ECOLOGICAL STATE OF LAKE DUROWSKIE: ALGAE ASSESSMENT

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Abstract

Lake Durowskie is one of many lakes in Wągrowiec, Poland, which is affected by eutrophication and low water quality 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, a collaboration of universities and the local government started annual research to monitor the restoration methods implemented through biomanipulation. Algae is a good indicator of the ecological state due to diversity of the species. Algae are sensitive indicators for physico-chemical properties, as well as prominent actors in the food web. In this study, samples were collected for both periphyton and phytoplankton at different sites around the lake. From the samples, identification of species was carried out and data was compiled to perform specific indices and calculations. From the results, both periphyton and phytoplankton analysis showed indicators of a eutrophic lake. However, biodiversity and some mesotrophic areas are increasing, and this implies that the water quality of the lake has slightly improved from the previous years. Even with these small improvements, there are still management options that can be done to achieve an optimal water quality for both the ecosystem and the people who use the lake.

Introduction

Wągrowiec is located on the Northwestern region of Poland, which is about 50km from Poznan and Bydgoszcz. This small town has a total land area of the town is 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. The lakes also serve as a water source for agriculture. The main lake that is a concern for the municipality is Durowskie Lake due to its attraction for tourism and recreational use.

The lake is surrounded by buildings and some agricultural fields, which causes some levels of eutrophication since 1999. Surface runoffs from agriculture pollute the lake with mostly nitrogen (N), phosphorus (P) and potassium (K) through fertilizers, pesticides and other agricultural chemicals. This level of pollution is mainly from other lakes, which then flow into the Lake Durowskie causing an 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 lake.

Researches and restoration measures, which started in 2009, have been made to restore the quality of the lake. The restoration measures implemented to improve the quality of the lake include biomanipulation which involves including pike, aeration of hypolimnion with aerators and phosphorus immobilization by adding ferrous ion (Fe^{2+}).

Research is done annually to investigate 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 from algae, macrophytes, macroinvertebrates, to hydrology to investigate the ecological stat of the lake, which will decide which management techniques best resolves the challenge of improving the quality of the lake.

Algae is a good indicator for the quality of water due to its diversity. Algae are primary producers and help shape the food web for the body of water that they inhabit. Any shifts in species can cause effects in higher trophic levels through feeding relationships, population growth or overall structure. (McCormick, 1994). Therefore, algae are important in assessing the overall ecological state in lakes.

In 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 2018 is another objective of this study to find progress of restoration efforts of the lake.

Materials and Methods

Study area

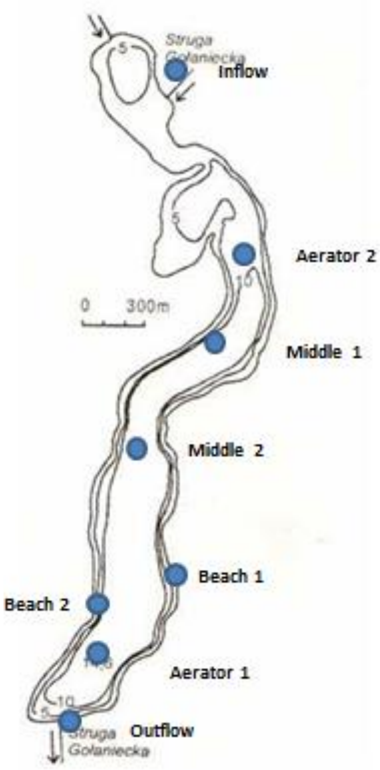
Lake Durowskie, the study site is in the town of Wągrowiec with coordinates 52^{o} N 49’ 06” and 17^{o} E 12’ 01”. The 14.6 meters deep, post-glacial lake is connected to other upstream lakes and it is a tourist destination known for its sporting and beach facilities. The lake is also surrounded by various flora species. Comprehensive information about the lake could be seen in Table 1.

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

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

Sampling

Water samples from 12 were taken for Periphyton analysis, while 8 sites were taken for Phytoplankton, Figure 1 and Figure 2 respectively. Water samples (30L) were collected at different depths from 0 to 3 meters and filtered using the plankton nets to analyze the vertical distribution of phytoplankton and then preserved with Lugol's iodine. Samples were also taken from stones along the shore to analyze periphyton samples, also being preserved with Lugol's iodine.



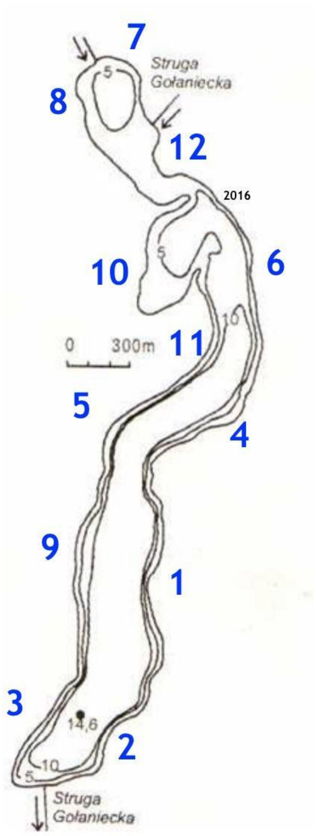


Figure 1: Phytoplankton sampling sites

Figure 2: Periphyton sampling sites

Physico-chemical parameters

Physico-chemical parameters such as temperature, pH, conductivity and dissolved oxygen were analyzed at various points on the Lake using the multi-parameter water quality meter (YSI 556) while the secchi disc was used to measure transparency. Water samples were also collected from the same sites to analyze Chlorophyll-a.

