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ECOLOGICAL STATE OF LAKE DUROWSKIE

ALGAE ASSESSMENT

23th June – 7th July 2019

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Abstract

Lake Durowskie is a lake situated in Wągrowiec, on Northwestern Poland. It is an eutrophic lake and this situation is due to surface runoffs from agricultural fields that utilize pesticides, inorganic fertilizers, herbicides and other anthropogenic sources. The Lake serves as a deposit point for four other lakes and this also contributes to the levels of contamination in the lake. In 2009, started a collaboration beetwen the universities and the local government for rehabilitation of lake using three different methods: oxygenation of hypolimnic waters with two mechanical wind aerators, phosphorus immobilization with iron treatment and biomanipulation measures – stocking in the lake pike fingerlings. The last method was less effective. Every year, from 2009, a summer school is revealed to monitor the lake’s progress.

Algae are a good indicator of the ecological state of lake thanks to the high diversity of species. Algae are sensitive indicators for physical-chemical properties and they are very important in the food web. In this study, samples were collected for both periphyton and phytoplankton in 12 different sites around the lake. From the samples, identification of species was carried out and data was compiled to perform specific indices and calculations.

Although it is possible to notice that the results from the research conducted on phytoplankton and periphyton indicate a eutrophic status of the lake, our analysis show that biodiversity is increasing and there is the presence of mesotrophic areas, implying that the quality of the water is actually better from the last year. The results are satisfying, but there is a need of improving the management plan for lake Durowskie and including the whole system of lakes in the northern part in order to maintain a stable environment.

Introduction

Wągrowiec is a small town located on the Northwestern region of Poland, which is about 50km from Poznan. It has a total land area of 17.91 km^2 and a population of about 30000 people. The town is known for its five interconnected lakes: Laskowickie, Grylewskie, Bukowieckie, Kobyleckie and Durowskie, and Struga Gołaniecka River flows through them and interconnects them. The main lake that is a concern for the municipality is Durowskie Lake due to its attraction for tourism and recreational use.

Durowskie is a postglacial lake, its surface is 143.7 ha and the maximum depth is 14.6 m. When the interest on this lake began, it was strongly eutrophic with cyanobacterial water blooms. The lake's pollution is mainly due to industrial agriculture and domestic drains, infact the lake is surrounded by buildings and some agricultural fields. Surface runoffs from agriculture pollute the lake with mostly nitrogen (N), phosphorus (P) and potassium (K) through mainly fertilizers and pesticides. The level of pollution in Durowskie Lake, the last of the lake series, is in part due to the other four interconnected lakes, the waters of which then flow into this lake causing an important accumulation. Anthropogenic activity like recreational activities and sewage waste from houses also contribute significantly to the state of the lake as it has a negative impact on the quality of the water.

Researches and restoration measures started in 2009 and have the intent to restore the ecological state of the waters.

The restoration measures tested to improve the quality of the lake are three: the oxygenation of hypolimnic water using two mechanic aerators permanently located in two different points of the lake, they move thanks to the wind; the phosphorus immobilization in the sediments through adding iron ions (Fe^{2+}); and the biomanipulation through the storage of pike in the lake. The pikes infact are high predators fish and they feed on zooplankton predators, storage therefore allows the increase of the zooplankton and consequently the decrease of phytoplankton. Currently, the latter method was less effective than the others.

Every summer, during the international summer school, is monitored if the restoration measures in place have improved the quality of the lake and views trends of the ecological state. This research helps aid decision making of restoration and management of Lake Durowskie. The research considers different aspects in the lake, biological ones such as algae, macrophytes and macroinvertebrates, and chemical-phisical ones.

Algae are a good indicator for the quality of water thanks to different reasons. First at all, the algae are primary producers and control the whole food web so any shifts in species can cause effects in higher trophic levels through feeding relationships, population growth or overall structure (McCormick, 1994); the algae then present a strong biodiversity and the presence of one or the other family is rappresentative of the ecological state of lakes; moreover algae, with their coloring, change the transparency of water and decrease the depth of light. Therefore, algae are important in assessing the overall ecological state in lakes.

This report focuses on different aspects the algal communities, periphyton and phytoplankton. Through algae density, biomass, diversity, distribution and the relationship to water quality through oxygen, pH, and trophic level, the ecological state can be determined for Lake Durowskie. Comparative data analysis from 2008 to 2019 is another objective of this study to find progress of restoration efforts of the lake.

Materials and Methods

Study area

The study was conducted in Lake Durowskie between 24 and 29 July 2019. The Lake is situated in situated in central part of Poland, in the town Wągrowiec. The geographic coordinates of Lake Durowskie are 52° N 49’ 06” and 17° E 12’ 01”.

Table 1. Morphometry of the Lake Durowskie and its catchment area

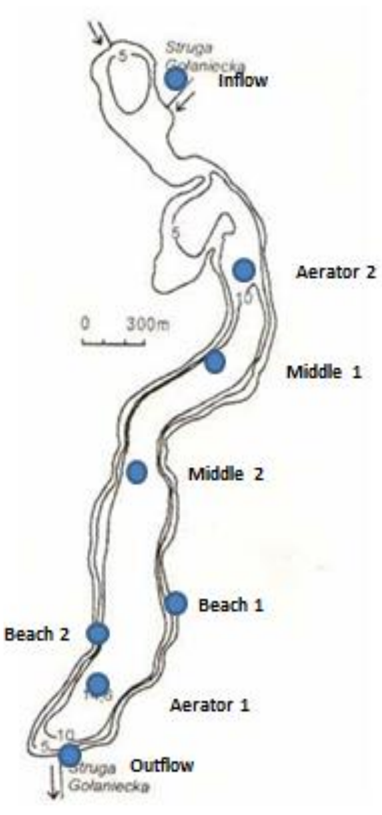
Morphometric Parameters	**Values**
Surface Area	143.7 ha
Volume	11322900 m^3
Maximum depth	14.6 m
Average depth	7.9 m
Total catchment area	236.1 km^2
Direct catchment area	1581.3 ha
Agricultural Land use	58.26 %
Forest Land use	33.52 %
Urban Land use	8.25 %

Methods

For phytoplankton analysis water were collected from eight stations across the Durowskie Lake. From the surface water at Inflow, beach 1 and 2, outflow; and from 0, 1,2 and 3 meters depth in all middle and aerator stations. Water sampler was used to collect samples. The samples (30L) were filtred using a plankton net to analyze. The samples were preserved immediatelywith Lugol's solution. Taxonomical analysis was performed during the same day of sampling.

Periphyton samples were collected from 12 sites along the shore. From each stations material was scratched using a brush from two stones from the bank of the lake. The samples were conserved using Lugol solution and the species were identified in the laboratory.

During all sampling period the presence of red algae *Hildebrandia rivularis* along the shoreline was observed.



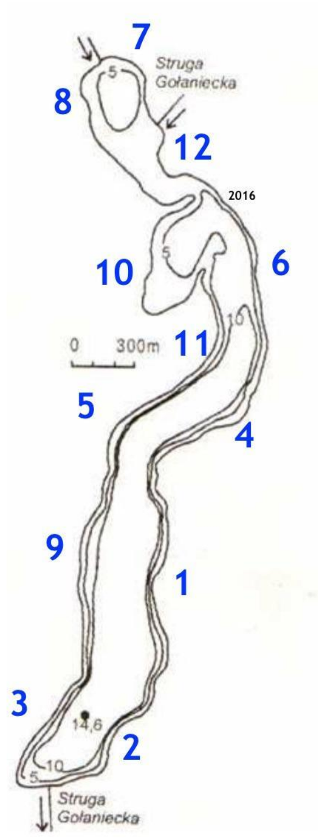


Figure 1. Phytoplankton sampling sites

Figure 2. Periphyton sampling sites

The individual samples were analyzed under a light microscope in the laboratory. Species were identified and the biomass of each of them was calculated. For a quantitative assesment the number of individuals was counted in 100 cells counting chamber of 0.0125mm3 each. (randomly selected fields inside the slide). Then the biomass of each species was calculated. The number of each species was multiplied by the volume of one cell. Data was expressed in mg x l^{-1}.

The phytoplankton data was used to calculate Mixed Index, Jaccard Index, Diversity Index and PMPL Index, while the distribution of red algae and determination of the diatom index was done using periphyton data.

Trophic status of the lake was estimated using the mixed index of Nygaard. The Jaccard Index was used to compare the similarity and diversity of the number of species between the years (2008-2019). In order to measure evenness and diversity of the species between different sites Shannon-Wiener and Evenness Indices were used. Van Dam’s ecological indicator values were used to estimate oxygen saturation, trophy and alkalinity in lake Durowskie. The diatom index was used to estimate the ecological state of the lake.

Result and discussion
Phytoplankton
Number of species

In total, 77 phytoplankton species were identified during laboratory studies (Fig.3). The number of species in 2019 is at the same level as the last 5 years (Annex 1).

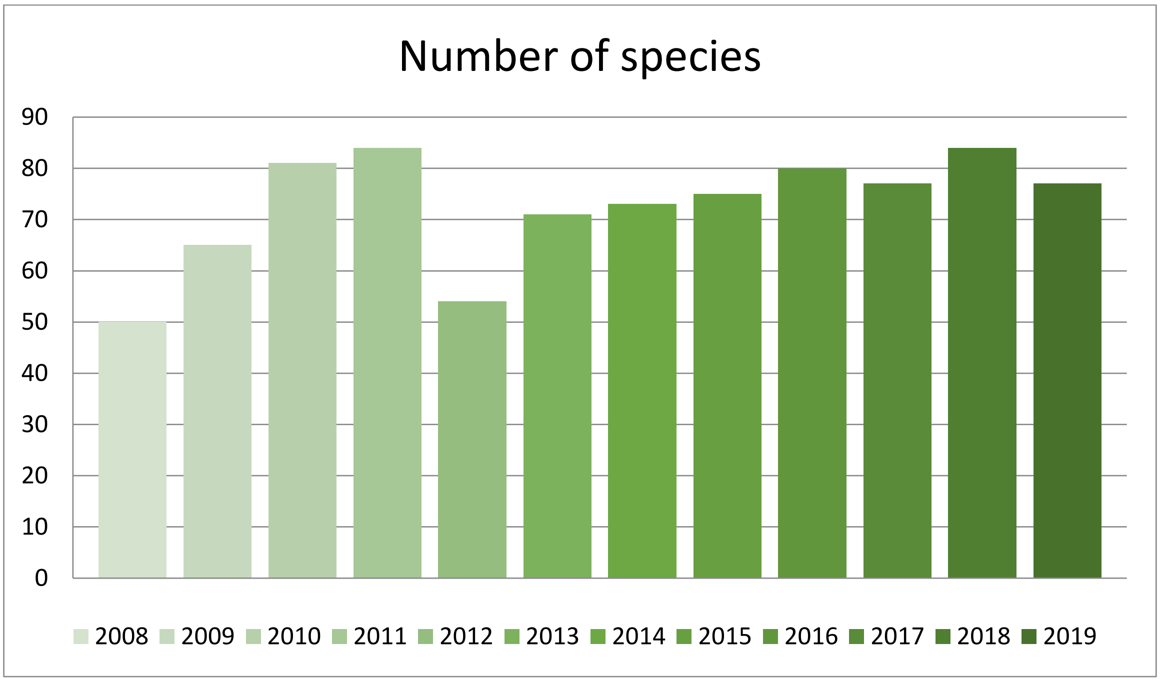


Figure 3. Total number of phytoplankton species in 2008-2019.

According to the results of the study of water samples, the total number of phytoplankton species differed between sites (Fig.4). Was noted that in the inflow the number of species is more than in the other sites, and the lowest number was found in the outflow and on the beach 1. In the other study sites, approximately the same number of species.

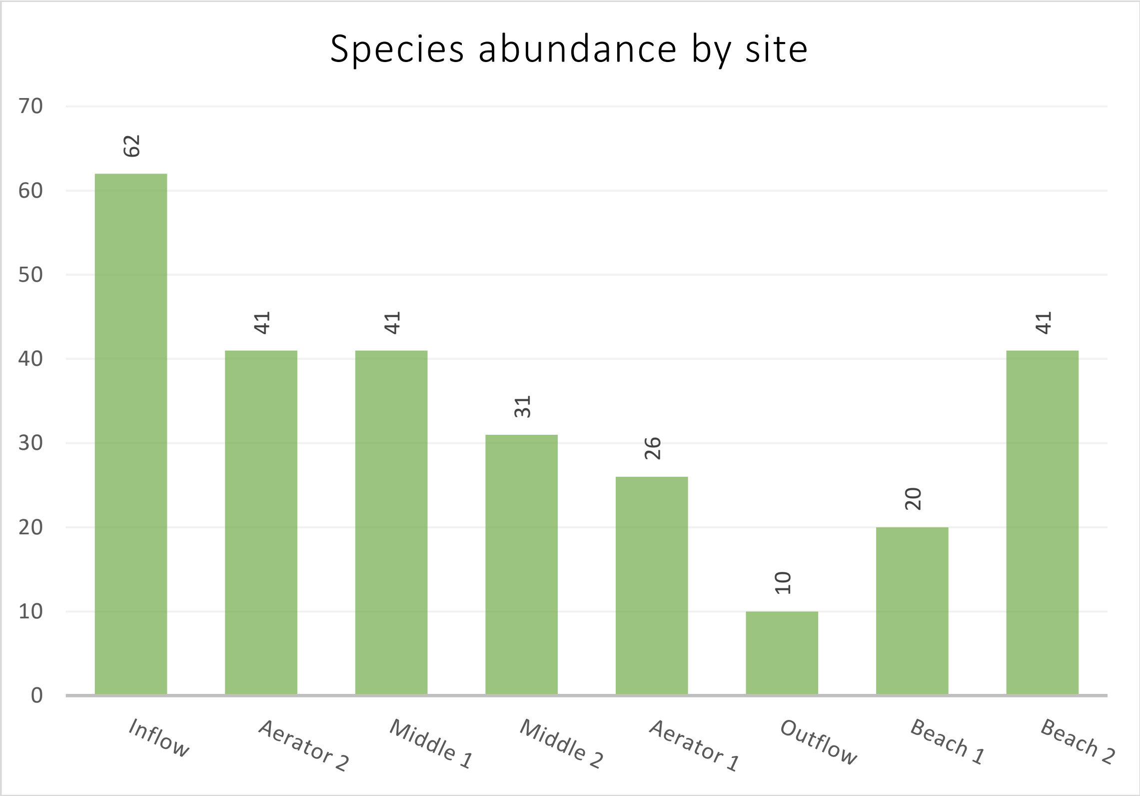


Figure 4. Species abundance of Phytoplankton at each site.

