. alba*, *N. lutea*, *S. aloides*. [BB-85] 50. **Busino** (Businowskie Duże), N 53° 27' 23,79" E 16° 26' 24,11"; *Charales*, (sq:): *C. sp.*, *P. perfoliatus*, *E. canadensis*. [BB-97] 51. **Górne Krąpsko** (Krępsko Górne, Piaski), N 53° 20' 2,97" E 16° 38' 9,00"; *E. canadensis*, *Charales*, *C. sp.*, FLS: *N. alba*, *N. lutea*. 52. **Trzebieskie** (Trzebieszki), N 53° 21' 10,74" E 16° 37' 7,07"; *N. lutea*, *P. lucens*, *P. perfoliatus*, *Charales*, *M. sp.*, *C. sp.*

[BC-04] 53. Wielki Bytyń (Bytyń Wielki); N 53° 16' 55,68" E 16° 16' 7,20"; *Charales*, *P. perfoliatus*, *P. lucens*. [BC-05] 54. Raduń, N 53° 15' 35,97" E 16° 25' 44,00"; *E. canadensis*, *M. sp.*, (sq:) *C. demersum*, *Ranunculus aquatilis*, *Charales*, *P. lucens*. [BC-12] 55. **Dominikowskie (Dominikowo Duże)**, N 53° 12' 49,30" E 15° 51' 0,47"; *E. canadensis*, *C. demersum*, *M. spicatum*, *L. trisulca*, *P. lucens*, *Charales* (a). [BC-13] 56. **Martwe** (Marta), N 53° 10' 42,71" E 16° 3' 48,65"; *Charales*, *P. perfoliatus*. [BC-18] 57. **Plocie**, N 53° 10' 49,75" E 16° 49' 20,69"; *Charales*, *P. lucens*, *E. canadensis*, *C. demersum*, *B. circinatum*. [BC-20] 58. **Niestobno** (Niesobia), N 53° 4' 46,03" E 15° 41' 49,02"; *C. demersum*, *Charales*, *P. lucens*, *M. spicatum*, *F. antipyretica*, *P. natans*, *N. lutea*. [BC-21] 59. **Przczno**, N 53° 4' 26,95" E 15° 45' 35,74"; *C. demersum*, *M. spicatum*, *Charales*, *P. lucens*, *N. lutea*, *S. aloides*, *F. antipyretica*. 60. **Radęcińskie** (Radęcino), N 53° 2' 47,93" E 15° 48' 35,32"; *Charales*, *P. perfoliatus*, *C. demersum*, *M. spicatum*, *N. lutea*, *N. alba*, *P. natans*. [BC-22] 61. **Ostrowite** (Ostrowiec), N 53° 5' 12,94" E 15° 58' 38,43"; *Charales*, *P. perfoliatus*, *P. lucens*, *C. demersum*, *M. spicatum*, *S. aloides*, *N. lutea*, *N. alba*. [BC-30] 62. **Osiek** (Chomętowskie, with Lake Żabie), N 52° 57' 14,11" E 15° 40' 57,29"; *Charales*, *E. canadensis*, (a:) *P. natans*, *F. antipyretica*, *B. circinatum*, *S. aloides*, *N. lutea*, *M. spicatum*, *C. demersum*. [BC-31] 63. **Słowic**, N 53° 0' 3,97" E 15° 49' 5,00"; *E. canadensis*, *Charales*, *N. lutea*, *P. lucens*, *M. spicatum*, *C. sp.* [BC-40] 64. **Lipie**, N 52° 55' 7,21" E 15° 39' 25,82"; *Charales*, *E. canadensis*, *P. lucens*, (sq:): *C. demersum*, *F. antipyretica*, *S. aloides*, *P. natans* (in the bays), *B. circinatum*, *N. lutea*. 65. **Słowa**, N 52° 55' 28,38" E 15° 38' 0,06"; *Charales*, *E. canadensis*, *P. lucens*, (sq:): *C. demersum*, *F. antipyretica*, *S. aloides*, *P. natans*, *B. circinatum*, *N. lutea*. [BC-42] 66. **Łubowo**, N 52° 53' 22,16" E 15° 53' 33,27"; *C. demersum*, *M. spicatum*, *Charales*, *P. lucens*, *E. canadensis*, *N. lutea*, *S. aloides*. [BC-72] 67. **Śremskie**, N 52° 36' 31,76" E 16° 2' 57,99"; *C. demersum*, *M. sp.*, *Charales*, *F. antipyretica*, *P. lucens*, *P. perfoliatus*, (sq:) *E. canadensis*, *B. circinatum*, *S. aloides*, *N. lutea*, *P. amphibium*. [BC-80] 68. **Szarcz**, N 52° 29' 39,74" E 15° 45' 17,80"; *E. canadensis*, *Charales*, *M. spicatum*, *C. demersum*, *P. lucens*, *P. perfoliatus*. 69. **Lubikowskie**, N 52° 31' 47,17" E 15° 40' 54,48"; *Groenlandia densa*, *P. lucens*, *P. pectinatus*, *Charales*, *C. sp.*, *M. spicatum*, *Najas sp.*, *A. vesiculosa*, *N. lutea*, *N. alba*. [BC-84] 70. **Białokoskie**, N 52° 34' 11,99" E 16° 13' 55,00"; *C. sp.*, *M. spicatum*, *Charales*, (sq:) *P. perfoliatus*, *P. lucens*, *E. canadensis*, *B. circinatum*, *N. alba*, *N. lutea*, *P. natans*. 71. **Zajączkowskie**, N 52° 34' 52,67" E 16° 20' 13,31"; *E. canadensis*, *C. sp.*, *M. sp.*, *Charales*, (sq:) *P. lucens*, *P. perfoliatus*, *B. circinatum*, *N. lutea*. [BC-96] 72. **Bytyńskie**, N 52° 30' 30,14" E 16° 29' 59,54"; *P. perfoliatus*, *Charales*, (with admixture:) *E. canadensis*, *Potamogeton sp.*, *N. lutea*, *F. antipyretica*, *B. circinatum*, *Utricularia sp.*

[BD-11] 73. **Zbąszyńskie**, N 52° 14' 4,97" E 15° 54' 12,99"; *F. antipyretica*, *M. sp.*, *P. perfoliatus*, *N. lutea*, (sq:) *B. circinatum*, *C. demersum*, *L. trisulca*, *N. alba*, *Charales*, *P. pectinatus*. [BD-23] 74. **Kuźnickie**, N 52° 13' 5" E 16° 5' 13"; *C. sp.*, *M. sp.*, *E. canadensis*, *P. perfoliatus*, *P. natans*, *P. crispus*, *B. circinatum*, *Charales*, *S. aloides*, *N. lutea*, *N. alba*. [BD-47] 75. **Wonieść**, N 52° 0' 14" E 16° 41' 50"; *Charales*, *C. sp.*, *F. antipyretica*, *N. lutea*, *P. perfoliatus*, *Batrachium sp.*, *H. vulgaris*. [BD-52] 76. **Sławskie**, N 51° 53' 19" E 16° 1' 1"; *C. sp.*, *M. sp.*, *Najas sp.*, (sq:) *F. antipyretica*, *B. circinatum*, *P. perfoliatus*, *P. lucens*, *Charales*, *N. lutea*. [BD-53] 77. **Breńskie**, N 51° 55' 41" E 16° 12' 52"; *Charales*, *C. demersum*, *F. antipyretica*, *M. sp.*, *P. perfoliatus*, *B. circinatum*. [BD-54] 78. **Dominickie**, N 51° 56' 56" E 16° 18' 26"; *Charales*, (sq:) *M. sp.*, *C. sp.*, *P. lucens*, *F. antipyretica*, *E. canadensis*, *Najas sp.*, *A. vesiculosa*. [BD-57] 79. **Łoniewskie**, N 51° 53' 58" E 16° 41' 17"; *N. lutea*, *P. perfoliatus*, *P. lucens*, *C. sp.*, (sq:) *F. antipyretica*, *Charales*, *H. vulgaris*.