Laboratory analysis

Individual Measurements

Quantitative analysis was carried out to determine the number of individual species (periphytons and phytoplanktons) per liter. The number of individual species per 100 cells was counted under the microscope, while the conversion factor was determined with the following equation:

Sample concentration 30 mL from 30 L; 30 000 mm^3: 1.25 mm^3 = 24 000
24 000 – 30 L
x – 1L
x = 800 – factual concentration
The total number of individuals counted in 100 cells was multiplied by 800 to determine the individual number of cells per liter.

Biomass Measurements (mg/L)

To estimate the biovolume of 1 cell of algae species; the biovolume (1 cell) is multiplied by cell count in 1mL, then divide the value derived in step 1 by 10^9 to get the biomass (mgL^{-1}). The biomass was always given to 3 decimal places.

Data Analysis

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.

Phytoplankton

Mixed Index of Nygaard

This method was developed depend on number of species from all different taxonomical groups.

$$\text{Mixed Index} = \frac{\text{Cyanobacteria+ Chlorococcales+ Centric diatoms+ Euglenoids}}{\text{Desmids}}$$

Classes of different trophic level as mentioned in below.

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

Jaccard Index (Jaccard, 1912)

The Jaccard index is used to compare species in different sites.

$S_J = a/(a + b + c)$

S_J = Jaccard similarity index;

a = number of species common to (shared by) site;

b = number of species unique to the first site;

c = number of species unique to the second site.

Diversity Index

Diversity and evenness of phytoplankton species in different sites can be measured by using Shannon-Wiener diversity and evenness indices.

$$H' = -\sum_{i=1}^{s} p_i \log(p_i);$$

H’ - Shannon index;

p_i – relative abundance of each species in the site

$$E = \frac{-\sum p_i \times \log(p)}{\log(S)};$$

E – Evenness (equitability);

S – Total number of species in each site

Phytoplankton Multimetric for Polish Lakes (PMPL Index)

Parameters important for this index are Chlorophyll-a, total biomass and cyanobacteria biomass. These parameters have ranges from 1 to 5. Also, this index is used as a tool for ecological state evaluation in Europe according to the Water Framework Directive.

$$\text{PMPL} = \frac{[\text{YCh} + \text{YBm} + \text{YCy}]}{3}$$

YCh - Chlorophyll-a concentrations

YBm - General biomass of phytoplankton

YCy - Biomass of cyanobacteria

Value obtained for PMPL is indicating different classes of tropic levels as below:

Ecological status	**PMPL**
very good	0,0 - 1,0
good	1,01 - 2,0
moderate	2,1 - 3,0
poor	3,1 - 4,0
bad	4,01 - 5,0

Periphyton

Periphyton species were collected from submerged stones at 12 stations along the lake shore. Samples were preserved using Lugol's iodine solution before taking the samples to the laboratory for analysis. The diatom index was used to determine the ecological condition of lake. Diatom index can only be determined when at least 10 species sensitive to trophic level are present in a sample. To calculate Diatom index, trophy index (TJ), the index of referential species (pGR) and their standardization are needed. For estimation in oxygen saturation, trophy and alkalinity, van Dam's ecological indicators values were used (van Dam et al., 1994).

Trophy index (TJ)

$$TJ = \frac{(TJi \times wTJi \times Li)}{(wTJi \times Li)};$$

TJi - sensitivity of species for the trophic state;

wTJi - range of the tolerance of the algal species;

Li - number of specimens of the determined species divided by the number of all identified individuals in the sample

Index of referential species (pGR)

$$pGR = \frac{NB - (NC + ND)}{NB + NC + ND};$$

NB - number of referential species for all lakes;

NC - number of referential species for deep lakes and of degradation species in shallow lakes;

ND - number of degradation species for both kinds of lakes

Transformation of standardized value in the range from 1 to 0,

$Z - TJ = 1 – ((TJ - 1) \cdot 0.25)$

$Z – pGR = (pGR + 1) \cdot 0.5$

Diatom Index

$DI = (Z\text{-}TJ + Z\text{-}pGR) / 2$

Obtained value for the Diatom index indicates ecological state for lake as bellow.

Diatom index	**Class**
> 0,83	Very good
0,55 - 0,82	Good
0,30 - 0,54	Moderate
0,15 - 0,29	Poor
< 0,15	Bad