Dominance of Algae Groups

Chrysophyceae was a dominant group of algae in all station (Fig. 5). The most abundant species in all study sites, except for the inflow, was *Dinobryon divergens* Imhof. At the inflow, the dominant species were *Erkenia subaequiciliata* Skuja (Chrysophyceae) - 38% and *Limnothrix redekei* (Van Goor) Meffert (Cyanoprokaryota) - 35% (Table 2). The reason for the high abundance at the inflow is due to Cyanobacterias preference for nutrient-rich water. Phosphourus and nitrogen flow with the Struga Gołaniecka stream from Lake Kobyleckie, which is located above Lake Durowskie and is very rich in nutrients.

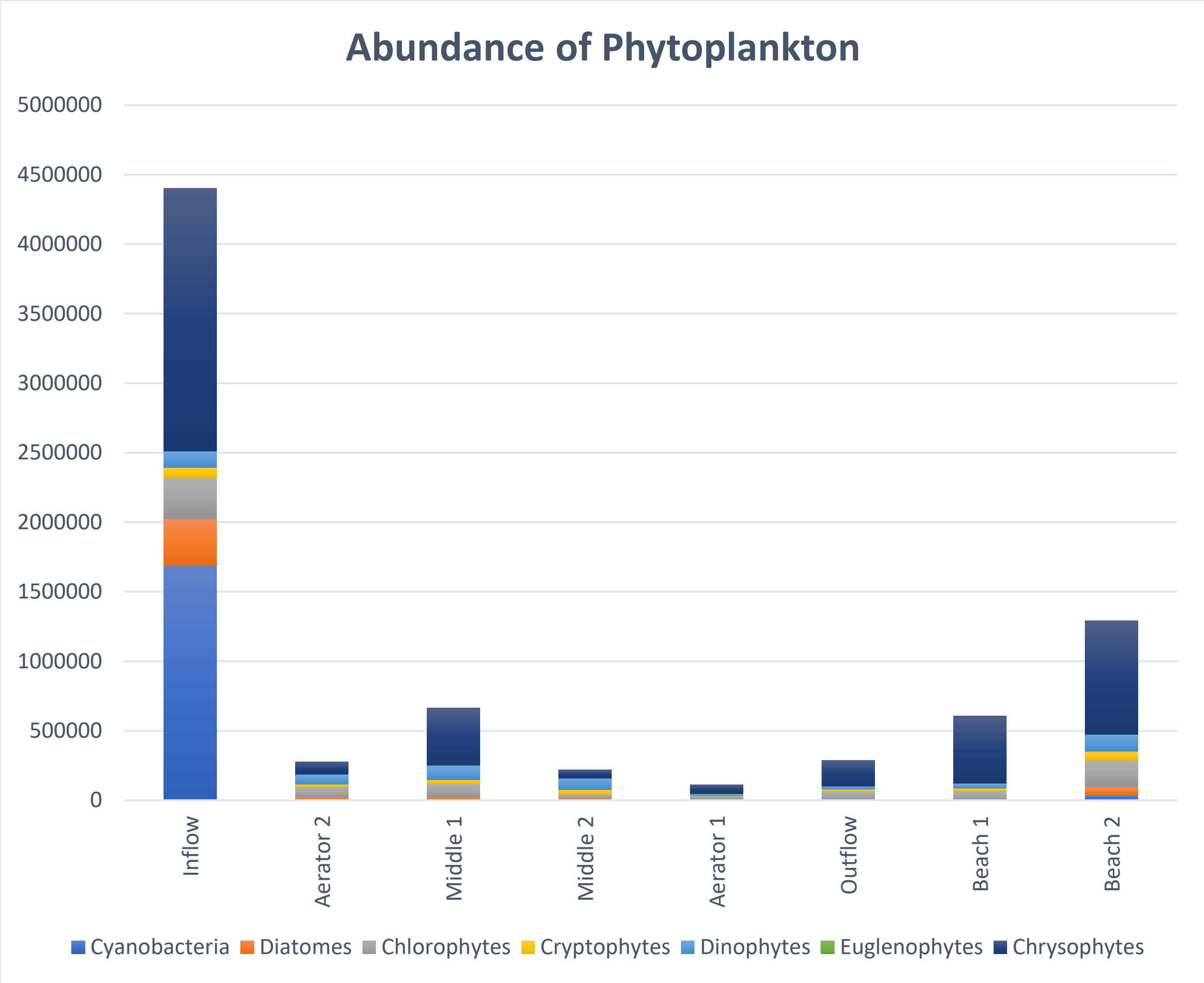


Figure 5. Phytoplankton group abundance for each site

Table 2. Dominants for phytoplankton according to cell number

	Inflow	Aerator 2	Middle 2	Middle 1	Aerator 1	Outflow	Beach 1	Beach 2
Dinobryon divergens Imhof	0%	27%	25%	56%	32%	65%	79%	59%
Sphaerocystis planctonica (Korsikov) Bourrelly	0%	11%	0%	13%	39%	13%	0%	0%
Erkenia subaequiciliata Skuja	38%	0%	0%	0%	0%	0%	0%	0%
Limnothrix redekei (Van Goor) Meffert	35%	0%	0%	0%	0%	0%	0%	0%
Peridiniopsis cuningtonii Lemm.	0%	0%	23%	0%	0%	0%	0%	0%
Cryptomonas erosa Ehrenberg	0%	0%	20%	0%	0%	0%	0%	0%

Coelastrum astroideum De Notaris	0%	0%	0%	0%	21%	0%	0%	0%
Tetraedron minimum (A. Br.) Hansgirg	0%	10%	0%	0%	0%	0%	0%	0%

Biomass of Algae Groups

Biomass was calculated for each group of algae selected at each study site. According to biomass, the most numerical group was Dinophytes (Table 3). As can be seen from the Figure 5 i Figure 6, high abundance no necessarily reflected in high biomass. Dinophytes which were not very noticeable as individuals, contributed significantly to the total biomass of phytoplankton in different sites. This is caused by the large cells of this group of Algae (Annex 3). On the other hand, Chrysophyceae are very numerous as individuals, but after conversion of the number into biomass their significance was reduced. This can be explained by the small biomass of cells.

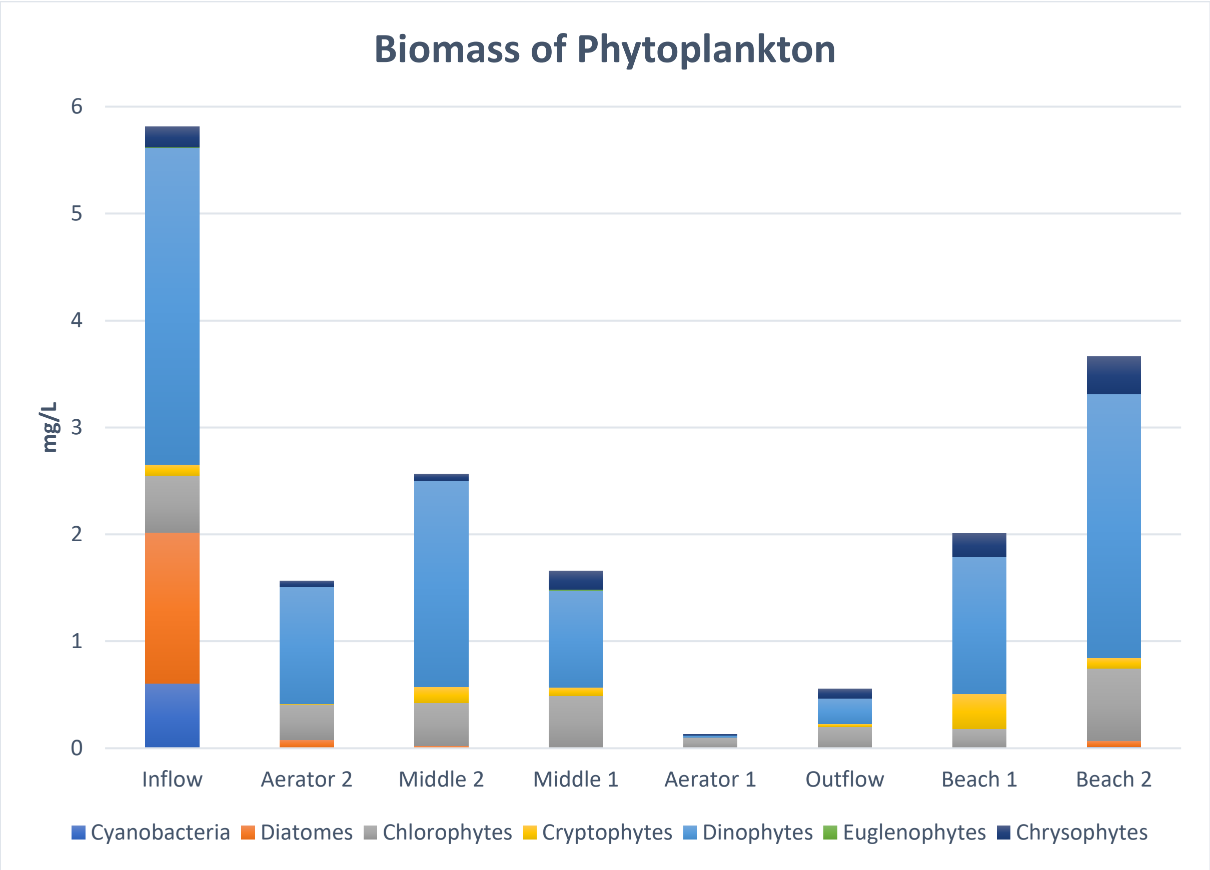


Figure 6. Phytoplankton group biomass for each site

Table 3. Dominants for phytoplankton according to biomass

	Inflow	Aerator 2	Middle 2	Middle 1	Aerator 1	Outflow	Beach 1	Beach 2
Peridinium cinctum (O.F. Müller) Ehrenberg	25%	14%	22%	13%	15%	0%	11%	26%
Peridiniopsis cuningtonii Lemm.	0%	29%	47%	23%	0%	43%	15%	21%
Ceratium hirundinella (F. B. Müller) Bergh	17%	10%	0%	0%	0%	0%	38%	17%
Sphaerocystis planctonica (Korsikov) Bourrelly	0%	0%	0%	12%	34%	15%	0%	0%
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	0%	13%	0%	14%	0%	0%	0%	0%
Coelastrum reticulatum (Dang.) Senn	0%	0%	0%	11%	0%	15%	0%	0%
Coelastrum astroideum De Notaris	0%	0%	0%	0%	25%	0%	0%	0%
Pediastrum boryanum (Turpin) Meneg.	0%	0%	0%	0%	18%	0%	0%	0%
Cryptomonas erosa Ehrenberg	0%	0%	0%	0%	0%	0%	16%	0%
Dinobryon divergens Imhof	0%	0%	0%	10%	0%	16%	11%	0%

Jaccard Index

Jaccard Index is a statistic used for gauging the similarity and diversity of sample sets. The table presents the results of the Jaccard Index and indicates how many species in percent are distributed in previous years. In accordance with this, it is possible to see that 48% of the species from 2018 reappeared in 2019 (Table 4).

Table 4. Jaccard Index from 2008 to 2019

YEAR	2009	2010	2011	2012	2013	2-014	2015	2-016	2017	2018	2019
2008	84	51	43	33	40	52	82	35	40	36	46
2009	-	48	28	20	29	35	39	13	34	31	29
2010	-	-	42	42	62	47	37	35	38	41	46
2011	-	-	-	34	58	47	50	40	38	48	42
2012	-	-	-	-	77	49	59	47	38	39	42
2013	-	-	-	-	-	52	78	45	46	45	51
2014	-	-	-	-	-	-	57	40	48	48	58
2015	-	-	-	-	-	-	-	43	47	50	57
2016	-	-	-	-	-	-	-	-	42	52	44
2017	-	-	-	-	-	-	-	-	-	52	54
2018	-	-	-	-	-	-	-	-	-	-	48

Nygaard's Mixed Index

According to the Nygaard's Mixed Index, which represents the trophic conditions of Lake Durowskie, most stations were in a eutrophic state (Table 5).

During the calculation of this index, two indicators were taken into account. The first one is the number of the species of algae connected with the eutrophic water. The second is the number of species of Desmidia, wich are connected with clean waters. Nygaard's index is proportion of this two groups. Based on this ratio, the quality of water is determined. In comparison to last year, the index improved in most stables.

The reason was that in May this year the biomanipulation was made. The group of young predatory fish: pike and perch was relase into the water. They ate the young planktoeater fish, so the zooplankton can grow. The species of big zooplankton (Cladocera, Copepoda) ate the small species of phytoplankton, that why did not find them in our samples. Only large species of phytoplankton were left, colony forms (like Dinobryon, Coleastrum) or species with big cell walls (Phatocus, Peridinium – Dinoflagellata).