[CA-44] 80. **Sarbsko**, N 54° 45' 53" E 17° 37' 43"; *Potamogeton sp.*, *Charales*, *E. canadensis*, *M. sp.* [CA-46] 81. **Choczewskie**, N 54° 44' 17" E 17° 55' 46"; *E. canadensis*, *Charales*, *C. sp.*, (sq:) *M. sp.*, *P. crispus*, *P. lucens*, *P. perfoliatus*, FLS: *S. aloides* (a), *N. alba*, *N. lutea*. 82. **Żarnowieckie**, N 54° 45' 53,72" E 18° 3' 25,37"; *B. circinatum*, *Charales*, *P. perfoliatus*, *Potamogeton gramineus*, (sq:) *E. canadensis*, FLS: *N. lutea*. [CB-03] 83. **Jeleń**, N 54° 12' 1" E 17° 31' 30"; *M. sp.*, *E. canadensis*, *Charales*, FLS: *P. natans*. [CB-04] 84. **Mausz**, N 54° 12' 26" E 17° 43' 22"; *E. canadensis*, *C. sp.*, *P. perfoliatus*, *Charales*. 85. **Mausz Mały**, N 54° 11' 8" E 17° 41' 46"; *E. canadensis*, *C. sp.*, *P. perfoliatus*, *Charales*. [CB-05] 86. **Sumino**, N 54° 10' 44" E 17° 47' 58"; *Charales*, (more often encountered:) *M. sp.*, *Potamogeton gramineus*, FLS: *N. lutea*, *S. aloides*, *P. natans*. [CB-15] 87. **Karpno**, N 54° 7' 2" E 17° 48' 28"; *E. canadensis*, *Charales*, *M. sp.*, (sq:) *B. circinatum*, *C. sp.*, *P. perfoliatus*, *P. crispus*, *P. lucens*. 88. **Sominko**, N 54° 4' 46" E 17° 52' 47"; *E. canadensis*, *M. sp.*, *Charales*, (la:) *B. circinatum*, *P. lucens*. 89. **Sudomie**, N 54° 5' 35" E 17° 53' 53"; *E. canadensis*, *Charales*, *P. perfoliatus*, *C. sp.*, *M. sp.* 90. **Mielnica**, N 54° 5' 39" E 17° 54' 57"; *E. canadensis*, *P. lucens*, *P. perfoliatus*, *Potamogeton compressus*, (la:) *Charales*, *B. circinatum*, *M. sp.*, *F. antipyretica*. [CB-21] 91. **Gwieżdzieniec**, N 54° 0' 30" E 17° 15' 16"; *Charales*, *E. canadensis*, *M. sp.* [CB-22] 92. **Borzyszowskie**, N 54° 2' 1" E 17° 21' 27"; *Charales*, *E. canadensis*, *M. sp.* 93. **Kiedrowickie**, N 53° 59' 37" E 17° 25' 32"; *Charales*, *E. canadensis*, *M. sp.* 94. **Trzebielsk**, N 53° 59' 38" E 17° 22' 21"; *Charales* (lum). [CB-23] 95. **Kielsk**, N 54° 1' 25" E 17° 31' 41"; *E. canadensis*, *M. sp.*, *Charales*. 96. **Kruszyńskie**, N 53° 59' 36" E 17° 36' 57"; *Charales*, *E. canadensis*, (sq:) *M. sp.*, *P. lucens*, *F. antipyretica*, FLS: *S. aloides* (c). [CB-25]

97. **Wdzydze Południowe**, N 54° 0' 49" E 17° 55' 0"; *E. canadensis*, (sq:) *M. sp.*, *C. sp.*, *Charales*. 98. **Wdzydze Północne**, N 53° 58' 35" E 17° 54' 23"; *E. canadensis*, (sq:) *M. sp.*, *C. sp.*, *Charales*. [CB-26] 99. **Chądzie**, N 53° 59' 53" E 18° 0' 6"; *M. sp.*, *E. canadensis*, *Charales*, *C. sp.* 100. **Kotel**, N 54° 0' 48" E 18° 0' 50"; *E. canadensis*, *M. sp.*, *Charales*, FLS: *S. aloides* (la). [CB-27] 101. **Polaszowskie**, N 54° 2' 58" E 18° 9' 45"; *E. canadensis*, *C. sp.*, *Charales*. [CB-33] 102. **Gardliczno Duże**, N 53° 53' 46" E 17° 32' 10"; *Charales*, *E. canadensis*, (sq:) *Potamogeton sp. div.*, *F. antipyretica*. [CB-34] 103. **Młosino Wielkie**, N 53° 57' 24" E 17° 46' 36"; *E. canadensis*, *M. sp.*, *Potamogeton sp. div.*, *Charales*, *C. sp.* [CB-37] 104. **Smolnik**, N 53° 52' 55" E 18° 7' 21"; *Charales*, *E. canadensis*. [CB-38] 105. **Borzechowskie Wielkie**, N 53° 53' 36" E 18° 23' 22"; *E. canadensis*, *C. sp.*, *B. circinatum*, *M. spicatum*, *Potamogeton sp. div.*, *F. antipyretica*. [CB-39] 106. **Steklno**, N 53° 53' 31" E 18° 24' 25"; *E. canadensis*, *M. spicatum*, *P. crispus*, *B. circinatum*, *Charales*, *F. antipyretica*. [CB-43] 107. **Charzykowskie**, N 53° 47' 9" E 17° 31' 3"; *P. perfoliatus*, *Potamogeton acutiformis*, *P. pectinatus*, *C. demersum*, *B. circinatum*, *E. canadensis*, *Chara fragilis*, (sq:) *M. spicatum*, *Chara foetida*, *F. antipyretica*. 108. **Ódlugie**, N 53° 49' 31" E 17° 29' 38"; *E. canadensis*, *Charales*. 109. **Karsińskie**, N 53° 50' 17" E 17° 30' 48"; *E. canadensis*, *Charales*. 110. **Ostrowite** N 53° 47' 54" E 17° 35' 44"; *Charales* (a), (others:) *E. canadensis*, *C. sp.*, *M. sp.*, FLS: *S. aloides*, *P. natans*, *N. alba*, *N. lutea*. [CB-62] 111. **Rychnowskie**, N 53° 40' 29" E 17° 23' 59"; *E. canadensis*, *Charales*, *C. sp.*, *M. sp.* [CB-76] 112. **Drzycimskie**, N 53° 31' 53" E 17° 58' 43"; *C. sp.* (d), *Charales*, *B. circinatum*, *M. sp.* 113. **Gwiazda**, N 53° 31' 43" E 17° 57' 49"; *Charales* (d), sporadycznie: *E. canadensis*, *B. circinatum*, FLS: *S. aloides*. [CB-85] 114. **Szpitalne**, N 53° 30' 34" E 17° 51' 36"; *E. canadensis*, *C. sp.*, *Charales*, (sp:) *M. sp.* FLS: *S. aloides*.