Result

Phytoplankton

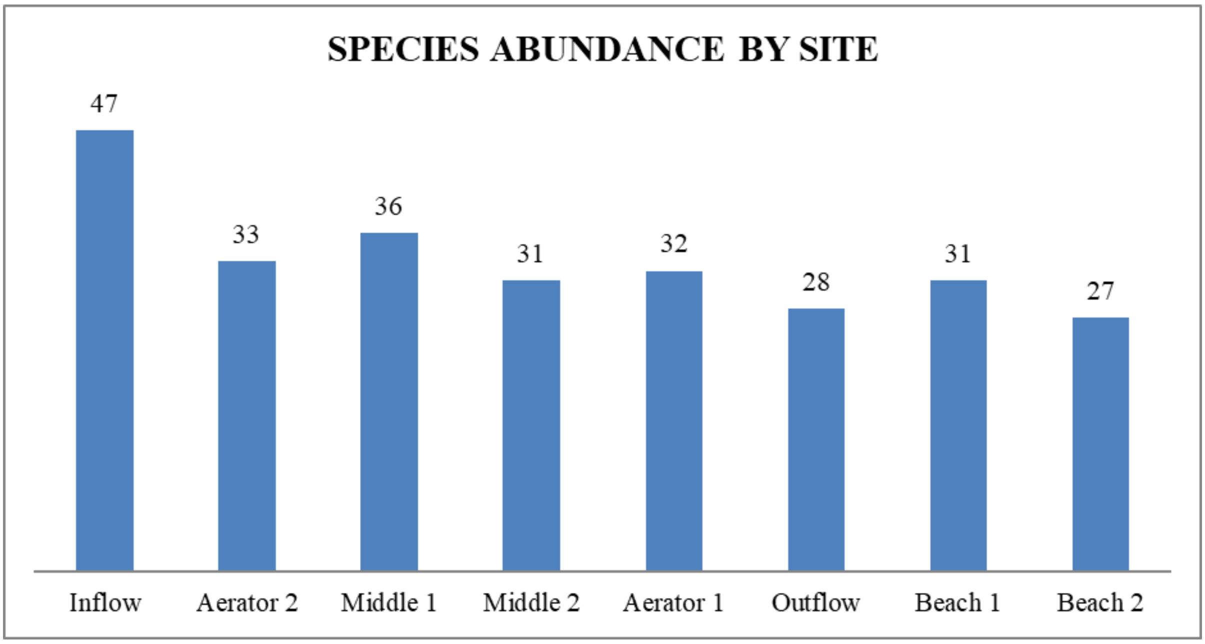


Figure 3: Species abundance of Phytoplankton at each site.

According to the results of the water sample study, it was established that in inflow the number of species is more than at other sites. All the other sites around the same number of species abundance.

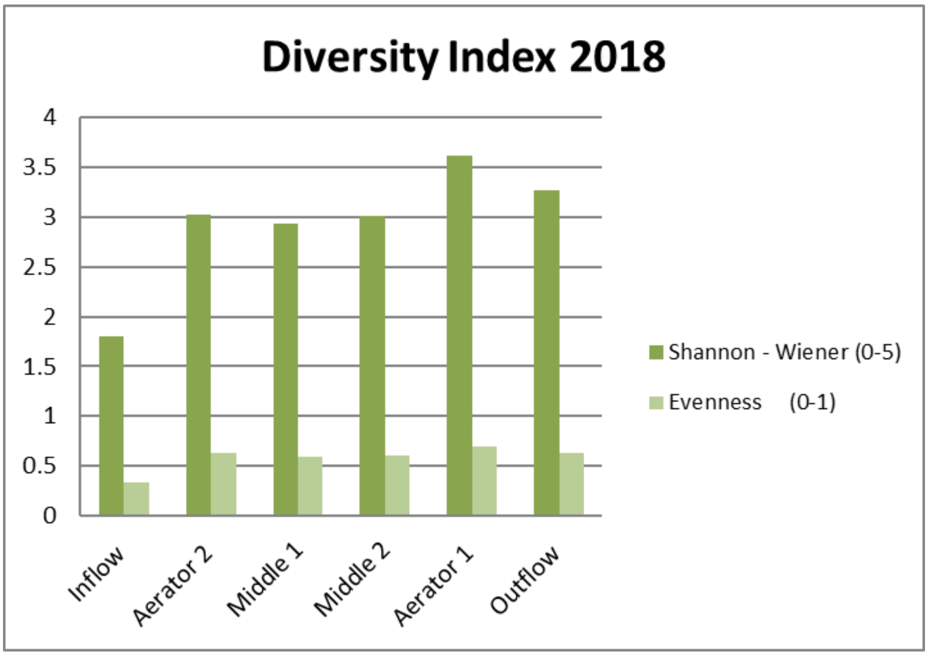


Figure 4: Phytoplankton diversity indices at each site.

Algae species is diverse on each site of the lake according to the Shannon-Wiener index and the evenness index, except for inflow. The highest index at the point Aerator 1, which is 3.8 while the lowest index at the point of Inflow point, 1.8.

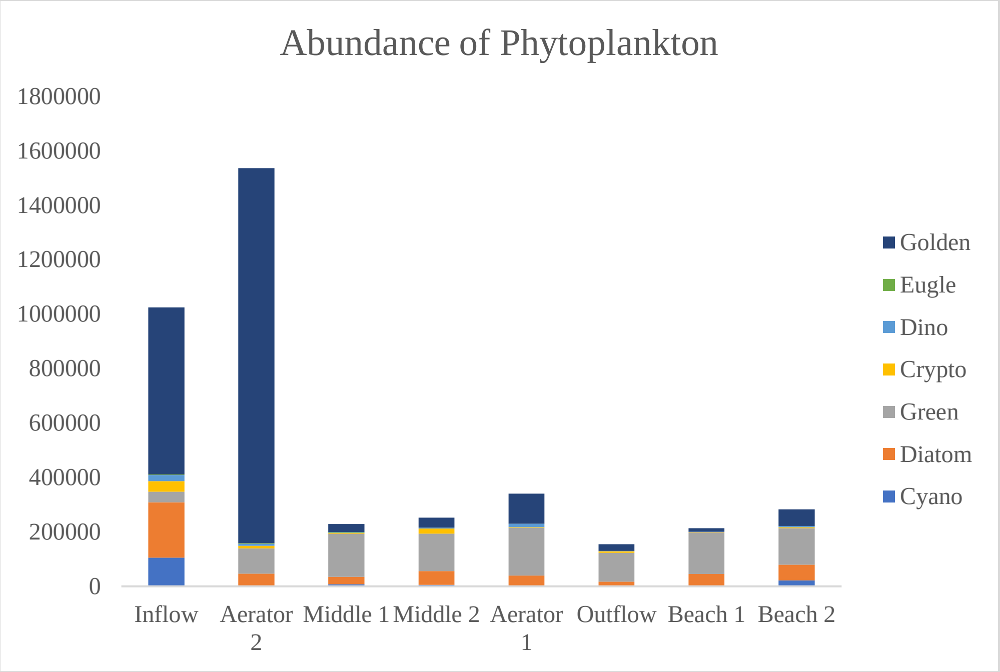
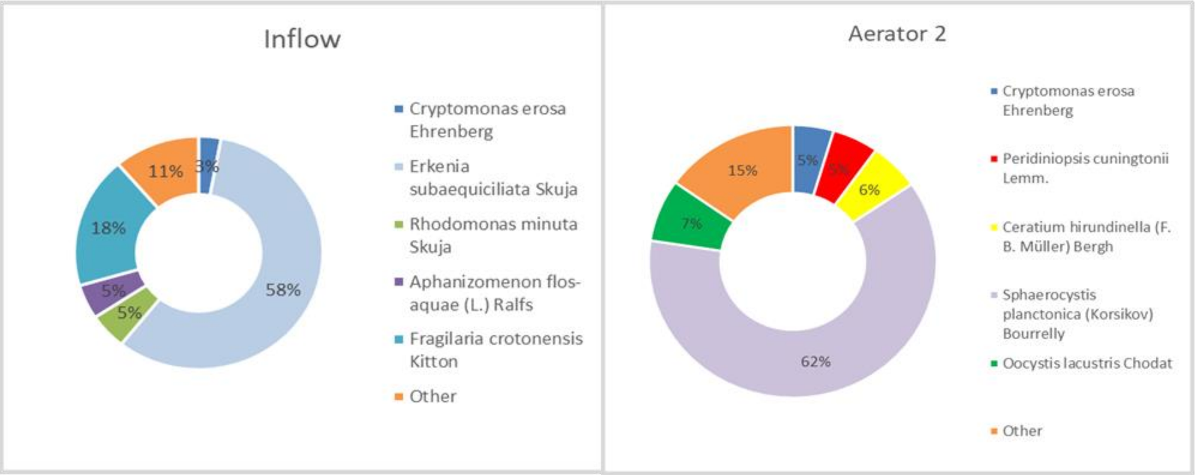