Table 5. Mixed index of Nygaard from 2009 to 2019

Station	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inflow	-	1.8	17	9	19	3.8	17	7	9	7	8.7
Aerator 2	26	11.5	5	8	14	20	4.3	12	8	8	3.8
Middle 1	9	12.5	13	3	5.5	11	4.8	7.7	6	4.8	2.8
Middle 2	-	8.3	18	9	7.5	20	4	8.5	6	5	4
Beach 1	-	-	3	9	7	5	5.5	-	3	3	3
Beach 2	-	-	-	5	6	10	12	-	5	5	2.5
Areator 2	16	8.3	9	7	8	9	6.7	-	7	5	4
Outflow	-	6.5	5	-	12	8	8	14	5	4	4

Legend:

Dystrophy	0.0 – 0.2
Oligotrophy	0.2 – 1.0
Mesotrophy	1.0 – 3.0
Eutrophy	3.0 – 5.0
Hypertrophy	5.0 – 43.0

Evenness and Shannon-Weaver Index

They are two indexes used to determine biodiversity. The maximal value of Shannon index is 5. And for Eveness is 1. The higher the value, the greater the biodiversity. In most sites the value is similar. We see that there is no dominance of one species (for example Cyanobacteria).

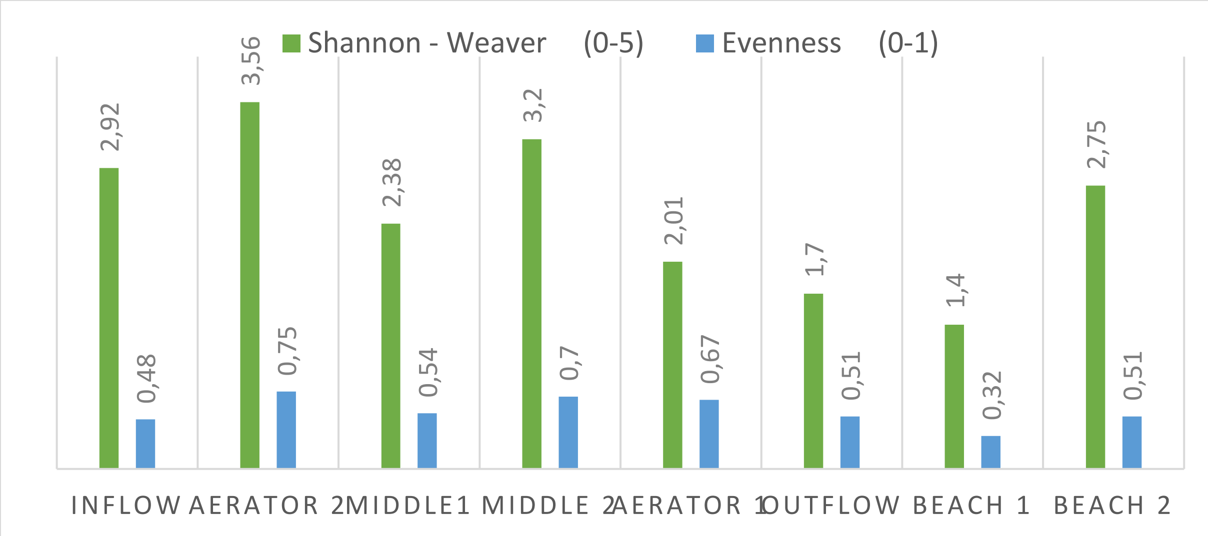


Figure 7. Phytoplankton diversity indices at each site

Phytoplankton method for Polish Lakes

PMPL is an indicator used in Poland. It is used to determine the ecological status of waters. The average is made in the vertical profile in the epilimnion. Three things are taken into account: the biomass of phytoplankton, how many cyanobacteria there are in this biomass and the concentration of Chlorophyll a. Based on this indicator, we can determine the state of waters as moderate.

The important thing that there are no cyanobacteria in the lake, which indicates that the reclamation treatments are effective. At such high temperatures as there were in this year, blooms of cyanobacteria could occur and they are not there.

Table 6. PMPL index from 2016 to 2019

	Inflow	A2	M1	M2	A1	Outflow
2019	3.46	2.81	2.67	2.63	2.58	2.52
2018	3.32	2.8	2.79	2.78	2.61	2.63
2017	3.4	2.74	2.78	2.78	2.78	2.5
2016	3.7	2.78	2.76	2.76	2.67	2.53

Legend:

Ecological status	PMPL
Very good	0.0 – 1.0
Good	1.01 – 2.0
Moderate	2.01 – 3.0
Poor	3.01 – 4.0
Bad	4.01 – 5.0

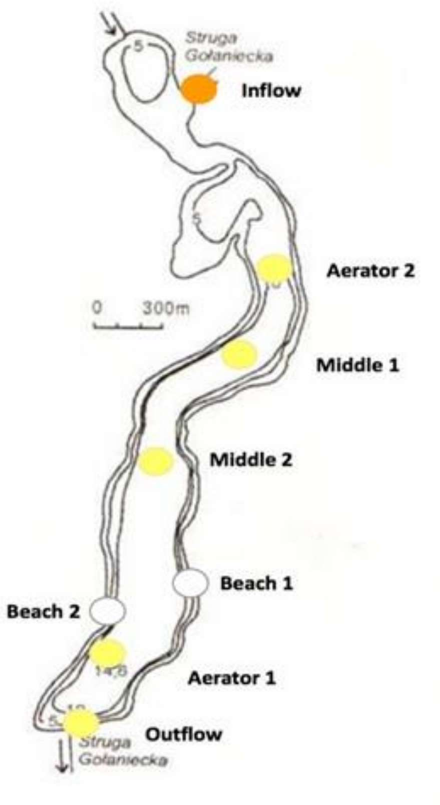


Figure 8. PMPL index in 2019

Periphyton

Periphyton is a complex community of algae, cyanobacteria, heterotrophic microbes, and detritus that is attached to submerged surfaces in most aquatic ecosystems. Periphyton covers most submerged substrates, ranging from sand to macrophytes to rock. (J.A. Peters, D.M. Lodge, 2009). In oligotrophic lakes, even those with few macrophytes for periphyton to grow on, periphyton can be an important component of whole-lake primary production. In eutrophic lakes, however, phytoplankton is more abundant and shading by phytoplankton reduces periphyton and macrophyte abundance. Periphyton is a common food source for invertebrates and some amphibians. (J.A. Peters, D.M. Lodge, 2009).

Diatom, (class Bacillariophyceae), any member of the algal class Bacillariophyceae (division Chromophyta), with about 16,000 species found in sediments or attached to solid substances in all the waters of Earth. Diatoms are among the most important and prolific microscopic sea organisms and serve directly or indirectly as food for many animals. Diatoms are unicellular eukaryotes with nano-patterned silica cell walls and they contribute about 20% of global primary production. (Thomas Mock, Linda K. Medlin, 2012).

The map below (Fig.9) shows the diatom index calculated in 2019 the comparison of the period from 2016 to 2019. The situation is variable but not optimal with stable points (eight on twelve) and worsening points (four on twelve). The values settle between moderate and bad state. The worse point is the number 1, situated in south-east part of lake, with a value of 0.12.

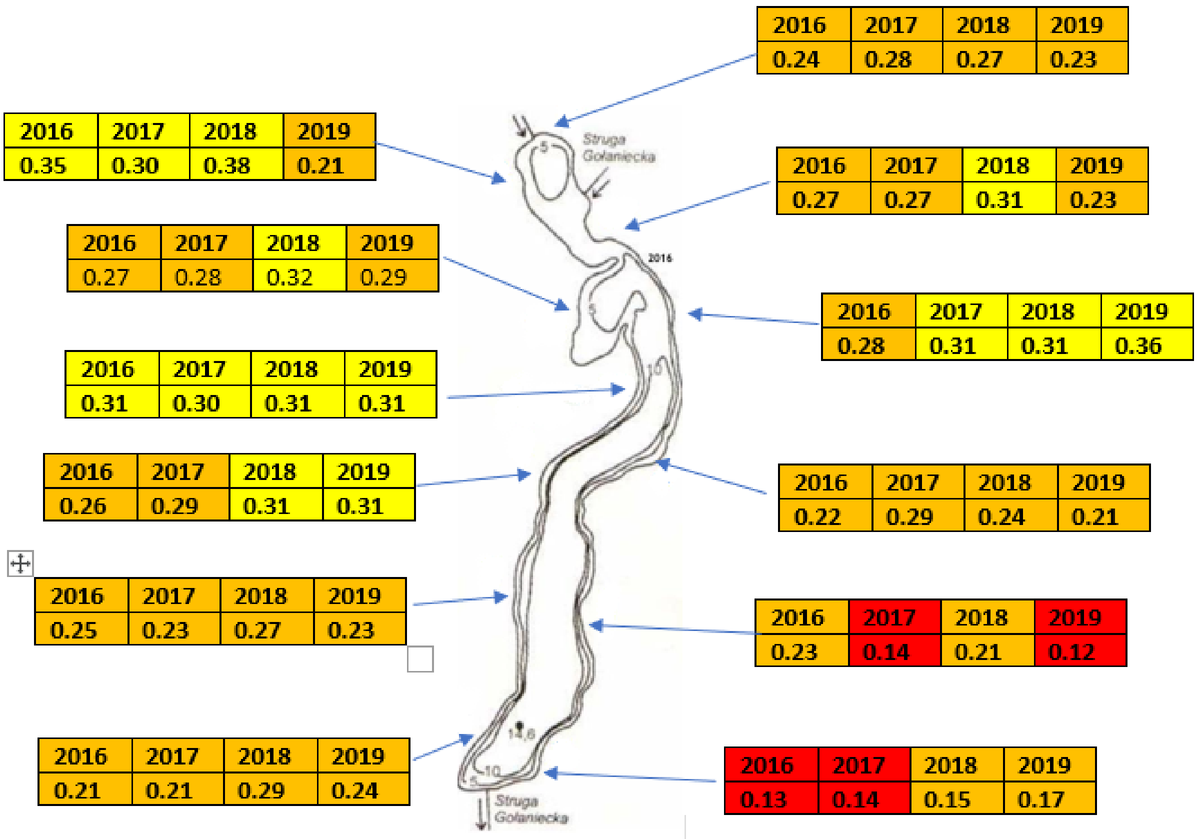


Figure 9. Map Periphyton Diatom Index from 2016 to 2019

Hildenbrandia rivularis (Liebm.) belongs to the family of phyllum Rhodophyta. It forms red, hard crust looking like patches on stone substrata. Due to its color it is called as a red algae.

It is epilithic species in flowing waters with fast currents but also occurs in standing water. It is adapted to low light thus it occurs in shadow places or deep water to avoid too bright light. It tends to aggregate in wavy zones and stony grounds. Hildenbrandia prefers alkaline water and hard, calcareous water. The species is indicator for oligosaprobic zone. (Eloranta&Kwandrans, 2007). It occurs right across the nutrient gradient, in eutrophic waters but probably more important than the nutrient concentration per se is the presence of stable substrata (Kelly&King, 2007) and oxygen saturated waters.

This species is situated on the Red List of threatened algae in Poland, as a vulnerable plant.Hildenbrandia rivularis is known in Poland from seldom stands with small quantities (Żelazna-Wieczorek&Ziułkiewicz, 2008).

In Durowskie Lake it occurs along shoreline in shallow water, especially in the south-eastern part. This places have constant conditions of good oxygenated water. The dominant wind direction in this area is from the west, this creates constant wave erosion and oxygenation of the water in the east region. The high motorboat acitivity could be the second factor of abundance the species in this area. The presence of the trees near the shoreline is the last factor causing the appearance of the red algae.

The presence of this Hildenbrandia rivularis in Durowskie Lake keep stable in the same

positions in comparison with 2018 year. Additionally, it grows in more stones in this positions (Fig.10).

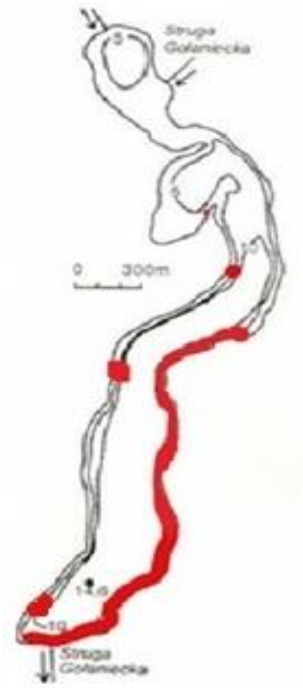


Figure 10. Map of red algae distribution in 2018/2019

The table 7 shows the dominant diatoms in periphyton community, in percentage on the total, across the twelve sites where samples were taken. In each site are shown only the five more dominant species. It can be noted that the most dominant species at all is *Achnanthes minutissima* (Kützing), it is present in 10 sites on 12 and has the highest percentages.

Achnanthes minutissima Kützing is a species with the ecological amplitude very broad, therefore it can easily adapt to any trophic condition. This is probably the reason why it was abundant in the majority of the sites. However, it requires high oxygen saturation (>75%) and circumneutral pH (van Dam et al, 1994). As a pioneer it can form massive associations, specifically on plant substrates in lake littorals.