[CC-44] 115. **Wąsoskie**, N 52° 56' 49" E 17° 44' 25"; *Charales*, *B. circinatum*, (la:) *E. canadensis*, *M. sp.* [CC-51] 116. **Bracholińskie** (Rgielskie Wschodnie), N 52° 49' 29" E 17° 15' 44"; *Charales* (d), (sq:) *P. perfoliatus*, FLS: *P. natans*, *N. lutea*, *N. alba*, *S. aloides*. 117. **Rgielskie** (Rgielskie Zachodnie), N 52° 49' 29" E 17° 15' 44"; *Charales* (d), *F. antipyretica*, *C. sp.*, *P. lucens*, (sq:) *Sagittaria sagittifolia*, *M. sp.*, *E. canadensis*, *P. perfoliatus*, *B. circinatum*, FLS: *N. lutea*, *S. aloides*. [CC-54] 118. **Żnińskie Duże**, N 52° 52' 24" E 17° 43' 7"; *Charales*, *P. perfoliatus*, *P. lucens*. [CC-62] 119. **Łopienno Północne**, N 52° 43' 12" E 17° 28' 55"; *C. sp.*, *M. sp.*, *B. circinatum*, (sq:) *Charales*, *E. canadensis*, *P. perfoliatus*. [CC-72] 120. **Kleckie**, N 52° 39' 29" E 17° 27' 58"; *M. sp.*, *C. sp.*, *Charales*, *B. circinatum*,

- P. perfoliatus*, *F. antipyrethica*, (sq:) *E. canadensis*, *P. lucens*. 121. **Łopienno Południowe**, N 52° 41' 58" E 17° 28' 29"; *C. sp.*, *M. sp.*, *B. circinatum*, (sq:) *Charales*, *E. canadensis*, *P. perfoliatus*. [CC-73] 122. **Dziadkowskie**, N 52° 41' 41" E 17° 36' 16"; *C. sp.*, *E. canadensis*, *B. circinatum*, *Charales*, *P. lucens*, *P. perfoliatus* FLS: *N. lutea*, *N. alba*. 123. **Ziolo**, N 52° 42' 17" E 17° 38' 9"; *Potamogeton gramineus*, *Charales*, (la:) *C. sp.* 124. **Mielno**, N 52° 39' 31" E 17° 36' 12"; FLS: *N. lutea*, *N. alba*, HF: *M. spicatum*, *C. sp.* (la), *P. perfoliatus*, *Charales*. [CC-75] 125. **Wiczanowskie**, N 52° 41' 13" E 17° 55' 39"; *Charales* (d), *C. sp.* [CC-78] 126. **Tryszczyn**, N 52° 40' 36" E 18° 21' 50"; *C. sp.*, *Charales*, *M. sp.*, (la:) *E. canadensis*. [CC-80] 127. **Turostowskie** (Turostowo), N 52° 33' 52" E 17° 13' 17"; *P. lucens*, *M. sp.* (d), *Charales*, *C. demersum*, *H. vulgaris*, *F. antipyrethica*, FLS: *N. lutea*, *N. alba*. [CC-81] 128. **Głębokie**, N 52° 33' 50" E 17° 20' 29"; *C. demersum*, *M. sp.*, (sq:) *Charales*, *B. circinatum*, *F. antipyrethica*, *N. lutea*. [CC-82] 129. **Gorzuchowskie**, N 52° 36' 58" E 17° 24' 33"; *F. antipyrethica*, *C. sp.*, *P. perfoliatus*, *M. sp.*, *B. circinatum*, *Charales*, *S. aloides*. [CC-86] 130. **Kamienieckie**, N 52° 33' 7" E 17° 58' 26"; *C. sp.*, *Charales*, *Potamogeton sp.*, *E. canadensis*, *F. antipyrethica*. [CC-95] 131. **Biale**, N 52° 27' 58" E 17° 53' 47"; *Charales* (d), mniej: *P. lucens*, *F. antipyrethica*, *B. circinatum*, *C. demersum*, *M. sp.*, *P. crispus*, *N. alba* (c). 132. **Niedzięgiel**, N 52° 26' 39" E 17° 53' 21"; *Charales* (d), (sq:) *C. sp.*, *F. antipyrethica*, *E. canadensis*, *P. lucens*, *M. sp.*, *Potamogeton gramineus*, *B. circinatum*, FLS: *N. lutea*, *S. aloides*. 133. **Ostrowite** (Ostrowickie), N 52° 31' 17" E 17° 52' 15"; *F. antipyrethica*, *E. canadensis*, *Charales*, *C. demersum*, *M. spicatum*, *B. circinatum*, *P. perfoliatus*, *P. natans*, *P. lucens*, FLS: *Salvinia natans*, *N. lutea*. [CC-96] 134. **Budziślowskie**, N 52° 27' 42" E 18° 3' 20"; *Charales*, *P. lucens*, *E. canadensis*, *C. sp.*, *B. circinatum*, *M. sp.*, *F. antipyrethica*, (sq:) *Stuckenia filiformis*, *S. aloides*, *N. lutea*. 135. **Wilczyńskie** N 52° 28' 48" E 18° 6' 37"; *E. canadensis*, *Charales*, *C. sp.*, *M. sp.*, FLS: *L. trisulca* *P. natans*, *N. alba*, *S. aloides*. [CC-97] 136. **Ostrowskie**, N 52° 32' 0" E 18° 6' 59"; *Charales*, *F. antipyrethica*, (la:) *C. sp.*, *E. canadensis*. [CC-98] 137. **Skulska Wieś**, N 52° 29' 32" E 18° 19' 1"; *Charales*, *M. sp.*, *F. antipyrethica*, *P. perfoliatus*, *P. lucens*, *C. sp.*, FLS: *N. lutea*. 138. **Skulskie**, N 52° 28' 15" E 18° 19' 23"; *Charales*, *F. antipyrethica*, *M. spicatum*, *C. demersum*, *P. lucens*, *P. crispus*, FLS: *N. lutea*.
- [CD-06] 139. **Napruszewskie** (Kosewskie), N 52° 24' 52" E 17° 58' 39"; *P. lucens*, *Charales*, *E. canadensis*, *B. circinatum*, *C. sp.*, *M. sp.*, *F. antipyrethica*, FLS: *N. lutea*. 140. **Koziegłowskie** (Koziegłowy), N 52° 21' 55" E 18° 4' 52"; *F. antipyrethica*, *Charales*, (sq:) *C. sp.*, *E. canadensis*, *P. perfoliatus*, *B. circinatum*, FLS: *N. lutea*. 141. **Ostrowite**, N 52° 23' 0" E 18° 3' 47"; *Charales*, *F. antipyrethica*, *C. sp.*, *M. sp.*, *P. lucens*, FLS: *N. alba*, *N. lutea*.