Figure 5: Phytoplankton group abundance for each site.

The community of green algae, Chlorophyta, have been found at all points. The highest content of the golden algae at the point Aerator 2. The smallest content of the algae was at the point of Outflow.



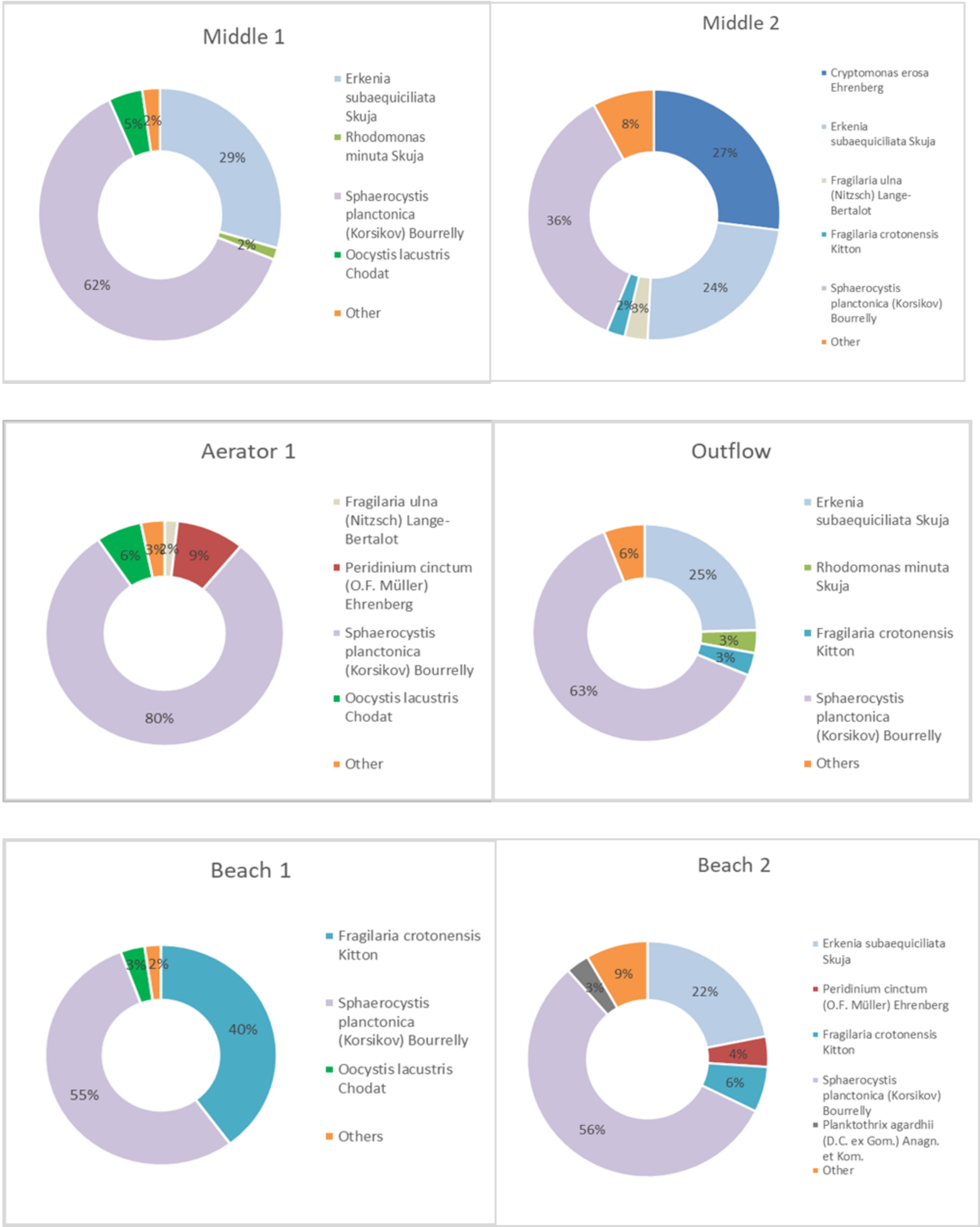


Figure 6: Dominant Phytoplankton species abundance percentages for each site.