Table 7. Dominant diatoms in periphyton community (%) in Lake Durowskie in June 2019

Taxon	site 1	site 2	site 3	site 4	site 5	site 6	site 7	site 8	site 9	site 10	site 11	site 12
Achnanthes conspicua Mayer	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Achnanthes minutissima Kützing	29,00%	16,00%	17,00%	14,00%	12.00%	8,00%	7.17%	26,09%	7,26%	0,00%	0,00%	7,60%
Fragilaria crotonensis Kitton	0,00%	0,00%	0,00%	0,00%	3.00%	0,00%	5,63%	0,00%	0,00%	0,00%	0,00%	0,00%
Cymbella affinis Kützing	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	10,50%	0,00%	0,00%
Cymbella minuta	4,00%	0,00%	0,00%	0,00%	6.00%	13,00%	6,27%	4,30%	0,00%	0,00%	0,00%	0,00%
Fragilaria ulna (Nitzsch) Lange-Bertalot	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Cocconeis pediculus	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	5,69%	0,00%	0,00%	0,00%
Cocconeis placentula Ehr.	0,00%	6,00%	11,00%	0,00%	0,00%	6,00%	0,00%	0,00%	6,02%	0,00%	10,36%	0,00%
Amphora pediculus (Kütz.) Grunow	4,00%	6,00%	7,00%	0,00%	0,00%	0,00%	0,00%	0,00%	5,42%	0,00%	0,00%	0,00%
Fragilaria capucina (Desm.) Rabenhorst	4,00%	0,00%	0,00%	5,00%	0,00%	0,00%	8,04%	4,61%	0,00%	0,00%	0,00%	7,20%
Fragilaria pinnata	0,00%	0,00%	0,00%	5,00%	0,00%	6,00%	0,00%	0,00%	0,00%	0,00%	0,00%	4,80%
Meridion circulare	0,00%	0,00%	6,00%	6,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Gomphonema olivaceum	0,00%	0,00%	0,00%	0,00%	10.00%	0,00%	0,00%	0,00%	10,66%	14,40%	0,00%	8,10%
Gomphonema olivaceoides	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Gomphonema parvulum	0,00%	5,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	4,30%	0,00%	0,00%
Cyclotella radiosa	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	5,43%	0,00%
Achnathes minutisima var. affinis	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Cocconeis placentula v. pseudolinesta	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Achnanthes exigua	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	6,96%	0,00%
Fragilaria exigua	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	5,99%	0,00%
Achnathes minutisima var. affinis	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Fragilaria crotonensis	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	5,99%	0,00%
Cyclotella ocellata Pant.	0,00%	0,00%	0,00%	18%	8.00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	5,00%
Amphora ovalis Kützing	0,00%	7,00%	6,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Cymbella microcephala Grun.	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	4,06%	0,00%	6,70%	0,00%	0,00%
Navicula capitata Patrick in Patrick & Reimer	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Navicula radiosa Kützing	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Diatoma vulgaris	3%	0,00%	0,00%	0,00%	0,00%	0,00%	7,24%	3,82%	0,00%	0,00%	0,00%	0,00%
Cymbella tumida	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Cocconeis placentula var. pseudolineata	0,00%	0,00%	0,00%	0,00%	0,00%	6,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%

Figure 11 presents in the lake's map, in each tested site, the percentage of periphyton species that prefer different concentrations of oxygen. It's possible to notice that in every sites the highest percentage is of the species that prefer high oxygen (75-100%). The dominance of species that like well-oxygenated waters indicates that the waters are well oxygenated. Over 50% for all over the whole year.

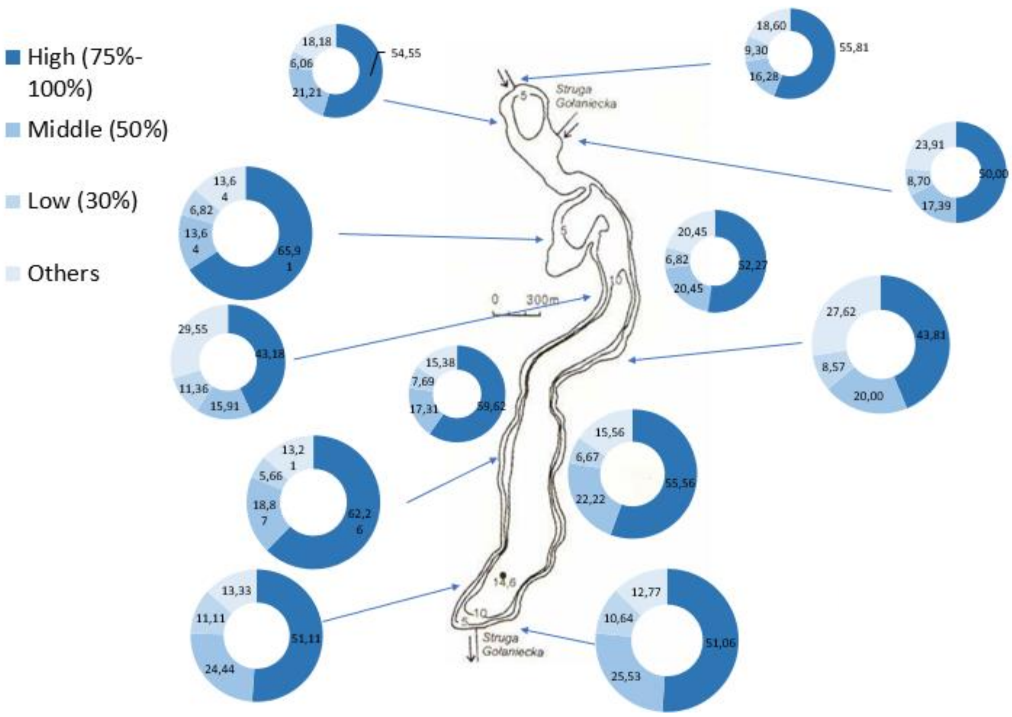


Figure 11. Periphyton species O_2 preference map

Figure 12 shows the various trophic states of the water and species abundance in these various states in percentages. The result indicates the eutrophic state majority of the Lake

Durowskie but unfortunatel also the hypertrophic state remains important. However there are also mesotrophic species that appeared and this indicates that the reclamation is good.

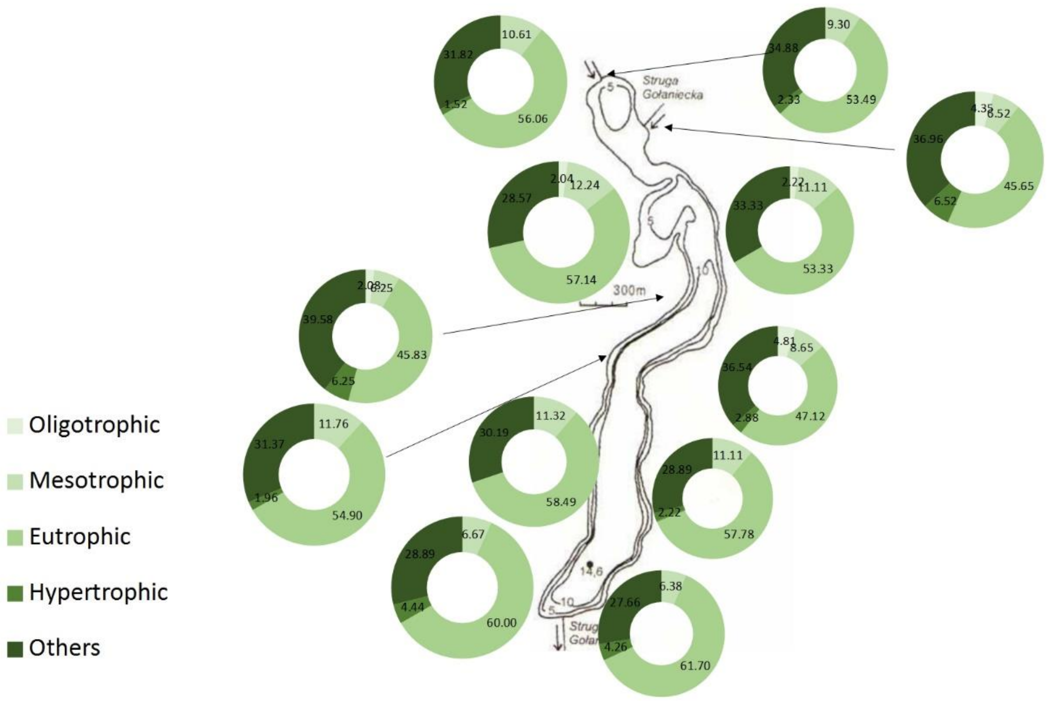


Figure 12. Periphyton trophic preference for each site

Regarding the periphyton pH preference, the map below shows that the major periphyton species are alkaliphilous, so they prefer pH greater of 7. This situation is normal in case of eutrophic waters. It followed by circumneutral and finally by acidophilous with very low percentuage. The situation is similar across the lake.

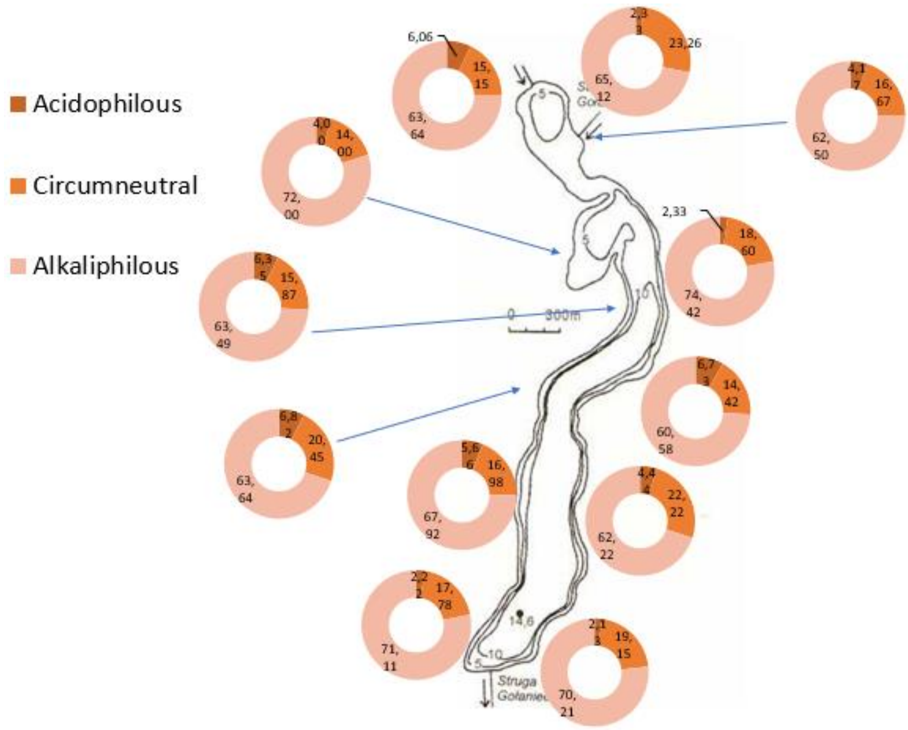


Figure 13. Periphyton pH preference for each site

Conclusion

1. Stocking of predatory fishes in 2019 caused the dominance of large forms of phytoplankton: colonies and thick cell walls (they are not grazed by the zooplankton)
2. The change in the species structure of phytoplankton is reflected in the improvement of the water trophy index (Nygaard composite factor).
3. Despite unfavorable weather conditions, there are no cyanobacteria in the lake's waters, which indicates the effectiveness of restoration
4. This year internal loading is clearly visible
5. The middle part of the lake has a moderate water level. The northern part is in a worse condition, it is connected with the influence of the Gołaniecka Stream and anthropopressure associated with buildings

Recommendations

Beginning of the restoration of Lake Kobyleckie. Otherwise, Struga Gołaniecka will constantly supply the Lake Durowskie with cyanobacteria.

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Annexes

Annex 1. Comparison of phytoplankton species composition in different investigated years in June/July in Lake Durowskie

Phytoplankton taxa	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
***Cyanoprokaryota* – cyanobacteria**												
Anabaena affinis Lemm.	.	.	.	.	.	.	+	.	+	.	.	.
Anabaena flos-aquae Brebisson	.	+	.	.	.	+	.	.	+	+	.	+
Aphanizomenon aphanizomenoides (Forti) Hort. & Kom.	+	.	.	.	+	.	.	.	.	.	.	.
Aphanizomenon flos-aquae (L.) Ralfs	+	+	+	+	.	.	+	+	.	+	+	+
Aphanizomenon gracile Lemmerman	+	.	.	.	.	.	.	.	.	.	.	.
Aphanizomenon isatschenkoi (Usacc.) Pros. - Lavrenko	+	+	+	.	.	.	.	.	.	.	.	.
Aphanocapsa grevillei (Ber.) Rabenhorst	.	+	.	.	.	.	.	.	.	.	.	.
Aphanocapsa incerta (Lemm.) Cronberg et Komarek	+	+	+	.	.	+	.	.	.	+	+	.
Arthrospira massartii Kuff.	.	+	.	.	.	.	.	.	.	.	.	.
Chroococcus limneticus Lemm.	+	+	.	+	.	.	.	.	.	+	.	.
Chroococcus turgidus (Kűtz.) Naeg.	.	+	.	+	.	.	+	+	.	+	+	.
Cyanogranis feruginea (Wawrik) Hind.	.	+	+	.	.	.	.	.	.	.	.	.
Gloeocapsa minuta Lemm.	.	.	.	.	.	.	+	.	.	+	.	.
Jaaginema pseudogeminatum (Schmid) Anagn. et Kom.	.	.	+	+	.	.	.	.	.	.	.	.
Limnothrix lauterbornii(Schmidle) Anagn.	.	+	.	.	.	.	.	.	.	.	.	.
Limnothrix redekei (Van Goor) Meffert	+	.	+	+	+	+	+	+	+	+	+	+
Lyngbya hieronymusii Lemm.	.	+	.	.	.	.	.	+	.	.	.	.