- [DB-37] 142. **Sambród**, N 53° 55' 21" E 19° 43' 39"; *Potamogeton sp. div.*, *Charales*, FLS: *S. aloides*. [DB-39] 143. **Narie**, N 53° 54' 33" E 20° 1' 8"; *E. canadensis* (d), *Charales* (d), *F. antipyrethica* (d), *P. perfoliatus*, (sq:) *C. demersum*, *M. spicatum*, *P. lucens*, *Potamogeton compressus*, FLS: *Lemna trisulca*, *P. natans*, *P. amphibium*, *N. lutea*, *S. aloides*. [DB-46] 144. **Rucewo Male**, N 53° 47' 40" E 19° 32' 52"; *Charales*, FLS (a): *S. aloides*, *N. alba*, *N. lutea*. [DB-54] 145. **Burgale**, N 53° 44' 56" E 19° 17' 38"; *C. sp.*, *P. lucens*, *Charales*, FLS: *N. lutea*, *N. alba*. 146. **Grażymowskie** (II i III-Wschodnie), N 53° 42' 54" E 19° 13' 21"; *Charales*, *P. lucens*, *E. canadensis*, *M. sp.*, *C. sp.*, FLS: *N. lutea*, *N. alba*, *S. aloides*. [DB-57] 147. **Gil Mały**, N 53° 42' 45" E 19° 44' 9"; *Charales*, *P. lucens*. 148. **Kociol**, N 53° 44' 37" E 19° 43' 4"; *E. canadensis*, *C. sp.*, *Charales*. [DB-59] 149. **Szeląg Wielki**, N 53° 43' 39" E 20° 2' 28"; *Charales*, *E. canadensis*, *M. sp.*, FLS: *N. alba*, *N. lutea*, *S. aloides*. 150. **Tabórz**, N 53° 47' 6" E 20° 1' 49"; *Charales* (d), *B. circinatum*, FLS: *N. alba*, *N. lutea*. [DB-73] 151. **Szynwałd**, N 53° 34' 38" E 19° 5' 50"; (sq:) *Charales*, *C. sp.*, FLS: *Lemna sp.*, *N. alba*, *N. lutea*, *P. natans*. [DB-75] 152. **Popówko**, N 53° 35' 40" E 19° 22' 28"; (sq:) *Charales*, FLS: *P. natans*, *S. aloides*. [DB-82] 153. **Księżę**, N 53° 27' 46" E 18° 58' 7"; *E. canadensis*, *Charales*, FLS: *N. alba*, *N. lutea*, *S. aloides*. [DB-98] 154. **Grądy**, N 53° 20' 38" E 19° 52' 14"; *C. sp.*, *Charales*. 155. **Tarczyńskie**, N 53° 20' 35" E 19° 53' 28"; *Potamogeton sp.*, *Charales*. [DB-99] 156. **Zarybinek**, N 53° 22' 28" E 19° 56' 55"; *E. canadensis*, *Charales*, *C. sp.*
- [DC-00] 157. **Kornatowskie**, N 53° 16' 36" E 18° 39' 21"; *C. sp.* *Charales*, *F. antipyrethica*, FLS: *N. alba*, *N. lutea*. [DC-10] 158. **Chelmżyńskie**, N 53° 10' 27" E 18° 39' 11"; *E. canadensis* (d), *C. sp.* (d), *Charales* (E, W parth of the lake). [DC-17] 159. **Wlecz**, N 53° 14' 47" E 19° 43' 22"; *Charales*, *E. canadensis*, *F. antipyrethica*. [DC-25] 160. **Długie**, N 53° 6' 4" E 19° 19' 2"; *E. canadensis*, *B. circinatum*, *C. sp.* *Charales*. [DC-90] 161. **Głuszyńskie**, N 52° 31' 20" E 18° 38' 42"; *P. perfoliatus*, *P. lucens*, *P. crispus*, *C. sp.*, *M. sp.* and: *Charales*, *F. antipyrethica*, *E. canadensis* (la), FLS: *S. aloides*.
- [DD-11] 162. **Modzerowskie** (with L. Długie), N 52° 21' 22" E 18° 45' 33"; *F. antipyrethica*, *C. sp.*, (sq:) *Charales*, *M. sp.*, *Stuckenia pectinata*, *P. perfoliatus*, *B. circinatum*, FLS: *N. lutea*.
- [EA-98] 163. **Arklickie**, N 54° 17' 27" E 21° 21' 7"; 1954: *C. demersum*, *M. spicatum* (sq:) *Charales*, *Potamogeton compressus*, FLS: *N. lutea*, *Spirodela polyrhiza*; 1955: *Charales*, 1957: *B. circinatum* (d), *Charales*, *E. canadensis*, *C. sp.*, *Potamogeton sp. div.* [EA-99] 164. **Osiek**, N 54° 16' 8" E 21° 33' 5"; *C. demersum*, FLS: *N. alba*, także: *P. natans*, *L. trisulca*, *Charales*. 165. **Rydzówka**, N 54° 13' 50" E 21° 35' 1"; *E. canadensis*, *P. lucens*, *P. perfoliatus*, *B. circinatum*, (c:) *M. sp.*, *Potamogeton compressus*, *Potamogeton trichoides*, *Chara sp.* (sp).
- [EB-09] 166. **Okragle** (Siniec Mały), N 54° 9' 3" E 21° 30' 52"; *Charales* (d) FLS: *N. lutea* and: *F. antipyrethica*, *L. trisulca*, *C. demersum*, *P. perfoliatus*. 167. **Silec**, N 54° 10' 38" E 21° 31' 54"; *M. spicatum*, *B. circinatum*, *C. demersum*, nielicznie: *P. lucens*, *P. perfoliatus*, *F. antipyrethica*, *Nitella sp.*, FLS: *N. lutea*. [EB-25] 168. **Luterskie**, N 53° 59' 30" E 20° 51' 10"; *Charales*, *P. perfoliatus*, FLS: *N. lutea*, *N. alba*. [EB-29] 169. **Wersminia**, N 54° 1' 7" E 21° 30' 31"; *Charales*, *E. canadensis*. [EB-35] 170. **Wegój**, N 53° 54' 32" E 20° 58' 41"; rare vegetation: *Charales*, FLS: *P. natans*, *N. alba*, *N. lutea*. [EB-38] 171. **Juksty**, N 53° 51' 1" E 21° 22' 24"; *Potamogeton sp. div.*, *Charales*. 172. **Soltysko**, N 53° 52' 26" E 21° 17' 40"; *Potamogeton sp. div.*, *Charales*. [EB-39] 173. **Taltowisko**, N 53° 52' 32" E 21° 34' 5"; *F. antipyrethica*, *Charales*, FLS: *P. natans*, *N. alba*, *N. lutea*. 174. **Notyst**, N 53° 54' 14" E 21° 27' 37"; *P. perfoliatus*, (sr:) *B. circinatum*, *Charales*, *F. antipyrethica*, *E. canadensis* (N parth of the lake), *E. canadensis* (N-W parth of the lake), FLS: *N. lutea*. [EB-43] 175. **Trackie**, N 53° 47' 13" E 20° 32' 33"; *Potamogeton sp. div.*, *Charales*. [EB-44] 176. **Kierzlińskie**, N 53° 47' 58" E 20° 44' 42"; *Potamogeton sp. div.*, *C. sp.*, *Charales*. 177. **Orzyc**, N 53° 49' 31" E 20° 44' 16"; *Potamogeton sp. div.*, *C. sp.*, *Charales*. [EB-47] 178. **Krzywe**, N 53° 46' 56" E 21° 16' 18"; *Potamogeton sp.*, *E. canadensis*, *Charales*. 179. **Pilakno**, N 53° 47' 16" E 21° 9' 52"; *Charales*, *E. canadensis*. 