According to the results of studies of the species of the algae, it was found that *Sphaerocystis planctonica* is the dominant species at all points except Inflow. *Erkenia subaequicllata* was also prominent in most of the sample sites.

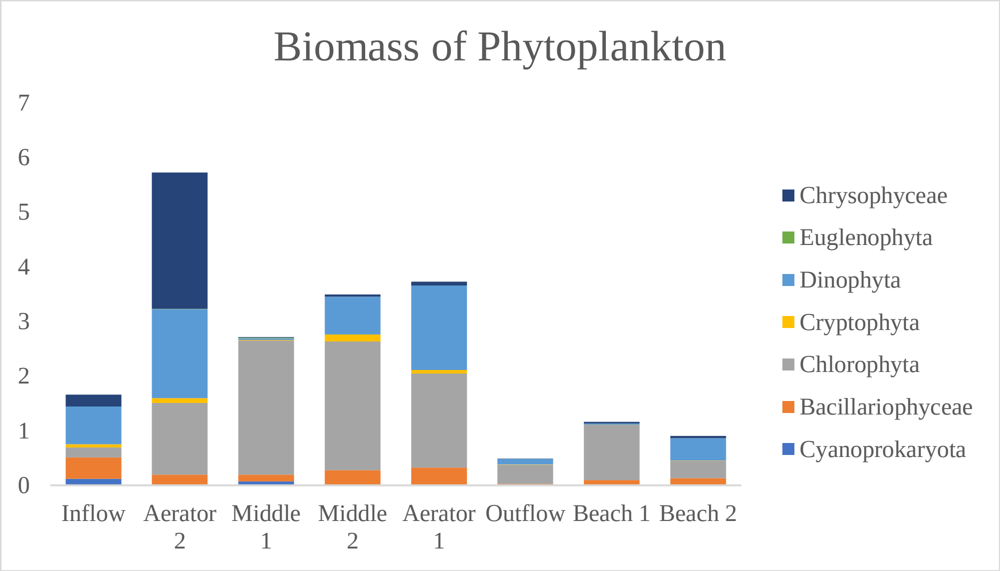
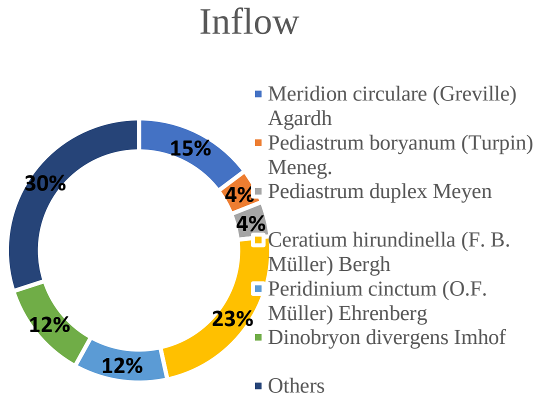
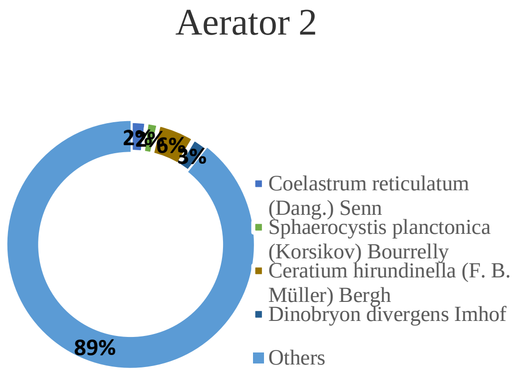
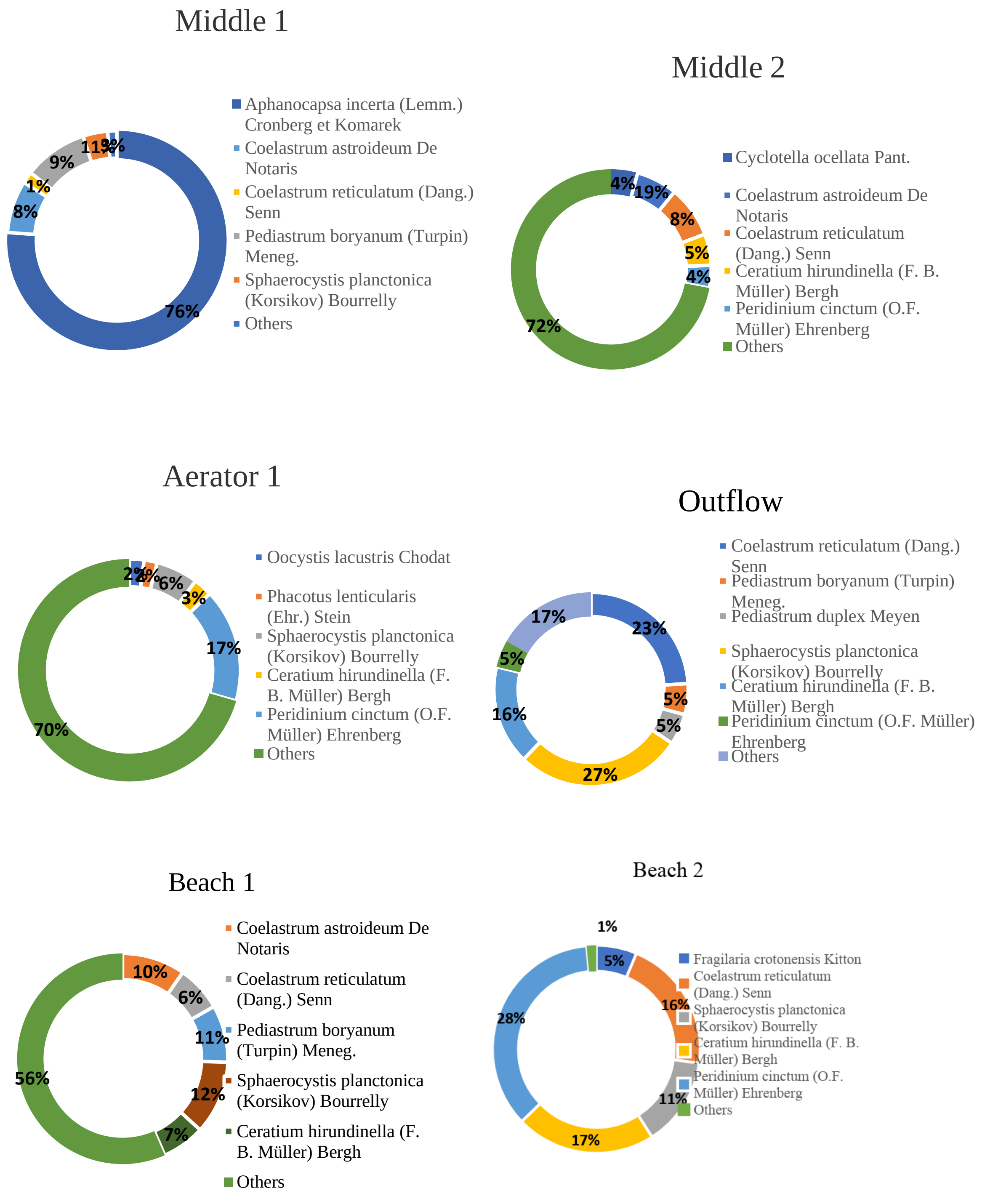