Merismopedia punctate Meyen	.	.	.	.	.	.	.	.	.	.	+	.
Microcystis aeruginosa Kützing	+	.	.	+	+	+	+	+	+	+	+	+
Microcystis flos-aquae (Wittrock) Kirchner	.	.	+	.	.	+	.	.	.	.	.	.
Microcystis wesebergii (Kom) Kom. ex Kom.	.	.	.	.	.	.	.	.	.	.	+	.
Jaaginema gracils (Bocher) Anagn. et kom.	.	+	.	.	.	.	.	+	.	.	.	.
Phormidium granulatum Gardn. Anagn.	+	+	+	.	+	.	.	.	.	.	.	.
Phormidium tenue (Agards ex Gomont) Anagn. et kom.	.	+	.	.	.	.	.	.	.	+	.	.
Phormidium autumnale Gomont	.	.	.	.	.	.	.	.	+	+	.	.
Planktolyngbya limnetica (Lemm.) Kom. – Legn. Et Cronenberg	.	+	+	+	+	+	+	+	+	+	+	+
Planktothrix agardhii (D.C. ex Gom.) Anagn. et Kom.	+	+	+	+	+	+	+	+	+	+	+	+
Pseudanabaena limnetica (Lemm.) Kom.	+	+	+	.	.	.	+	+	.	+	.	+
Woronichina naegeliana (Unger)Elenkin	.	.	.	.	.	.	.	+	+	+	+	.
Spirulina laxissima (W. West)	.	.	+	.	.	.	.	.	.	.	.	.
Spirulina maior Kütz.	.	.	.	.	+	.	.	.	.	.	.	.
Oscillatoria grossegranulata Skuja	.	.	.	.	.	+	.	.	.	.	.	.
Bacillariophyceae – diatoms												
Achnanthes exigua Grun.	.		+	.	.	.	.	.	.	.	.	+
Achnanthes minutissima Kützing	+	.	+	+	.	+	.	+	.	+	+	+
Amphora copulate (Kutz.)Schoeman & Archibald	.	.	.	.	.	.	.	+	.	.	.	.
Amphora ovalis Kützing	+	+	+	+	.	.	.	.	.	+	+	+
Amphora pediculus (Kütz.) Grun.	.	.	+	.	.	.	.	.	.	.	.	.

Asterionella formosa Hasall	.	+	.	+	+	+	+	+	+	+	+	+
Caloneis amphisbaena (Bory) Cleve	.	.	.	.	.	.	.	+	.	.	.	.
Cocconeis euglypta (Ehr.) Clevei	+	.	.	.	.	.	.	.	.	.	.	.
Cocconeis pediculus Ehr.	.	.	.	.	.	.	.	.	.	+	.	.
Cocconeis placentula Ehr.	+	.	+	+	+	+	.	+	+	+	.	+
Cyclotella atomus Hustedt	.	+	.	.	.	.	.	.	.	.	.	.
Cyclotella meneghiniana Kütz.	+	+	+	.	.	+	.	.	.	+	.	.
Cyclotella ocellata Pant.	+	.	+	+	+	+	+	+	+	+	+	+
Cyclotella operculata (Ag.) Kützing	+	+	+	.	.	+	.	.	.	+	.	.
Cyclotella radiosa (Grun.) Lemm.	+	+	+	+	+	+	+	+	+	+	+	+
Cymatopleura solea (Breb.) W. Smith	.	.	.	.	.	.	+	.	.	+	.	+
Cymbella affinis Kützing	.	.	.	+	.	.	.	.	.	.	.	.
Cymbella amphicephala (Nageli) Kützing	.	.	.	.	.	.	.	.	.	+	.	.
Cymbella lanceolata Agardh	.	.	.	.	.	.	.	.	.	+	.	.
Cymbella microcephala Grun.	.	.	.	+	.	+	.	.	.	.	.	.
Cymbella minuta Hilse ex Rabenhorst	+	.	+	+	+	+	+	+	+	+	+	+
Diatoma vulgare Bory	.	.	.	+	.	.	.	+	.	.	.	.
Fragilaria capucina (Desm.) Rabenhorst	.	.	.	+	.	+	.	.	.	.	.	.
Fragilaria crotonensis Kitton	+	+	.	+	+	+	+	+	+	+	+	+
Fragilaria pinnata Ehr.	+	.	.	+	.	.	+	+	.	.	.	.
Fragilaria ulna (Nitzsch) Lange-Bertalot	+	+	+	+	+	+	+	+	+	+	+	+
Fragilaria ulna var. *angustissima* Sippen	+	+	+	+	+	+	+	+	.	+	+	+

Gomphonema acuminatum Ehr.	.	.	.	.	+	+	+	.	.	.	.	+
Gomphonema olivaceum (Horn.) Breb.	.	.	+	+	.	.	+	.	.	+	.	+
Gomphonema parvulum (Kütz.) Kütz.	.	.	.	+	.	.	.	.	+	.	.	.
Gyrosigma attenuatum	.	.	.	.	.	.	.	.	.	.	.	+
Melosira varians Ag.	+	.	.	.	.	.	.	.	.	.	.	.
Meridion circulare (Greville) Agardh	.	.	.	.	.	.	.	.	.	.	+	.
Hippodonta capitata (Ehr.) L-B. Metz. et Witk.	.	.	.	.	.	+	.	+	+	.	.	.
Navicula cincta (Ehr.) Ralfs	+	+	+	.	.	+	+	+	.	+	.	+
Navicula mensiculus Schumann	+	.	.	.	.	.	.	.	.	.	.	.
Navicua obonga	.	.	.	.	.	.	.	.	.	.	.	+
Navicula radiosa Kützing	.	.	+	+	+	+	+	.	+	+	+	+
Navicula lanceolata Ehr.	.	.	.	.	.	.	.	.	+	.	.	.
Naviula tripunctata (O.F. Muller) Bory de Sain. Van.	.	.	+	.	.	+	.	+	.	+	.	+
Nitzschia palea (Kütz.) W. Smith	.	.	.	+	+	+	+	+	.	.	.	.
Nitzschia recta Hantzsch ex Rabenh.	.	.	.	.	.	+	.	.	.	.	.	.
Nitzschia sigmoidea (Ehr.) W. Smith	.	.	.	+	.	.	+	+	.	.	+	+
Nitzschia sinuata (W. Sm.) Grunow	.	.	.	+	.	.	.	.	.	.	.	.
Pinnularia maior (Kütz.) Rabenhorst	.	.	.	.	.	.	.	.	+	.	+	.
Pinnularia viridis (Nitzsch) Ehr.	.	.	.	+	.	.	+	+	.	.	+	+
Placoneis gastrum(Ehr.) Meresch.	.	+	.	.	.	.	.	.	.	.	.	.
Rhopalodia gibba (Ehr.) Muller	.	.	.	.	.	+	.	+	.	+	.	+
Staurosira construens Ehr.	.	+	.	.	.	.	.	.	+	.	+	.

Stephanodiscus hantzschii Grunow	.	.	.	.	.	.	.	.	.	.	+	.
Chlorophyta - green algae												
Actinastrum hantzschii Lagerh.	.	.	.	.	.	.	.	.	+	.	.	.
Ankistrodesmus bibrianus	.	.	.	.	.	.	.	.	.	.	.	+
Ankistrodesmus falcatus (Corda) Ralfs	.	+	.	.	.	.	.	.	.	+	+	.
Botryococcus braunii Kütz.	.	.	.	.	.	+	+	+	+	+	+	+
Characium aqngustatum A. Braun	.	+	.	+	+	+	+	+	+	.	+	.
Chlamydomonas globosa Snow	+	+	+	+	.	+	.	.	.	.	.	.
Chlamydomonas passiva Skuja	.	.	+	.	.	+	+	+	.	.	.	.
Chlamydomonas reinchardtii Dangeard	.	+	.	.	.	.	.	+	.	.	.	.
Chlorela oocystoides Hindak	.	.	.	.	.	.	.	.	.	.	+	.
Closterium acutum var. *variabile* (Lemm.) Krieg.	+	.	+	+	.	.	.	+	+	+	+	+
Coelasrum astroideum De Notaris	.	.	+	+	+	+	.	+	+	+	+	+
Coelastrum microporum Naegel.	.	.	+	.	.	.	.	.	.	+	.	.
Coelastrum reticulatum (Dang.) Senn	+	+	.	.	.	.	+	.	+	+	+	.
Coenocystis planctonica Korshikov	.	.	.	.	.	.	.	.	+	.	+	+
Cosmarium abbreviatum Raciborski	+	.	+	+	+	+	+	.	.	.	.	.
Cosmarium formosulm Lund	.	.	.	.	.	.	.	.	.	.	.	+
Cosmarium exiguum W. Archer	.	+	.	.	.	.	.	.	.	.	.	.
Cosmarium formulosum Lund	.	.	.	.	.	.	.	+	.	.	.	.
Cosmarium trilobulatum Reinsh	.	.	.	.	.	.	.	+	.	.	+	+
Cosmarium margaritatum (Turp.) Ralfs	.	.	.	+	.	.	.	.	+	.	+	+

Cosmarium phaseolus Brebisson in Ralfs	+	.	+	+	.	+	+	+	+	.	+	+
Cosmarium laeve Rabenhorst	.	.	.	.	+	.	.	.	.	.	.	.
Cosmarium regnellii Wille	+	+	+	.	+	.	+	+	+	+	+	+
Crucigeniella rectnagulrais (Naeg.) Kom.	.	.	.	.	.	+	.	.	.	.	+	.
Crucigenia tetrapedia (Kirchner) W. et G.S. West	.	.	+	.	.	.	.	.	.	+	+	.
Desmodesmus communis (Hegew.) Hegew.	+	+	+	+	+	+	+	+	+	+	+	+
Desmodesmus grahneisii (Heynig) Fott	.	.	.	+	.	.	.	.	.	.	.	.
Desmodesmus naegellii (Meyen) Hegew.	.	.	+	.	.	.	.	.	.	.	.	.
Desmodesmus opoliensis (Rchter) Hegew.	.	.	+	.	.	+	.	.	.	.	.	.
Desmodesmus subspicatus (Chod.) Hegew. et Schmidt	+	.	+	.	.	+	+	+	.	.	.	+
Dicellula geminata (Printz) Kors.	.	.	.	.	.	.	.	.	+	.	.	.
Dictyosphaerium pulchellum Wood	+	+	+	+	.	.	.	.	.	+	.	.
Didymocystis planctonica Korsikov	.	.	.	+	.	+	.	.	.	.	.	.
Elkatothrix gelatinosa Wille	.	.	+	+	.	+	+	+	+	+	+	+
Eutetramorus plantonicus (Korschikov) Bourrelly	.	.	.	.	.	.	.	.	.	.	+	+
Franceia ovais (France) Lemm.	.	.	+	.	.	.	+	.	.	.	.	.
Golenkinia radiata Chodat	+	.	+	+	+	+	+	+	+	.	+	+
Kirchneriella contorta var. *elegans* (Schmidle) Bohlin	+	.	.	.	.	+	+	+	.	+	+	.
Kirchneriella incurvata Belcher et Swale	.	.	.	.	.	.	.	.	+	.	.	.
Kirchneriella obesa (West) West & West	.	.	.	.	.	.	.	.	+		+	.

Koliella longiseta (Vischer) Hindak	+	.	.	.	.	.	.	.	.	.	.	.
Lagerheimia ciliata (Lag.) Chodat	.	.	.	.	.	.	+	.	.	.	.	+
Micractinium crassisetum Hortobagyi	.	.	.	+	.	.	.	.	.	.	.	.
Micractinium pusillum Fresenius	.	.	.	+	.	.	.	.	+	.	.	+
Mougeotia sp.	.	.	.	+	+	.	.	.	.	.	.	.
Monoraphidium arcuatum (Kors.) Hindak	+	.	.	.	.	.	.	.	.	.	.	.
Monoraphidium circinale (Nyg.) Nygaard	+	.	.	.	.	.	.	.	.	.	+	.
Monoraphidium contortum (Thur.) Kom.-Legn.	+	+	+	+	+	+	+	+	+	+	+	+
Monoraphidium griffithii (Berk.) Kom.-Legn.	+	.	+	.	.	.	+	+	.	.	.	+
Monoraphidium irregulare (G.M. Sm.) Kom.-Legn.	+	.	+	.	.	.	.	.	.	.	.	.
Monoraphidium komarkovae Nygaard	+	+	+	.	.	.	+	+	.	+	.	+
Monoraphidium minutom (Nageli) Kom. - Legn.	.	+	.	.	.	.	.	.	.	.	.	.
Monoraphidium obtusum (Kors.)Kom. - Legn.	+	.	.	.	.	.	.	.	.	.	.	.
Nephrocystium agardhianum Naegeli	.	.	.	.	.	.	.	.	+	.	.	.
Nephrocytium limneticum (G. M. Sm.) G. M. Sm.	.	.	.	+	.	.	.	.	.	.	.	.
Oocystidium ovale (Korshikov)	.	.	.	.	.	.	.	.	.	.	+	.
Oocystis lacustris Chodat	+	+	+	+	+	.	+	+	+	+	+	+
Oocystis romboides (Ehr.) De Toni	.	.	.	.	.	.	.	.	.	.	+	.
Oedogonium sp.	.	.	.	.	.	.	.	+	.	+	.	.
Palmelochette tenerrima Kors.	.	.	.	+	.	.	.	.	.	.	.	.