180. **Sarż**, N 53° 50' 46" E 21° 12' 18"; *M. sp.*, *Charales*, *E. canadensis*. [EB-48] 181. **Probarskie**, N 53° 49' 18" E 21° 22' 43"; *C. sp.*, *E. canadensis*, *Charales*. [EB-49] 182. **Majcz Wielki**, N 53° 46' 43" E 21° 27' 22"; *C. sp.*, *F. antipyrethica*. [EB-51] 183. **Gilwa**, N 53° 46' 5" E 20° 14' 13"; *C. sp.*, *Charales*, FLS: *N. lutea*, *N. alba*. [EB-53] 184. **Skanda**, N 53° 45' 24" E 20° 31' 50"; *Charales*, *C. sp.*, *Potamogeton sp.* [EB-54] 185. **Purdy**, N 53° 41' 29" E 20° 43' 22"; *Charales*, *E. canadensis*, *F. antipyrethica*. 186. **Serwent**, N 53° 43' 3" E 20° 45' 28"; *Charales*, *E. canadensis*, *F. antipyrethica*. [EB-57] 187. **Babięty Male**, N 53° 43' 52" E 21° 8' 5"; *Charales*, *E. canadensis*. 188. **Babięty Wielkie**, N 53° 43' 0" E 21° 7' 19"; *C. sp.*, *Charales*, *E. canadensis*, FLS: *S. aloides* (in the bays). [EB-58] 189. **Mojtyny**, N 53° 41' 25" E 21° 20' 38"; *Charales*. 190. **Mokre**, N 53° 41' 3" E 21° 23' 16"; *Potamogeton sp. div.*, *Charales*, *C. sp.* 191. **Nawiady**, N 53° 41' 42" E 21° 19' 35"; *Charales*, *Potamogeton sp. div.* [EB-59] 192. **Beldany**, N 53° 42' 28" E 21° 34' 45"; *E. canadensis*, *M. spicatum*, *C. demersum*, *Charales*, *F. antipyrethica*, *B. circinatum*, *P. lucens*, *P. perfoliatus*, *Potamogeton compressus*, FLS (in the bays): *N. alba*, *N. lutea*, *S. aloides*. [EB-64] 193. **Kalwa**, N 53° 40' 42" E 20° 47' 8"; *C. sp.*, *M. sp.*, *E. canadensis*, *Charales*. [EB-65] 194. **Gromskie**, N 53° 37' 52" E 20° 53' 7"; *Charales*, *M. sp.*, *C. sp.* 195. **Leleskie**, N 53° 38' 33" E 20° 50' 33"; *Charales*, *M. sp.*, *E. canadensis*. 196. **Sasek Wielki**, N 53° 38' 30" E 20° 55' 40"; *C. sp.*, *P. lucens*, *E. canadensis*, *F. antipyrethica*, *Charales*. [EB-66] 197. **Łęczek**, N 53° 38' 34" E 21° 5' 9"; *Charales*, *E. canadensis*. 198. **Łęsk**, N 53° 39' 26" E 21° 4' 7"; *E. canadensis*, *C. sp.*, *Charales*. 199. **Starokiejkuckie**, N 53° 37' 42" E 21° 4' 16"; *M. sp.*, *Charales*, *E. canadensis*.

200. **Walpusz**, N 53° 36' 17" E 21° 4' 21"; *F. antipyrretica*, *E. canadensis*, *C. sp.*, *Charales*. [EB-67] 201. **Krawienko**, N 53° 40' 19" E 21° 12' 46"; *C. sp.*, *Charales*. 202. **Krawno**, N 53° 40' 19" E 21° 12' 46"; *Charales*, *Najas sp.*, *C. sp.* 203. **Marksoy**, N 53° 37' 34" E 21° 7' 53"; *E. canadensis*, *Charales*. 204. **Nożyce**, N 53° 37' 15" E 21° 11' 40"; (sq:) *Charales*, *Potamogeton sp. div.*, *P. amphibium*. 205. **Piasutno**, N 53° 36' 24" E 21° 12' 25"; *M. sp.*, *Charales*. 206. **Świątajno**, N 53° 36' 11" E 21° 14' 44"; *Charales*, *E. canadensis*, *Potamogeton sp. div.* [EB-68] 207. **Spychowskie**, N 53° 36' 9" E 21° 20' 18"; *Charales* (d), *C. sp.* (d). [EB-72] 208. **Pluszne**, N 53° 35' 32" E 20° 23' 50"; *Charales* (d), *C. sp.* (d), *E. canadensis*, FLS: *P. natans*, *N. alba*, *N. lutea*. [EB-73] 209. **Łabuny Wielkie**, N 53° 34' 17" E 20° 38' 30"; *M. sp.*, *Charales*. [EB-74] 210. **Malszewskie**, N 53° 35' 6" E 20° 43' 32"; *E. canadensis*, *Charales*. 211. **Świątajno**, N 53° 32' 46" E 20° 47' 13"; *Charales*, *E. canadensis*. [EB-75] 212. **Brajnickie**, N 53° 32' 50" E 20° 48' 55"; *E. canadensis*, *C. sp.* *Charales*. 213. **Sędańskie**, N 53° 31' 50" E 20° 48' 49"; *Charales*, *C. sp.* 214. **Warchaldzkie**, N 53° 31' 50" E 20° 48' 49"; *C. sp.*, *E. canadensis*, *Charales*. [EB-79] 215. **Nidzkie**, N 53° 34' 30" E 21° 32' 34"; *E. canadensis*, *Charales*, *M. spicatum*. [EB-82] 216. **Borówko**, N 53° 28' 20" E 20° 21' 57"; *C. sp.*, *Charales*. [EB-83] 217. **Trzciano**, N 53° 27' 53" E 20° 34' 42"; *Charales*, *M. sp.* [EB-91] 218. **Szkotowskie**, N 53° 24' 38" E 20° 16' 51"; *Charales*, *C. sp.*
- [FA-78] 219. **Wizajny**, N 54° 23' 2" E 22° 51' 27"; (ip:) *M. sp.*, *Charales*, *C. sp.*, *B. circinatum*, *E. canadensis*, *P. lucens*, FLS: *S. aloides*. [FA-86] 220. **Boczne**, N 54° 16' 38" E 22° 38' 49"; *Charales* (d), *E. canadensis* (d), *P. perfoliatus* (d), *M. sp.*, *F. antipyrretica*, FLS: *S. aloides*, *P. amphibium*. 221. **Przerosił**, N 54° 16' 54" E 22° 36' 4"; *P. lucens*, *E. canadensis*, *Charales*, *F. antipyrretica*, FLS: *N. lutea* (ip), *N. alba* (ip). [FA-90] 222. **Dejguny**, N 54° 2' 22" E 21° 36' 28"; *Charales* (d), *E. canadensis* (d), *C. sp.*, *M. sp.*, *B. circinatum*, *Potamogeton sp.*, *F. antipyrretica*, FLS: *Lemna sp.*, *S. aloides*. [FA-95] 223. **Bitkowskie**, N 54° 13' 27" E 22° 30' 32"; *E. canadensis* (d), *Charales* (d), *P. perfoliatus*, *P. lucens*, *P. crispus*, *B. circinatum*, FLS: *P. natans*, *N. alba* (ip), *N. lutea* (ip). [FA-96] 224. **Kamienne**, N 54° 11' 43" E 22° 37' 39"; *Charales* (d), *E. canadensis* (d), *P. lucens*, *P. perfoliatus*, *P. crispus*, *B. circinatum*, FLS: *P. natans*. 225. **Rospuda Filipowska**, N 54° 13' 24" E 22° 34' 33"; *E. canadensis*, *Charales*, *M. sp.*, *P. crispus*, *P. perfoliatus*, *P. lucens*, *B. circinatum*, *C. sp.*, FLS: *S. aloides* (ip), *N. alba* (ip), *N. lutea* (ip).