Figure 7: Phytoplankton group biomass for each site.

When measuring the biomass of phytoplankton, it was revealed that the main biomass groups of lake were Chrysophyceae, Dinophyta and Chlorophyta. The smallest biomass was Cyanoprokaryota.

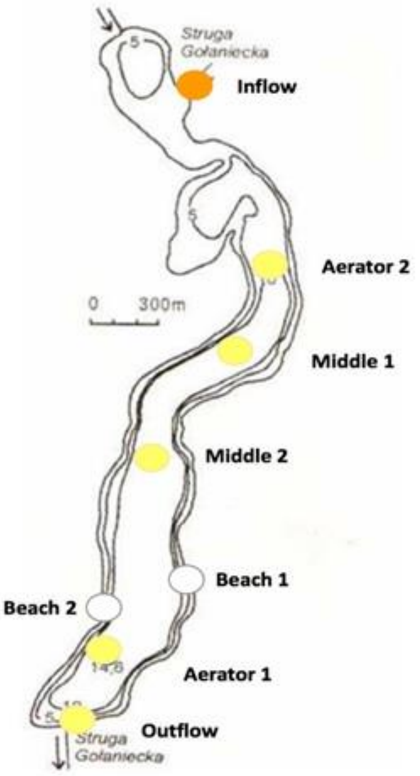


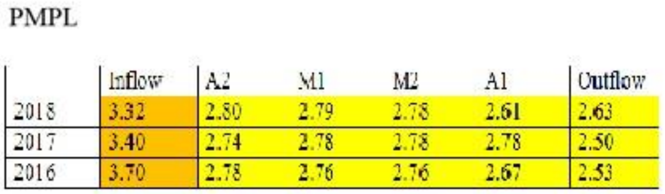




The dominant species in point Inflow was *Peridinium cinctum.* At the outflow the dominant species were *Sphaerocycystis planktinica*. At the sites Middle 1 dominate species was *Aphanocapsa incerta.*

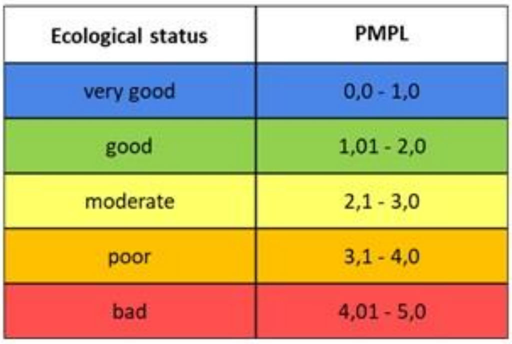
Figure 8: Dominant Phytoplankton species biomass percentages for each site.





PMPL

	Inflow	A2	M1	M2	A1	Outflow
2018	3.32	2.80	2.79	2.78	2.61	2.63
2017	3.40	2.74	2.78	2.78	2.78	2.50
2016	3.70	2.78	2.76	2.76	2.67	2.53



Ecological status	PMPL
very good	0,0 - 1,0
good	1,01 - 2,0
moderate	2,1 - 3,0
poor	3,1 - 4,0
bad	4,01 - 5,0

Figure 9: PMPL from 2016 to 2018.

The PMPL index was at the level moderate, except the Inflow point, where high nutrients for algae growth. Over the last three years, the ecological status has stayed the same.