Pandorina morum (O.F. Müller) Bory	.	.	+	.	.	+	.	.	.	+	.	+
Pediastrum biradiatum	.	.	.	.	.	.	.	..	+	.	.	.
Pediastrum boryanum (Turpin) Meneg.	.	.	+	+	+	+	+	+	+	+	+	+
Pediastrum simplex Meyen	.	.	.	.	.	+	.	.	+	+	.	.
Pediastrum duplex Meyen	.	.	.	.	.	+	+	+	+	+	+	+
Pediastrum duplex var. gracillium West	.	.	.	.	.	.	.	.	+	.	.	.
Pediastrum tetras (Ehr.) Ralfs	.	.	+	.	.	.	+	.	.	.	.	.
Phacotus lendneri Chodat.	.	.	.	+	+	.	.	.	.	.	.	.
*Phacotus lenticularis (*Ehr.) Stein	+	.	.	+	+	+	+	+	+	+	+	+
Plankosphaceeria gelatinosa G.M. Smith	.	.	.	.	.	.	.	.	+	.	+	.
Provasoliella saccata (Skuja) Ettl	.	.	.	.	+	.	.	.	.	.	.	.
Provasiorella sp.	.	.	.	.	.	.	+	.	.	.	.	.
Pteromonas angulosa (Carter) Lemm.	.	+	+	.	.	.	.	.	+	.	.	.
Pteromonas cordiformis Lemm.	.	.	+	.	.	.	.	.	+	.	.	.
Radiococcus nimbatus (De Wildeman) Schmidle	.	.	.	.	.	.	.	.	.	.	+	.
Scenedesmus acuminatus (Lager.) Chodat	.	.	+	.	+	.	+	+	+	+	+	+
Scenedesmus bicaudatus Dedusenko	.	.	+	+	+	.	.	.	+	.	.	.
Scenedesmus dimorphus (Turp.) Kütz.	.	+	.	+	.	.	.	.	.	.	.	.
Scenedesmus ecornis (Ehr.) Chod.	.	.	+	+	+	.	+	.	+	.	+	.
Scenedesmus ellipticus Corda	.	.	.	.	.	.	.	.	.	.	+	+
Scenedesmus obtusus Meyen	.	.	.	+	.	.	.	.	.	+	.	.

Scenedesmus regularis Swirenko	.	+	.	.	.	.	.	.	.	.	.	.
Scenedesmus verucosus Roll	.	.	.	+	.	.	.	.	.	.	.	.
Sphaerocystis planctonica (Korsikov) Bourrelly	.	.	.	+	+	+	+	+	+	+	+	+
Staurastrum chaetoceras (Schroeder) Smith	.	.	.	.	.	.	.	.	.	.	+	.
Staurastrum gracile Ralfs	.	.	+	+	+	+	+	+	+	+	+	+
Staurastrum paradoxum Meyen	.	.	.	.	.	.	+	.	.	.	.	.
Staurastrum tetracerum Ralfs ex Ralfs	.	.	.	.	.	.	.	.	+	+	+	.
Tetraedron caudatum (Corda) Hansgirg	+	.	+	.	.	.	.	+	.	.	.	.
Tetraedron minimum (A. Br.) Hansgirg	+	+	+	+	+	+	+	+	+	+	+	+
Tetraedron triangulare (Chod.) Kom.	+	+	.	+	.	+	.	.	+	.	.	.
Tetrastrum glabrum (Roll) Ahlstr. et Tiff	.	.	+	+	.	.	+	.	.	+	.	.
Tetrastrum staurogeanieforme (Schroed.) Lemm.	.	.	+	+	.	+	+	+	+	+	+	+
Treubaria schmidlei (Schroeder) Fott et Kovacik	.	+	+	+	.	+	+	.	.	.	.	+
Ulothrix zonata (Weber & Mohr) Kutzing	.	.	.	.	.	.	.	.	.	.	+	.
Cryptophyta - cryptophytes												
Chroomonas acuta Uterm.	+	.	.	.	+	.	+	.	.	.	.	.
Cryptomonas erosa Ehrenberg	+	+	+	+	+	+	+	+	+	+	+	+
Cryptomonas gracilis Skuja	.	+	.	.	.	.	.	.	.	.	.	.
Cryptomonas marssonii Skuja	+	+	+	+	+	+	+	+	+	+	+	+
Cryptomonas ovata Ehrenberg	+	+	+	+	+	+	+	+	+	+	+	+
Cryptomonas rostrata Troitzskaja emend I. Kiselev	+	.	+	+	+	+	+	+	+	+	+	+

Rhodomonas minuta Skuja	+	+	+	+	+	+	+	+	+	+	+	+
Dinophyta - dinophytes												
Ceratium hirundinella (F. B. Müller) Bergh	+	+	.	+	+	+	+	+	+	+	+	+
Ceratium cornutum (Ehr) Clap.& Lachman	.	.	.	.	.	.	.	+	.	.	.	.
Gymnodinium aeruginosum Stein	+	.	.	.	.	+	.	+	.	.	.	.
Peridiniopsis cuningtonii Lemm.	+	+	+	+	+	+	+	+	+	+	+	+
Peridiniopsis polonicum	.	.	.	.	.	.	.	.	.	.	.	+
Peridinium cinctum (O.F. Müller) Ehrenberg	+	+	+	+	+	+	+	+	+	+	+	+
Peridinium gatunense Nygaard	.	.	.	.	.	+	.	.	.	.	.	.
Peridinopsis berolinense (Lemm.) Bourrelly	+	+	+	+	+	+	+	+	+	+	+	+
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	+	.	+	+	+	+	+	+	+	+	+	+
Peridinopsis kevei Grig. & Vasas	.	.	.	.	.	.	.	.	+	.	.	.
Euglenophyta - euglenoids												
Colacium vesiculosum Ehr.	.	+	.	+	.	+	.	+	.	.	+	.
Euglena caudata Hübner	.	.	.	.	+	.	.	.	+	.	.	.
Euglena pisciformis Klebs	.	+	.	+	.	.	.	+	+	.	.	.
Phacus caudatus Hubner	.	.	.	.	.	.	.	+	.	.	.	.
Phacus pusillus Lemm.	.	.	.	.	.	.	.	+	+	.	.	.
Phacus orbicularis Hubner	+	+	.	.	.	.	.	.	.	.	.	.
Trachelomonas hispida (Perty) Stein	+	.	+	+	+	+	+	+	+	+	+	+
Trachelomonas intermedia Dangeard	.	.	.	.	.	.	.	.	+	.	.	.
Trachelomonas planctonica Swirenko	+	.	+	+	.	.	.	.	.	.	.	.

Trachelomonas volocina Ehrenberg	+	.	+	+	+	+	+	.	+	.	.	.
Chrysophyceae - chrysophyces												
Chrysococcus rufescens Klebs	.	.	+	+	.	.	.	.	.	.	.	.
Dinobryon bavaricum Imhoff	.	+	+	+	+	+	+	.	+	.	.	+
Dinobryon crenulatum W. et G.S. West	.	+	+	+	.	.	.	.	.	.	.	.
Dinobryon divergens Imhof	.	+	+	.	+	+	+	+	+	+	+	+
Dinobryon sociale Ehrenberg	+	.	+	+	.	+	.	.	+	.	+	.
Erkenia subaequiciliata Skuja	+	+	+	.	+	+	+	+	+	+	+	+

Annex 2. List of phytoplankton species from different taxonomical algal groups and their frequency in Lake Durowskie from 24th June to 29th June 2019

	0m	**0-3m**	**0-3m**	**0-3m**	**0-3m**	**0m**	**0m**	**0m**
	Inflow	**Aerator 2**	**Middle 1**	**Middle 2**	**Aerator 1**	**Outflow**	**Beach 1**	**Beach 2**
	26.06.19	**25.06.19**	**27.06.19**	**27.06.18**	**26.06.19**	**28.06.19**	**28.06.19**	**28.06.19**
Cyanoprokaryota								
Aphanocapsa incerta (Lemm.) Cron. et Kom.								
Aphanizomenon flos-aquae (L.) Ralfs			+	+			+	+
Limnothrix redekei (Van Goor) Meffert	+	+	+	+				
Microcystis aeruginosa Kützing	+	+	+	+	+	+	+	+
Planktolyngbya limnetica (Lemm.) Kom. – Legn. Et Cronenberg	+							
Planktothrix agardhii (D.C. ex Gom.) Anagn. et Kom.	+							
Pseudanabaena limnetica (Lemm.) Kom.	+	+			+			+
Total	**6**	**3**	**3**	**3**	**2**	**1**	**2**	**3**
Bacillariophyceae								
Amphora ovalis Kützing	+							
Achnanthes exigua Grun.	+							
Achnanthes minutissima Kutz.	+							
Asterionella formosa Hasall	+		+					+
Cocconeis placentula Ehr.	+							
Cymatopleura solea (Breb.) W.Smith	+							
Cyclotella ocellata Pant.	+	+	+	+				+
Cyclotella radiosa (Grun.) Lemm.	+	+	+	+	+			+

Cymbella minuta Hilse ex Rabenhorst	+	+	+					+
Fragilaria crotonensis Kitton	+	+	+	+				+
Fragilaria ulna (Nitzsch) Lange-Bertalot	+	+	+	+	+		+	+
Fragilaria ulna var. *angustissima* Sippen	+							
Gomphonema acumintum Ehr.	+							
Gomphonema olivaceum (Horn.) Breb.	+							
Gyrosigma attenuatum (Kütz.) Rab.	+							
Navicula radiosa Kutz	+	+	+				+	+
Navicula cincta (Ehr.) Ralfs	+							
Navicula oblonga (Kütz.) Kütz.	+							
Naviula tripunctata (Muller) Bory	+							
Nitzschia sigmoidea (Ehr.) W. Smith	+							
Pinnularia viridis (Nitzsch) Ehr.	+							
Rhopalodia gibba (Ehr.) Muller	+							
Total	**22**	**6**	**7**	**4**	**2**	**0**	**2**	**7**
Chlorophyta								
Ankistrodesmus bibrianus (Rein.) Kors.			+					
Botryococcus braunii Kutzing	+	+		+				+
Closterium acutum var. *variabile* (Lemm.) Krieg.	+							
Coelastrum astroideum De Notaris	+	+	+	+	+			+

Coelastrum reticulatum (Dang.) Sen.	+	+	+	+		+	+	+
Coenocystis planctonica Kors.					+			
Cosmarium phaseolus Brebisson in Ralfs	+	+	+	+	+	+	+	+
Cosmarium regnellii Wille			+					+
Cosmarium formosulm Lund	+	+	+	+	+		+	
Cosmarium trilobulatum Reinsch		+	+	+	+			+
Crosmarium margaritatum (Turp.) Ralfs		+	+	+	+	+		+
Desmodesmus communis (Hegew.) Hegew.	+	+	+		+			+
Desmodesmus subspicatus (Chod.) Hegew. et Schmidt	+							
Elkatothrix gelatinosa Wille	+	+						
Eutetramorus planctonicus (Kors.) Bour.				+			+	+
Golenkinia radiata Chodat	+	+		+				
Lagerheimia ciliata (Lag.) Chodat				+				
Micractinium pusillum Fres.				+				
Monoraphidium contortum (Thur.) Kom.-Legn.	+		+					+
Monoraphidium griffithii (Berk.) Kom.-Legn.	+							
Monoraphidium komarkovae Nygaard	+							
Oocystis lacustris Chodat	+	+	+		+			+
Pandorina morum (O.F. Müller) Bory			+			+	+	+

Pediastrum boryanum (Turpin) Meneg.	+	+	+		+	+	+	+
Pediastrum duplex Meyen		+						+
*Phacotus lenticularis (*Ehr.) Stein	+	+	+	+			+	+
Scenedesmus acuminatus (Lager.) Chodat	+	+	+					+
Scenedesmus ellipticus Corda								+
Sphaerocystis planctonica (Korsikov) Bourrelly		+	+	+	+	+	+	+
Tetraedron minimum (A. Br.) Hansgirg	+	+			+			+
Tetrastrum staurogeanieforme (Schroed.) Lemm.	+	+		+	+			
Treubaria schmidlei (Schr.) Fott et Kor.	+							
Staurastrum gracile Ralfs	+	+	+					+
Total	**21**	**19**	**17**	**14**	**12**	**6**	**8**	**20**
Cryptophyta								
Cryptomonas erosa Ehrenberg	+	+	+	+		+	+	+
Cryptomonas marssonii Skuja	+	+	+		+			+
Cryptomonas ovata Ehrenberg	+	+	+	+	+		+	
Cryptomonas rostrata Troitzskaja emend I. Kiselev	+	+	+	+				+
Rhodomonas minuta Skuja	+	+	+		+			+
Total	**5**	**5**	**5**	**3**	**3**	**1**	**2**	**4**
Dinophyta								
Peridinopsis berolinense (Lemm.) Bourrelly		+	+	+				

Ceratium hirundinella (F. B. Müller) Bergh	+	+	+	+	+		+	+
Peridiniopsis cuningtonii Lemm.	+	+	+	+	+	+	+	+
Peridinoipsis polonicum (Woł.) Bour.				+				
Peridinium cinctum (O.F. Müller) Ehrenberg	+	+	+	+	+		+	+
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	+	+	+	+	+			+
Total	**4**	**5**	**5**	**6**	**4**	**1**	**3**	**4**
Euglenophyta								
Trachelomonas hispida (Perty) Stein	+		+	+	+			
Total	**1**		**1**	**1**	**1**			
Chrysophyceae								
Erkenia subaequiciliata Skuja	+	+	+	+			+	+
Dinobryon bavaricum Inhof	+	+	+	+	+		+	+
Dinobryon divergens Imhof	+	+	+	+	+	+	+	+
Total	**3**	**3**	**3**	**3**	**2**	**1**	**3**	**3**

Annex 3. Average number of phytoplankton species cells (ind./mL) from different depth in Lake Durowskie