- [FB-00] 226. **Kirsajty**, N 54° 8' 40" E 21° 42' 36"; *Charales* (93%), *E. canadensis*, *E. canadensis*, FLS: *L. trisulca*. 227. **Mamry Północne**, N 54° 10' 25" E 21° 42' 0"; *Charales* (84%), *E. canadensis* (6%), *C. sp.* (4%), *F. antipyrretica* (2%), *Potamogeton sp.*, *M. sp.*, *B. circinatum*, FLS: *Lemna sp.*, *N. lutea*. [FB-01] 228. **Harsz**, N 54° 8' 59" E 21° 46' 11"; *Chara sp.*, *B. circinatum*, *P. perfoliatus*, *E. canadensis*, *M. sp.*, *Nitella sp.*, *P. lucens*, *F. antipyrretica* (sr), FLS: *P. natans*, *L. trisulca* (sr). [FB-02] 229. **Krzywa Kuta**, N 54° 9' 4" E 21° 57' 55"; *M. spicatum*, *Chara vulgaris* (sr), FLS: *N. lutea* (sr). [FB-05] 230. **Czarne**, N 54° 6' 59" E 22° 28' 18"; *E. canadensis*, *M. sp.*, *Charales*. [FB-06] 231. **Garba**, N 54° 8' 8" E 22° 37' 20"; *E. canadensis* (d), *Charales* (a), *P. lucens* (a), *P. perfoliatus* (a), *Potamogeton gramineus*, *M. sp.*, *F. antipyrretica*. [FB-07] 232. **Skazdubek**, N 54° 6' 52" E 22° 41' 40"; *E. canadensis*, *Charales*, *F. antipyrretica*, *B. circinatum*, *C. sp.*, *Utricularia sp.* FLS: *N. alba*, *N. lutea*. [FB-10] 233. **Dargin**, N 54° 7' 11" E 21° 43' 60"; *Charales* (69%), *E. canadensis* (8%), *P. perfoliatus*, *B. circinatum*, *P. pectinatus*, *F. antipyrretica*, *M. sp.*, *P. compressus*, FLS: *N. lutea*, *P. natans*, *S. aloides*, *P. amphibium*, *Lemna sp.* 234. **Dobskie**, N 54° 5' 45" E 21° 37' 27"; *Charales* (74%), *C. sp.* (12%), *E. canadensis* (6%), *P. pectinatus*, FLS: (w zatokach): *N. lutea*, *N. alba*, *P. natans*, *S. aloides*. 235. **Kisajno**, N 54° 4' 14" E 21° 42' 32"; *Charales* (61%), *E. canadensis* (10%), *B. circinatum* (7,7%), *P. compressus* (4,8%), *C. sp.* (2,2%), *P. lucens* (1,2%), FLS: *L. trisulca* (7,5%). [FB-11] 236. **Dgał Wielki**, N 54° 6' 34" E 21° 47' 33"; *Chara sp.* (d), *Nitella sp.* (d), *E. canadensis* (d), *F. antipyrretica*, *P. perfoliatus*, *P. lucens*, *P. compressus*, *P. crispus*, *P. amphibium*, *B. circinatum*, *C. demersum*, *M. spicatum*, FLS: *N. lutea*, *P. natans*, *S. aloides*. [FB-12] 237. **Oczko** (Babka), N 54° 4' 16" E 21° 57' 9"; *E. canadensis*, *Chara sp.*, *Nitella sp.*, *C. submersum*, *F. antipyrretica*, *U. vulgaris*, *P. crispus*, FLS: *N. alba*, *P. natans*, *S. aloides*. 238. **Sołtmany**, N 54° 2' 43" E 22° 1' 44"; *C. sp.*, *M. sp.*, *Nitella sp.* 239. **Goldopiwo**, N 54° 6' 49" E 21° 57' 0"; *P. perfoliatus*, *P. compressus*, *E. canadensis*, *Charales*, *C. demersum*, *M. spicatum*, FLS: *N. lutea* (sr), *P. natans* (sr). [FB-14] 240. **Romoty** (Rumity), N 54° 2' 51" E 22° 20' 47"; *Charales*, *P. perfoliatus*, *P. lucens*, *P. crispus*, FLS: *N. lutea* (ip), *N. alba* (ip), *P. natans* (ip), *S. aloides* (ip). [FB-15] 241. **Dobskie**, N 54° 2' 21" E 22° 24' 45"; *F. antipyrretica*, *E. canadensis*, *Charales*, *P. perfoliatus*, *P. lucens*. 242. **Sedraneckie**, N 54° 4' 10" E 22° 27' 48"; *E. canadensis* (d), *Charales* (d), *M. sp.*, *P. lucens*, *P. perfoliatus*, FLS: *N. alba*, *N. lutea*, *S. aloides*. [FB-19] 243. **Białe Wigierskie**, N 54° 1' 52" E 23° 5' 31"; *E. canadensis* (d), *Charales* (d), *M. spicatum* (a), *P. lucens*, FLS: *S. aloides*. 244. **Długie Wigierskie**, N 54° 1' 25" E 23° 1' 46"; *Charales*, FLS: *N. lutea* (a), *N. alba* (a), *P. natans*. 245. **Krusznik**, N 54° 0' 45" E 23° 6' 28"; *Charales*, *P. lucens*, *M. sp.*, *F. antipyrretica*. 246. **Muliczne**, N 54° 1' 41" E 23° 2' 16"; *Charales* (d), *P. lucens*, *C. sp.*, *M. sp.*, *F. antipyrretica*, FLS: *P. natans* (d), *N. lutea* (d), *N. alba*. 247. **Wigry**, N 54° 1' 55" E 23° 7' 52"; *Charales*, *P. lucens*, *E. canadensis*, *C. sp.* [FB-20] 248. **Dejgunek**, N 54° 0' 43" E 21° 37' 59"; *Charales*, *E. canadensis*, *C. sp.*, *M. sp.*, *B. circinatum*, *Potamogeton sp.*, *F. antipyrretica*, FLS: *Lemna sp.*, *S. aloides*. 249. **Wilkasy**, N 54° 0' 57" E 21° 43' 36"; *Charales*, *C. sp.* [FB-21] 250. **Niegocin**, N 54° 0' 9" E 21° 46' 46"; *Charales*, *E. canadensis*, *C. demersum*, *B. circinatum*, *P. perfoliatus*. [FB-23] 251. **Szóstak**, N 53° 31' 1" E 22° 9' 13"; *E. canadensis*, *M. sp.*, *Ranunculus sp.*, *Charales* (sr), *P. lucens* (sr). [FB-24] 252. **Zawadzkie**, N 53° 56' 29" E 22° 14' 4"; *Charales*, *Potamogeton sp. div.*, *M. sp.* 253. **Mul**, N 54° 1' 7" E 22° 19' 0"; *E. canadensis*, *P. perfoliatus*, *P. lucens*, *M. sp.*, *Charales*, *C. sp.*, *B. circinatum*. [FB-25] 254. **Dudeckie**, N 53° 58' 22" E 22° 23' 54"; *E. canadensis*, *M. sp.