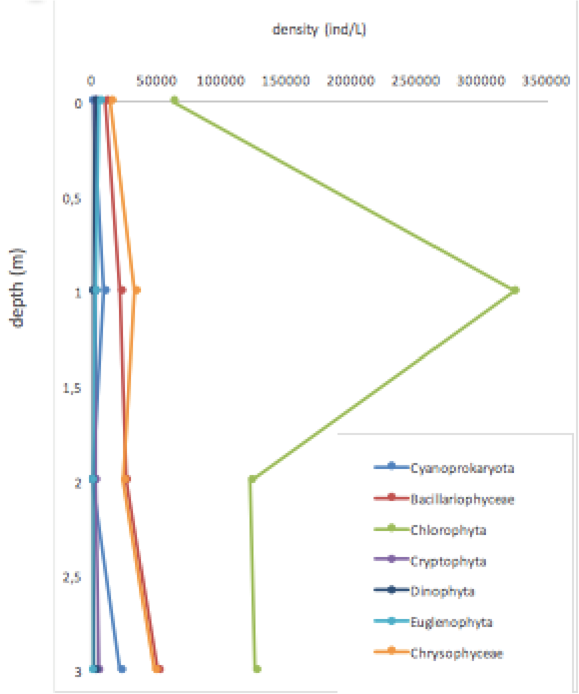


Figure 10: Vertical distribution of Phytoplankton groups.

The highest density was in chlorophyte compared to other species. The highest density of this species at a depth of the 1 meter, which is 330000 ind/L.

Periphyton

Table 2: Dominant diatoms in periphyton community in Lake Durowskie in June 2018

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 exigua Grun.								7				
Achnanthes minutissima Kützing	26	18	19	15	13	8	7		7	5	9	8
Achnanthes minutissima var. affinis Kützing						8			7			
Amphora ovalis Kützing		8	6									
Amphora pediculus (Kütz.) Grunow		6	7						5			
Cocconeis pediculus Ehr.									6			
Cocconeis placentula Ehr.		7	12			7		10	6			
Cocconeis placentula var. pseudolineata Geitler						6						
Cyclotella ocellata Pant.		9		21	9							5
Cyclotella radiosa (Grun.) Lemm.				4				5				
Cymbella afinis Kützing							5			11		
Cymbella microcephala Grun.	4										4	
Cymbella minuta Hilse ex Rabenhorst	4			4	6	14	7			4	4	
Cymbella tumida (Bréb.) Van Heurck	4										4	
Diatoma vulgaris Bory							7					
Fragilaria capucina Desmazieres *var. capucina*	5			4			8				4	7
Fragilaria crotonensis Kitton					4		5	6				
Fragilaria exigua Grun.								6				
Fragilaria pinnata Ehr.			6	5		7		5				5
Gomphonema olivaceum (Horn.) Breb.					11				11	15		8
Gomphonema parvulum (Kütz.) Kütz.										5		
Meridion circulare Ag.				7								

Table 2 shows the number of dominant species across the 12 sites where samples were taken. The table above shows the most dominant diatoms within the periphyton community. It also shows that *Achnanthes minutissima* Kützing has the highest number of individuals total for all 12 sites. Others include *Gomphonema parvulum, Cyclotella ocellata, Cymbella minuta, Cocconeis placentula*.

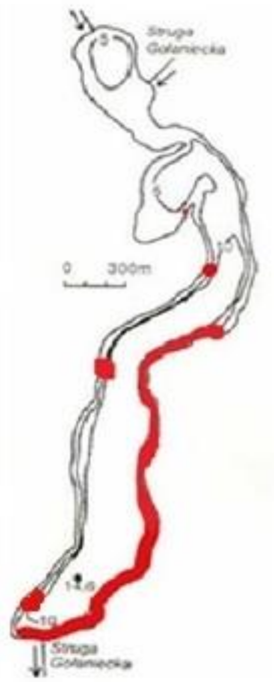


Figure 11: Map of red algae distribution in 2018.

Figure 11 shows the spread of red algae (*Hidelandia rivularis*) close to the shores of the lake. Particularly, the red algae occurred majorly in Aerator 1, Beach 1, Middle 2, Middle 1 and slightly occurred in areas close to Beach 2 and Aerator 2.