	0m	**0-3m**	**0-3m**	**0-3m**	**0-3m**	**0m**	**0m**	**0m**
	Inflow	**Aerator 2**	**Middle 1**	**Middle 2**	**Aerator 1**	**Outflow**	**Beach 1**	**Beach 2**
	26.06.19	**25.06.19**	**27.06.19**	**27.06.18**	**26.06.19**	**28.06.19**	**28.06.19**	**28.06.19**
Cyanoprokaryota								
Aphanocapsa incerta (Lemm.) Cron. et Kom.			6800	7200			2400	33600
Aphanizomenon flos-aquae (L.) Ralfs	19200	2400	800	800				
Limnothrix redekei (Van Goor) Meffert	1519200	4000	8000	3600	27200	800	1600	2400
Microcystis aeruginosa Kützing	23200							
Planktolyngbya limnetica (Lemm.) Kom. – Legn. Et Cronenberg	34400							
Planktothrix agardhii (D.C. ex Gom.) Anagn. et Kom.	43200	800			3200			1600
Pseudanabaena limnetica (Lemm.) Kom.	46400							
Total	**1685600**	**7200**	**15600**	**11600**	**30400**	**800**	**4000**	**37600**
Bacillariophyceae								
Amphora ovalis Kützing	16000							
Achnanthes exigua Grun.	5600							
Achnanthes minutissima Kutz.	3200							
Asterionella formosa Hasall	58400		6400					12000
Cocconeis placentula Ehr.	17600							
Cymatopleura solea (Breb.) W.Smith	2400							
Cyclotella ocellata Pant.	8000	4000	800	4266,667				3200
Cyclotella radiosa (Grun.) Lemm.	36000	2000	2666,667	800	800			15200

Cymbella minuta Hilse ex Rabenhorst	15200	4800	800					800
Fragilaria crotonensis Kitton	83200	5333,333	14400	2400				16800
Fragilaria ulna (Nitzsch) Lange-Bertalot	34400	12800	3200	4266,667	2000		800	10400
Fragilaria ulna var. *angustissima* Sippen	3200							
Gomphonema acumintum Ehr.	800							
Gomphonema olivaceum (Horn.) Breb.	4000							
Gyrosigma attenuatum (Kütz.) Rab.	2400							
Navicula radiosa Kutz	8000	3200	800				800	1600
Navicula cincta (Ehr.) Ralfs	4800							
Navicula oblonga (Kütz.) Kütz.	1600							
Naviula tripunctata (Muller) Bory	8800							
Nitzschia sigmoidea (Ehr.) W. Smith	4000							
Pinnularia viridis (Nitzsch) Ehr.	800							
Rhopalodia gibba (Ehr.) Muller	19200							
Total	**337600**	**32133,33**	**29066,67**	**11733,33**	**2800**	**0**	**1600**	**60000**
Chlorophyta								
Ankistrodesmus bibrianus (Rein.) Kors			3200					
Botryococcus braunii Kutzing	4000	4000		9600				3200
Closterium acutum var. *variabile* (Lemm.) Krieg.	4000							
Coelastrum astroideum De Notaris	5600	1800	4800	1866,667	3400			4000

Coelastrum reticulatum (Dang.) Sen.	28000	18400	53066,67	4800		22400	3791	69600
Coenocystis planctonica Kors.					800			
Cosmarium phaseolus Brebisson in Ralfs	800	800	800	800	800	800	800	800
Cosmarium regnellii Wille			1600					3200
Cosmarium formosulm Lund	800	800	800	800	800		800	
Cosmarium trilobulatum Reinsch		800	800	800	800			800
Crosmarium margaritatum (Turp.) Ralfs		800	800	800	800	800		800
Desmodesmus communis (Hegew.) Hegew.	8800	1200	3200		1200			6400
Desmodesmus subspicatus (Chod.) Hegew. et Schmidt	4800							
Elkatothrix gelatinosa Wille	8000	3200						
Eutetramorus planctonicus (Kors.) Bour.				9600			3200	6400
Golenkinia radiata Chodat	13600	13600		3733,333				
Lagerheimia ciliata (Lag.) Chodat				800				
Micractinium pusillum Fres.				2400				
Monoraphidium contortum (Thur.) Kom.-Legn.	51200		800					4800
Monoraphidium griffithii (Berk.) Kom.-Legn.	9600							
Monoraphidium komarkovae Nygaard	11200							
Oocystis lacustris Chodat	8800	800	3466,667		800			4800
Pandorina morum (O.F. Müller) Bory			4800			1600	7200	44800

Pediastrum boryanum (Turpin) Meneg.	5600	2400	2400		800	800	800	1600
Pediastrum duplex Meyen		1600						800
*Phacotus lenticularis (*Ehr.) Stein	75200	6400	8600	3200			7200	11200
Scenedesmus acuminatus (Lager.) Chodat	4800	1600	800					2400
Scenedesmus ellipticus Corda								2400
Sphaerocystis planctonica (Korsikov) Bourrelly		26200	31600	10133,33	13900	36000	36800	10400
Tetraedron minimum (A. Br.) Hansgirg	30400	48000			800			5600
Tetrastrum staurogeanieforme (Schroed.) Lemm.	4800	800		3200	4800			
Treubaria schmidlei (Schr.) Fott et Kor.	6400							
Staurastrum gracile Ralfs	9600	40000	1600					4800
Total	**296000**	**173200**	**123133,3**	**52533,33**	**29700**	**62400**	**60591**	**188800**
Cryptophyta								
Cryptomonas erosa Ehrenberg	40800	18000	26666,67	32200		16000	20000	50400
Cryptomonas marssonii Skuja	9600	4266,667	5066,667		800			2400
Cryptomonas ovata Ehrenberg	800	800	800	800	800		800	
Cryptomonas rostrata Troitzskaja emend I. Kiselev	7200	2400	4000	1600				5600
Rhodomonas minuta Skuja	16800	3200	6400		2400			5600
Total	**75200**	**28666,67**	**42933,33**	**34600**	**4000**	**16000**	**20800**	**64000**
Dinophyta								
Peridinopsis berolinense (Lemm.) Bourrelly		8000	800	800				

Ceratium hirundinella (F. B. Müller) Bergh	10400	13066,67	2600	29600	8400		800	6400
Peridiniopsis cuningtonii Lemm.	37600	29066,67	50600	42400	1600	20800	25600	69000
Peridinoipsis polonicum (Woł.) Bour.				800				
Peridinium cinctum (O.F. Müller) Ehrenberg	54400	24600	28800	19400	3200		8000	36000
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	9600	11800	16200	9600	4800			13600
Total	**112000**	**86533,33**	**99000**	**102600**	**18000**	**20800**	**34400**	**125000**
Euglenophyta								
Trachelomonas hispida (Perty) Stein	4000		3733,333	800	10000			
Total	**4000**		**3733,333**	**800**	**10000**			
Chrysophyceae								
Erkenia subaequiciliata Skuja	**1676800**	**10000**	**9400**	**2933,333**			**3200**	**48000**
Dinobryon bavaricum Inhof	11200	4000	16000	13200	205600		2400	8000
Dinobryon divergens Imhof	204800	83800	533066,7	104800	13800	188000	480800	761600
Total	**1892800**	**97800**	**558466,7**	**120933,3**	**219400**	**188000**	**486400**	**817600**

Annex 4. Average biomass of phytoplankton species (mg/mL) from different depth in Lake Durowskie

	0m	**0-3m**	**0-3m**	**0-3m**	**0-3m**	**0m**	**0m**	**0m**
	Inflow	**Aerator 2**	**Middle 1**	**Middle 2**	**Aerator 1**	**Outflow**	**Beach 1**	**Beach 2**
	26.06.19	**25.06.19**	**24.06.19**	**27.06.19**	**26.06.19**	**28.06.19**	**28.06.19**	**28.06.19**
Cyanoprokaryota								
Aphanocapsa incerta (Lemm.) Cron. et Kom.			0,002	0,0025			0,001	0,011
Aphanizomenon flos-aquae (L.) Ralfs		0,005						
Limnothrix redekei (Van Goor) Meffert	0,037		0,002	0,002				
Microcystis aeruginosa Kützing	0,477	0,0055	0,002	0,00115	0,0085	0,0003	0,0005	0,001
Planktolyngbya limnetica (Lemm.) Kom. – Legn. Et Cronenberg	0,012							
Planktothrix agardhii (D.C. ex Gom.) Anagn. et Kom.	0,011							
Pseudanabaena limnetica (Lemm.) Kom.	0,054	0,001			0,004			0,002
Pseudanabaena limnetica (Lemm.) Kom.	0,015							
Bacillariophyceae								
Amphora ovalis Kützing	0,08							
Achnanthes exigua Grun.	0,001							
Achnanthes minutissima Kutz.	0,001							

Asterionella formosa Hasall	0,01		0,001					0,002
Cocconeis placentula Ehr.	0,117							
Cymatopleura solea (Breb.) W.Smith	0,008	0,004	0,001	0,004333				0,003
Cyclotella ocellata Pant.	0,045	0,0025	0,003333	0,001	0,001			0,019
Cyclotella radiosa (Grun.) Lemm.	0,029	0,0085	0,001					0,001
Cymbella minuta Hilse ex Rabenhorst	0,231							
Fragilaria crotonensis Kitton	0,038	0,002	0,006333	0,001				0,015
Fragilaria ulna (Nitzsch) Lange-Bertalot	0,047	0,017333	0,004	0,005667	0,00274		0,001	0,014
Fragilaria ulna var. *angustissima* Sippen	0,037							
Gomphonema acumintum Ehr.	0,001							
Gomphonema olivaceum (Horn.) Breb.	0,003							
Gyrosigma attenuatum (Kütz.) Rab.	0,398							
Navicula radiosa Kutz	0,013							
Navicula cincta (Ehr.) Ralfs	0,015							
Navicula oblonga (Kütz.) Kütz.	0,02	0,008	0,001				0,002	0,003

Naviula tripunctata (Muller) Bory	0,084							
Nitzschia sigmoidea (Ehr.) W. Smith	0,043							
Pinnularia viridis (Nitzsch) Ehr.	0,036							
Rhopalodia gibba (Ehr.) Muller	0,157							
Chlorophyta								
Ankistrodesmus bibrianus (Rein.) Kors			0,003					
Botryococcus braunii Kutzing	0,017	0,004		0,06				0,0003
Closterium acutum var. *variabile* (Lemm.) Krieg.	0,002							
Coelastrum astroideum De Notaris					0,000603			
Coelastrum reticulatum (Dang.) Sen.	0,018	0,0055	0,015	0,006333	0,01083		0,003	0,012
Coenocystis planctonica Kors.	0,106	0,069333	0,201	0,018		0,085	0,003	0,263
Cosmarium phaseolus Brebisson in Ralfs	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001
Cosmarium regnellii Wille			0,0002					0,006
Cosmarium formosulm Lund	0,001	0,001	0,001	0,001	0,001		0,001	
Cosmarium trilobulatum Reinsch		0,001	0,001	0,001	0,001			0,001

Crosmarium margaritatum (Turp.) Ralfs		0,002	0,002	0,002	0,002	0,002		0,002
Desmodesmus communis (Hegew.) Hegew.	0,007	0,001	0,002		0,001065			0,005
Desmodesmus subspicatus (Chod.) Hegew. et Schmidt	0,002							
Elkatothrix gelatinosa Wille	0,009	0,004						
Eutetramorus planctonicus (Kors.) Bour.				0,086333			0,021	0,042
Golenkinia radiata Chodat	0,007	0,007		0,002				
Lagerheimia ciliata (Lag.) Chodat				0,0005				
Micractinium pusillum Fres.				0,007				
Monoraphidium contortum (Thur.) Kom.-Legn.	0,009		0,0001					0,001
Monoraphidium griffithii (Berk.) Kom.-Legn.	0,019							
Monoraphidium komarkovae Nygaard	0,037							
Oocystis lacustris Chodat	0,023	0,002	0,008667		0,00204			0,012
Pandorina morum (O.F. Müller) Bory			0,083			0,008	0,035	0,215
Pediastrum boryanum (Turpin) Meneg.	0,164	0,071	0,070667		0,02326	0,024	0,024	0,047
Pediastrum duplex Meyen		0,047						0,023

*Phacotus lenticularis (*Ehr.) Stein	0,06	0,004667	0,005525	0,003			0,006	0,008
Scenedesmus acuminatus (Lager.) Chodat	0,003	0,001	0,001					0,001
Scenedesmus ellipticus Corda								0,002
Sphaerocystis planctonica (Korsikov) Bourrelly		0,06375	0,07175	0,023	0,037918	0,082	0,084	0,023
Tetraedron minimum (A. Br.) Hansgirg	0,003	0,005			0,0008			0,001
Tetrastrum staurogeanieforme (Schroed.) Lemm.	0,001	0,0001		0,0005	0,00072			
Treubaria schmidlei (Schr.) Fott et Kor.	0,016							
Staurastrum gracile Ralfs	0,025	0,103	0,004					0,012
Cryptophyta								
Cryptomonas erosa Ehrenberg	0,066	0,028667	0,086	0,052		0,026	0,324	0,081
Cryptomonas marssonii Skuja	0,012	0,005333	0,006333		0,001			0,003
Cryptomonas ovata Ehrenberg	0,001	0,001	0,001	0,138	0,001		0,001	
Cryptomonas rostrata Troitzskaja emend I. Kiselev	0,015	0,005	0,008333	0,003				0,011
Rhodomonas minuta Skuja	0,012	0,002	0,004		0,0017			0,003
Dinophyta								
Peridinopsis berolinense (Lemm.) Bourrelly		0,074	0,007	0,007				