*, *Charales*, *P. lucens*, *P. perfoliatus*, *C. sp.*, *B. circinatum*. 255. **Kukowino**, N 53° 57' 31" E 22° 24' 23"; *E. canadensis*, *M. sp.*, *Charales* and: *P. perfoliatus*, *P. lucens*, *B. circinatum*. 256. **Przytułskie**, N 53° 56' 12" E 22° 24' 17"; *E. canadensis*, *C. sp.*, *C. sp.*, (sq:) *P. lucens*, *P. perfoliatus*, *B. circinatum*. 257. **Zajdy**, N 53° 58' 34" E 22° 24' 59"; *E. canadensis*, *P. perfoliatus*, *P. lucens*, (sq:) *M. sp.*, *C. sp.*, *Charales*, *B. circinatum*. [FB-29] 258. **Blizienko**, N 53° 57' 15" E 23° 6' 40"; *E. canadensis*, *Charales*, *P. perfoliatus*, *M. sp.*, *C. sp.*, FLS: *N. alba* (ip), *N. lutea* (ip), *S. aloides* (ip), *P. natans* (ip). 259. **Busznica**, N 53° 56' 38" E 23° 5' 0"; *Charales*. [FB-30] 260. **Jagodne**, N 53° 55' 34" E 21° 43' 21"; low diversity of vegetation and low macrophyte abundance: *E. canadensis*, *Charales*. [FB-32] 261. **Długie**, N 53° 52' 18" E 21° 58' 22"; *Charales*. [FB-33] 262. **Garbas**, N 53° 54' 14" E 22° 9' 44"; *Charales* (d), *P. lucens* (ip), *P. perfoliatus* (ip), *M. sp.* (ip), *E. canadensis* (ip), *B. circinatum* (ip), *F. antipyrretica* (ip). 263. **Rekąty**, N 53° 55' 3" E 22° 11' 16"; *M. sp.*, *Charales* (sr), *P. perfoliatus* (sr), *C. sp.* (sr), *E. canadensis* (sr). [FB-34] 264. **Łaśmiady**, N 53° 54' 55" E 22° 17' 42"; *P. perfoliatus* (d), *Charales* (d), *Potamogeton sp. div.*, *M. sp.*, *E. canadensis*, *C. sp.* 265. **Straduńskie**, N 53° 53' 51" E 22° 19' 31"; *Charales* (d), *P. lucens*, *F. antipyrretica*, *E. canadensis*, *M. sp.* (sr), *C. sp.* (sr). 266. **Ułówiki**, N 53° 54' 60" E 22° 13' 7"; *M. sp.*, *P. perfoliatus*, *Charales*, *C. sp.* (sr), *E. canadensis* (sr), FLS: *N. alba*, *N. lutea*. 267. **Woszczelskie**, N 53° 51' 7" E 22° 14' 44"; *M. sp.*, *Potamogeton sp. div.* (a), *E. canadensis* (a), *C. sp.* (a), *Charales* (d), FLS: *S. aloides* (sr), *P. natans* (sr). 268. **Sawinda Mała** (Zawindki), N 53° 54' 22" E 22° 12' 30"; *M. sp.* (d), *Charales* (d), *C. sp.* (d), *P. perfoliatus*, *P. lucens*, FLS: *S. aloides* (sr), *N. alba* (sr), *N. lutea* (sr). [FB-35] 269. **Krzywionka**, N 53° 55' 18" E 22° 25' 35"; *H. vulgaris* (d), *Charales* (d), *P. perfoliatus* (ip), *P. lucens* (ip), *C. sp.* (ip), FLS: *P. natans*, *N. lutea*, *N. alba*. 270. **Plociczne**, N 53° 53' 52" E 22° 23' 47"; *Charales*, *M. sp.*, *C. sp.*, *P. lucens*, *B. circinatum*, FLS: *P. natans* (ip), *S. aloides* (ip), *N. alba* (ip), *N. lutea* (ip). [FB-36] 271. **Golubskie**, N 53° 52' 39" E 22° 31' 20"; *Charales* (d), *C. sp.*, *M. sp.*, *P. lucens*, FLS: *S. aloides* (ip), *N. alba* (ip), *N. lutea* (ip). 272. **Skomętno**, N 53° 50' 47" E 22° 37' 28"; *M. sp.*, *C. sp.*, *Charales*, *Potamogeton sp. div.*, *E. canadensis*. [FB-39] 273. **Białe Augustowskie**, N 53° 51' 42" E 23° 2' 53"; *Charales* (d), *E. canadensis*, *P. perfoliatus*, *Potamogeton compressus*, *F. antipyrretica*, *C. sp.* 274. **Długie Augustowskie**, N 53° 53' 12" E 23° 3' 17"; *E. canadensis*, *Charales*, (sq:) *F. antipyrretica*, *C. sp.*, *P. perfoliatus*, *Potamogeton compressus*, FLS: *P. natans*. 275. **Necko**, N 53° 51' 46" E 22° 57' 34"; *E. canadensis*, *Charales*, *P. perfoliatus*, *P. lucens*, *C. sp.* (sr), *M. sp.* (sr), FLS: *N. alba* (sr), *N. lutea* (sr), *S. aloides* (sr). 276. **Rospuda Augustowska**, N 53° 52' 32" E 22° 58' 56"; *E. canadensis*, *Charales*, *P. perfoliatus*, *P. lucens*, *C. sp.* (sr), *M. sp.* (sr), FLS: *N. alba* (sr), *N. lutea* (sr), *S. aloides* (sr). 277. **Sajno**, N 53° 49' 37" E 23° 2' 23"; [*E. canadensis* (d), *Charales* (d), *P. perfoliatus* (a)]. [FB-40] 278. **Mikolajskie**, N 53° 46' 34" E 21° 35' 46"; *E. canadensis*,

M. spicatum, *C. demersum*, *P. perfoliatus*, *P. lucens*, *Charales*, *F. antipyretica*. 279. **Luknajno**, N 53° 48' 50" E 21° 37' 39"; *Charales* (d), *M. spicatum* (a), *P. pectinatus* (a), *Potamogeton compressus* (a), *E. canadensis* (sr), *C. demersum* (sr). [FB-42] 280. **Strzelnickie**, N 53° 48' 38" E 22° 1' 54"; *Charales* (d). 281. **Orzysz** (with L. Wierzbińskie), N 53° 50' 1" E 22° 1' 31"; *E. canadensis*, *C. sp.*, *M. sp.*, *Potamogeton* sp. div., *Charales*. [FB-43] 282. **Druglin**, N 53° 48' 52" E 22° 8' 34"; *P. lucens*, *M. sp.*, *C. sp.*, *E. canadensis*, *Charales*. 283. **Kraksztyn**, N 53° 47' 59" E 22° 6' 41"; [*M. sp.*, *E. canadensis*, *Charales*, *P. lucens*, *P. perfoliatus*, FLS: *N. alba* (sr), *N. lutea* (sr)]. 284. **Rostki**, (N 53° 48' 25" E 22° 4' 9"; [FLS: *N. alba* (sr), *N. lutea* (sr), *Charales*, *C. sp.