Ceratium hirundinella (F. B. Müller) Bergh	1,006	0,799667	0,25125	2,8635	0,81239		0,774	0,619
Peridiniopsis cuningtonii Lemm.	0,435	0,324	0,585	0,48975	0,018505	0,24	0,296	0,786
Peridinoipsis polonicum (Woł.) Bour.				0,009				
Peridinium cinctum (O.F. Müller) Ehrenberg	1,444	0,65225	0,76425	0,515	0,085265		0,212	0,955
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	0,077	0,09425	0,1295	0,028	0,0384			0,108
Euglenophyta								
Trachelomonas hispida (Perty) Stein	0,004		0,003667		0,01426			
Chrysophyceae								
Erkenia subaequiciliata Skuja	0,093	0,0006	0,00055	0,0002			0,0002	0,002
Dinobryon bavaricum Inhof	0,002	0,002	0,01	0,0085	0,134		0,002	0,001
Dinobryon divergens Imhof	0,094	0,038	0,243	0,048	0,00621	0,086	0,219	0,347

Annex 5. Comparison of periphyton species composition in different investigated sites

Diatom taxa	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**pH**	**O_2**	**T**
Achnanthes conspicua Mayer		+									+		3	2	7
Achnanthes exigua Grun.		+	+	+	+	+	+	+	+	+	+	+	4	1	7
Achnanthes hungarica(Grunow) Grun. in Cleve				+							+	+	4	4	6
Achnanthes lanceolata (Breb.) Grunow	+	+	+	+				+			+		4	3	5
Achnanthes lanceolata v. elliptica Cleve sensu Straub						+							4	-	-
Achnanthes minutissima Kützing	+	+	+	+	+	+	+	+	+	+	+	+	3	1	7
Achnanthes minutissima var. affinis (Grun.) Lange-Bertalot						+	+			+	+	+	4	-	-
Achnanthes minutissima var. *gracillima* (Meister) Lange-Bertalot						+					+		4	-	1
Achnanthes minutissima var. L*anceolata* (Lang-Bertalot) Lange-Bertalot							+					+	-	-	-
Amphipleura pellucida (Kützing) Kützing													4	2	2
Amphora ovalis Kützing	+	+	+	+	+	+	+	+	+	+	+	+	4	2	5
Amphora pediculus (Kütz.) Grunow	+	+	+	+	+	+	+	+	+	+	+	+	4	2	5
Asterionella formosa Hass	+				+			+	+	+	+		4	2	5
Aulacoseira granulata (Ehr.) Simonsen									+				4	3	5
Aulacoseira granulata var. Angustissima f. curvata (O. Mül.) Sim.													4	3	5

Caloneis bacillum (Grun.) Meresz.	+	+	+			+		+				+	4	2	4
Caloneis silicula (Ehr.) Cleve													4	2	4
Cocconeis euglypta (Ehr.) Clevei											+				
Cocconeis pediculus Ehr.	+	+	+	+	+	+	+	+	+	+		+	4	2	5
Cocconeis placentula Ehr.	+	+	+	+	+	+	+	+	+	+	+	+	4	3	5
Cocconeis placentula var. linearis Ehr.		+	+	+									-	-	-
Cocconeis placentula var. lineata Ehr.		+	+	+		+					+		4	3	5
Cocconeis placentula var. pseudolineata Geitler	+					+	+	+				+	-	-	-
Craticula cuspidata (Kützing) Mann W Round	+							+			+		4	3	5
Cyclotella meneghiniana Kütz.		+	+	+	+	+	+	+	+	+			4	5	5
Cyclotella ocellata Pant.	+	+	+	+	+	+	+	+	+	+	+	+	4	1	4
Cyclotella operculata (Ag.) Kützing		+	+		+		+	+	+	+	+	+	-	-	-
Cyclotella radiosa (Grun.) Lemm.	+	+	+	+		+	+	+	+	+	+	+	4	2	5
Cyclotella steligera Cl. et Grun.											+				
Cymatopleura solea (Breb.) W. Smith					+			+	+	+			4	3	5
Cymbella affinis Kützing	+	+	+	+	+	+	+	+	+	+	+	+	4	1	5
Cymbella caespitosa (Kützing) Brun.												+	0	-	7
Cymbella cistula (Ehr.) Kirchner	+	+	+	+	+			+	+				4	2	5
Cymbella lanceolata (Ehr.) Kirchner					+			+	+	+			4	1	7
Cymbella microcephala Grun.		+	+	+	+	+	+	+	+	+	+	+	4	1	4
Cymbella minuta Hilse ex Rabenhorst	+	+	+	+	+	+	+	+	+	+	+	+	3	-	-

Cymbella prostrata (Berkeley) Cleve					+		+	+	+	+			4	1	5
Cymbella tumida (Bréb.) Van Heurck	+	+						+	+	+			4	1	4
Cymbella turgida (Greg.) Cleve	+							+					-	-	-
Diatoma tenuis Agardh					+			+		+			4	3	5
Diatoma vulgaris Bory	+	+		+	+	+	+	+	+	+	+	+	5	2	4
Diatoma vulgaris Bory Morphotyp *ovalis*													-	-	-
Diploneis elliptica (Kütz.) Lange-Bertalot					+	+		+	+	+			4	1	3
Encynomena silesiacaum (Bleisch in Rabenh.) D. G. Mann															
Eunotia bilunaris Ehr.													-	-	-
Eunotia exigua (Breb.) Rabenh.	+				+			+	+	+			1	2	7
Eunotia faba (Ehr.) Grun.					+	+		+	+				2	1	2
Eunotia intermedia (Krasske) Noerpel & Lange - Bertalot													2	-	1
Eunotia praerupta Ehr.	+	+	+		+		+	+	+	+	+	+	2	1	2
Eunotia tenella (Grun.) Hustedt						+						+	2	1	1
Fragilaria capitata Ehr.		+	+										-	-	-
Fragilaria capucina (Desm.) Rabenhorst	+	+	+	+	+		+	+	+	+	+	+	3	-	3
Fragilaria capucina v. amphcephala (Kütz.) Lange-Bertalot				+		+				+			-	-	-
Fragilaria constricta Ehr.													2	-	1
Fragilaria construens (Ehr.) Grun.		+	+		+		+		+				4	1	4
Fragilaria crotonensis Kitton	+	+	+	+	+		+	+	+	+	+	+	4	2	3

Fragilaria dilatata (Breb.) Lange-Bertalot				+		+									
Fragilaria exigua Grun.											+				
Fragilaria martyi (Heribaud) Lange-Bertalot					+			+	+	+			-	-	-
Fragilaria pinnata Ehr.	+	+	+		+		+	+	+	+	+	+	4	1	7
Fragilaria ulna (Nitzsch) Lange-Bertalot	+	+	+	+	+	+	+	+	+	+	+	+	4	3	7
Fragilaria ulna var. *angustissima* Sippen	+	+	+	+	+	+		+	+		+		4	2	7
Fragilaria vaucheriae *(Kütz.) Carlson*				+		±		+					-	-	-
Gomphonema acuminatum Ehr.	+		+		+			+	+	+	+	+	4	2	5
Gomphonema angustatum (Kütz.) Rabenhorst				+		+							-	-	-
Gomphonema angustum Agardh										+		+	4	1	1
Gomphonema augur Ehr.	+							+					4	1	4
Gomphonema gracile Ehr.	+				+			+	+	+			3	1	3
Gomphonema intricatum Kützing					+			+	+			+	-	-	-
Gomphonema italicum Kützing															
Gomphonema micropus Kütz.					+			+	+	+			4	2	5
Gomphonema olivaceoides Hustedt	+				+			+	+	+		+	-	-	-
Gomphonema olivaceum (Horn.) Breb.	+	+	+		+		+	+	+	+	+	+	5	2	5
Gomphonema parvulum (Kütz.) Kütz.	+	+	+	+	+	+	+	+	+	+	+	+	3	4	5
Gomphonema truncatum Ehr.						+							4	2	4
Hantzschia amphioxys (Ehr.) Grunow					+		+	+	+				3	2	7

Mastogloia smithii Thwaites													4	-	-
Meridion circulare Ag.		+	+			+	+			+		+	4	2	7
Navicula anglica Grunow											+		3	-	-
Navicula agrestis Hustedt				+	+	+	+				+		4	3	4
Navicula capitata Patrick in Patrick & Reimer		+	+		+		+	+	+	+		+	4	3	5
Navicula cincta (Ehr.) Ralfs	+	+	+		+	+		+	+	+	+	+	3	3	7
Navicula cryptocephala Kütz.	+			+	+			+	+				-	-	-
Navicula dicephala (Ehr.) W. Sm.	+							+					4	4	5
Navicula gastrum (Ehr.) Meres.										+			4	4	5
Navicula gregaria Donkin							+				+		-	-	-
*Navicula oblonga (*Kützing) Kützing						+							4	2	5
*Navicula placentula (*Placeneis)					+			+	+	+			3	2	4
Navicula radiosa Kützing	+	+	+		+		+	+	+	+	+	+	5	2	5
Navicula reinhardtii Grun.		+	+	+		+	+			+					
Navicula sp				+									-	-	-
Navicula tenella Hustedt											+		4	2	5
Navicula tripunctata (O. F. Müller) Bory	+	+	+		+		+	+	+	+	+	+	4	2	5
*Navicula viridula (*Kütz.) Ehr.				+	+	+	+	+	+				4	4	5
Nitzchia acicularis (Kützing) W. Smith	+	+	+										4	3	5
Nitzschia amphibia Grunow	+			+	+			+	+			+	4	3	5
Nitzschia incospicua Grun.				+			+	+		+					

Nitzschia linearis (Ahardh) Smith												+			
Nitzschia intermedia Hantzsch						+							-	-	-
Nitzschia micropus (Kütz.)	+							+					3	4	6
Nitzschia palea (Kütz.) *W. Sm.*	+	+	+		+		+	+			+	+	4	3	5
Nitzschia paleacea Grun.	+	+	+	+			+	+				+	4	2	7
Nitzschia recta Hantzsch	+		+	+	+	+	+	+	+		+	+	4	3	5
Nitzschia sigmoidea (Ehr.) *W. Sm.*		+	+		+	+	+	+	+			+	3	3	7
Pinnularia gibba Ehr.				+											
Pinnularia maior (Kütz.) Cleve											+	+	3	3	7
Pinnularia viridis (Nitzsch) Ehr.		+	+				+					+			
Placoneis eleginensis (Greg.) Cox				+		+									
Placoneis placentula (Ehr.) Cox													4	2	5
Rhoicosphaenia abbreviata (Ag.) Lange-Bertalot												+	-	-	-
Rhoicosphaenia curvata (Kütz.) Grun.		+	+										5	3	5
Rhopalodia gibba (Ehr.) Müller	+	+		+		+		+	+	+	+		3	3	4
Stauroneis phoenicentron Ehr.	+	+	+	+		+		+			+		-	-	-
Stephanodiscus astraea (Ehr.) Grunow					+		+	+	+	+	+		5	4	6
Stephanodiscus hantzschii Grun.		+	+								+	+			
Stephanodiscus minutulus (Kütz.) Cleve-Mőller													4	3	5
Surirella minuta Breb.		+	+	+									4	4	5
Surirella ovalis Breb.					+			+	+				3	1	2

Tabellaria fenestrata (Lyngb.) Kützing	+					+	+			+	+		2	1	3
Tabellaria flocculosa (Roth) Kütz.								+							

pH*

1. acidobiontic (optimaloccurrenceatpH<5.5)
2. acidophilous (mainlyoccurrenceatpH<7)
3. circumboreal (mainlyoccurringatpH – valuesabout 7)
4. alkaliphilous (mainlyoccurringatpH>7)
5. alkalibiontic (exclusivelyoccurringatpH>70
6. indifferent (no apparent optimum)

O*

1. continuously high (about 100% saturation)
2. fairly high (above 75% saturation)
3. moderate (above 50% saturation)
4. low (above 30% saturation)
5. verylow (about 10% saturation)

T*

1. oligotraphenic
2. oligo-mesotraphenic
3. mesotraphenic
4. meso-eutraphenic
5. eutraphenic
6. hypereutraphenic

Annex 6

Taxon	site 1	site 2	site 3	site 4	site 5	site 6	site 7	site 8	site 9	site 10	site 11	site 12
Achnanthes minutissima Kützing	29.00%	16.00%	17.00%	14.00%	12.00%	8.00%	7.17%	26.09%	7.26%			7.60%
Fragilaria crotonensis Kitton					3.00%		5.63%					
Cymbella affinis Kützing										10.50%		
Cymbella minuta Hilse ex Rabenhorst	4.00%				6.00%	13.00%	6.27%	4.30%				
Cocconeis pediculus									5.69%			
Cocconeis placentula Ehr.		6.00%	11.00%			6.00%			6.02%		10.36%	
Amphora pediculus (Kütz.) Grunow	4.00%	6.00%	7.00%						5.42%			
Fragilaria capucina (Desm.) Rabenhorst	4.00%			5.00%			8.04%	4.61%				7.20%
Fragilaria pinnata Ehrenberg				5.00%		6.00%						4.80%
Meridion circulare (Greville) C.Agardh			6.00%	6.00%								
Gomphonema olivaceum (Horn.) Breb.					10.00%				10.66%	14.40%		8.10%

Gomphonema parvulum (Kützing) Kützing		5%								4.30%		
Cyclotella radiosa (Grun.) Lemm.											5.43%	
Achnanthes exigua Grun.											6.96%	
Fragilaria exigua Grunow											5.99%	
Achnathes minutisima var. affinis (Grunow)										4.50%		
Fragilaria crotonensis Kitton											5.99%	
Cyclotella ocellate Pant.				18%	8.00%							5.00%
Amphora ovalis Kützing		7.00%	6.00%									
Cymbella microcephala Grun.								4.06		6.70%		
Diatoma vulgaris Bory	3%						7.24	3.82				
Cocconeis placentula var. pseudolineata Geitler						6.00%						