*, *E. canadensis*, *P. perfoliatus*, FLS: *N. alba* (ip), *N. lutea* (ip)]. 285. **Lipińskie**, N 53° 46' 50" E 22° 9' 22"; *M. sp.*, *C. sp.*, *P. lucens*, *E. canadensis*, *Charales*, FLS: *N. lutea* (ip), *N. alba* (ip), *S. aloides* (ip). [FB-44] 286. **Sunowo**, N 53° 49' 54" E 22° 17' 21"; *P. perfoliatus* (d), *P. lucens* (d), *E. canadensis* (d), *P. crispus*, *M. sp.*, *C. demersum*, *Charales*, FLS: *N. lutea*, *N. alba*, *P. natans*, *S. aloides*. [FB-45] 287. **Selmeł Wielki**, N 53° 49' 46" E 22° 28' 33"; *Charales*, *B. circinatum*, *P. lucens*, (la:) *E. canadensis*, *M. sp.* 288. **Regielskie** (Regiel), N 53° 47' 37" E 22° 26' 20"; *P. perfoliatus*, *P. lucens*, *E. canadensis*, *Charales*, *M. sp.*, *C. sp.* [FB-47] 289. **Biale**, N 53° 47' 33" E 22° 39' 27"; *P. lucens*, *P. perfoliatus*, *Charales*, *C. sp.*, *M. sp.* 290. **Rajgrodzkie**, N 53° 44' 34" E 22° 39' 6"; *E. canadensis*, *Charales*, *M. sp.*, *P. lucens*, *P. perfoliatus*, *B. circinatum*, *F. antipyretica*, *C. sp.* [FB-49] 291. **Kolno**, N 53° 46' 8" E 23° 1' 9"; *Charales* (d), *E. canadensis*, FLS: *N. alba*, *N. lutea*, *P. natans*, *S. aloides* (la). [FB-51] 292. **Białolawki**, N 53° 44' 8" E 21° 49' 35"; *E. canadensis*, *Charales*, *M. sp.*, *Potamogeton* sp. div. 293. **Kociol**, N 53° 43' 12" E 21° 51' 32"; *E. canadensis* (d), *Charales* (d), *Potamogeton* sp. div. 294. **Śniardwy**, N 53° 45' 27" E 21° 44' 2"; *Charales* (60% of biomass), *Charales* (d), *P. perfoliatus*, *E. canadensis*. [FB-58] 295. **Tajno**, N 53° 41' 32" E 22° 50' 59"; *M. sp.* (d), *Charales* (a), *C. sp.* (a), *E. canadensis* (a), *P. perfoliatus* (a), *P. lucens* (a), *P. crispus* (a), FLS: *N. lutea*, *N. alba*, *S. aloides*, *P. natans*. [FB-60] 296. **Jegocin**, N 53° 40' 5" E 21° 41' 13"; *E. canadensis*, *Charales*, *B. circinatum*, *Potamogeton* sp. div. [FB-64] 297. **Borowe**, N 53° 38' 39" E 22° 15' 34"; *Charales* (d), *Potamogeton* sp. div., FLS: *S. aloides*.

[GB-00] 298. **Gremzdel**, N 54° 8' 36" E 23° 10' 3"; *C. sp.*, *Charales*, *E. canadensis*, *P. perfoliatus*, *B. circinatum*, *P. crispus*, FLS: *S. aloides*, *Lemna* sp., *N. alba*, *N. lutea*. 299. **Długie Kranopolskie** (Długie Sejneńskie), N 54° 6' 32" E 23° 10' 46"; *E. canadensis* (d), *M. sp.*, *C. sp.*, *Charales*, FLS: *S. aloides* (ip). [GB-01] 300. **Sztabinki**, N 54° 7' 30" E 23° 25' 5"; *Charales*, *E. canadensis*, *F. antipyretica*, *B. circinatum*, *C. sp.* [GB-20] 301. **Gorczyckie**, N 53° 54' 18" E 23° 14' 35"; *E. canadensis*, *P. perfoliatus*, *Charales*. 302. **Serwy**, N 53° 54' 52" E 23° 12' 45"; *Charales*, *E. canadensis*, *F. antipyretica*, *P. perfoliatus*, *Potamogeton compressus*, *M. sp.* [GB-21] 303. **Paniewo**, N 53° 54' 16" E 23° 17' 44"; *Charales*, *E. canadensis*, *P. perfoliatus*, *P. lucens*, *C. sp.* [GB-22] 304. **Brożane**, N 53° 55' 44" E 23° 25' 50"; *Charales*, *P. perfoliatus*, *P. lucens*, *C. sp.*, FLS: *P. natans*, *S. aloides*, *N. alba*, *N. lutea*. 305. **Szlamy**, N 53° 54' 24" E 23° 30' 11"; *E. canadensis* (d), *Charales* (d), *M. sp.* (ip), *C. sp.* (ip), *P. lucens* (ip), FLS: *N. alba*, *S. aloides*. [GB-30] 306. **Studzieniczne**, N 53° 51' 54" E 23° 6' 52"; *E. canadensis* (d), *Charales* (d), *P. crispus*, *C. sp.*, FLS: *N. alba* (ip), *N. lutea* (ip), *S. aloides* (ip), *P. natans* (ip). [GB-31] 307. **Mikaszówek**, N 53° 53' 22" E 23° 22' 23"; *E. canadensis*, *C. sp.*, *Charales*, FLS: *N. lutea* (ip), *N. alba* (ip), *S. aloides* (c).

[GD-90] 308. **Bialskie**, N 51° 32' 7" E 23° 0' 55"; *Charales* (d), *E. canadensis* (d), *M. sp.* (d). 309. **Czarne Sosnowickie**, N 51° 30' 56" E 23° 1' 39"; *M. sp.* (d), *F. antipyretica*, *Charales*. [GE-00] 310. **Krasne**, N 51° 25' 33" E 22° 57' 33"; *Charales* (d), *E. canadensis* (d), *B. circinatum*, *M. sp.*, *C. sp.* [GE-11] 311. **Piaseczno**, N 51° 23' 3" E 23° 1' 46"; *E. canadensis*, *Charales*, *M. sp.*, *C. sp.*

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[DC-97] 312. **Górskie**, N 52° 28' 0" E 19° 40' 30"; *Charales* (a), *P. lucens* (a), *C. demersum* (a), *M. spicatum* (a), *E. canadensis*, *P. perfoliatus*, *Stuckenia pectinata*, FLS: *N. alba*, *N. lutea*, *S. aloides*, *P. amphibium*. 313. **Ciechomickie**, N 52° 28' 0" E 19° 40' 30"; (ip:) *F. antipyretica*, *B. circinatum*, (at the inflow from L. Zdworskie:) *P. perfoliatus*, *P. lucens*, *C. demersum*, *M. spicatum*, *Sagittaria sagittifolia*, *Chara globularis* (a few tufts at a depth of 5-20 cm).