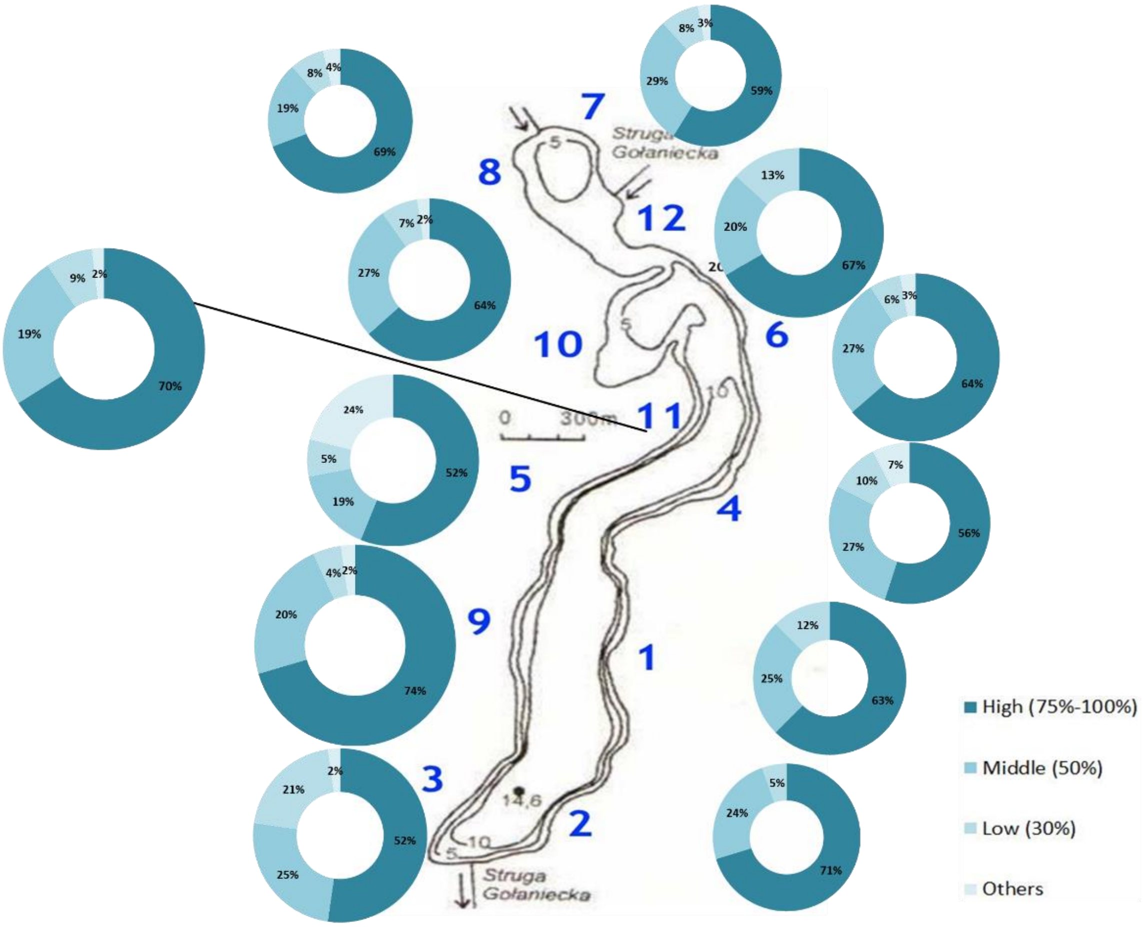


Figure 12: Periphyton O_2 preference for each site.

Figure 12 shows oxygen saturation and species preference ranging from high to low and others. It also shows that oxygen saturation points are “high”.

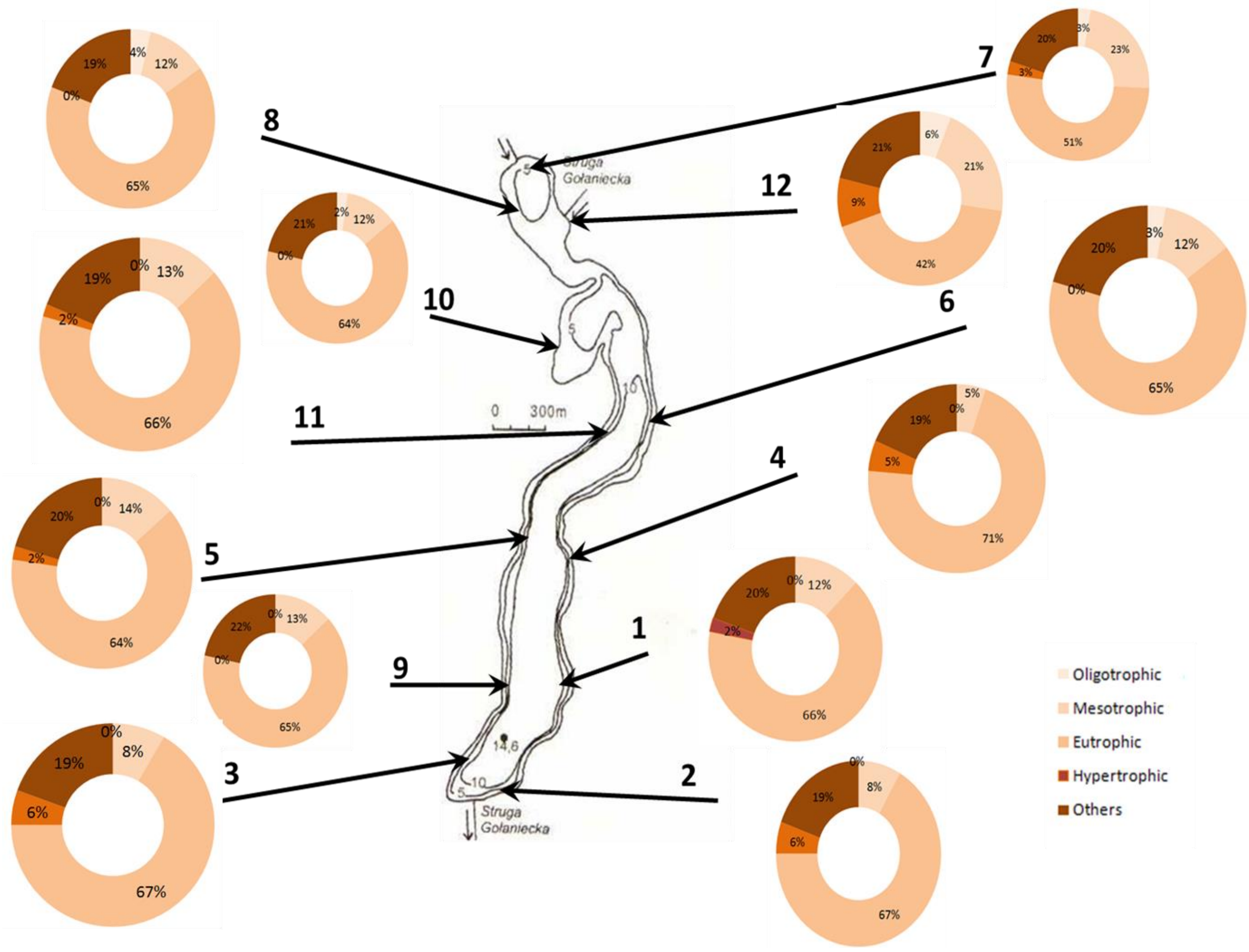


Figure 13: Periphyton trophic preference for each site.

Figure 13 shows the various trophic states of the water and species abundance in these various states in percentages. The result also indicates the eutrophic state of the Lake Durowskie; however, mesotrophic levels are increasing.

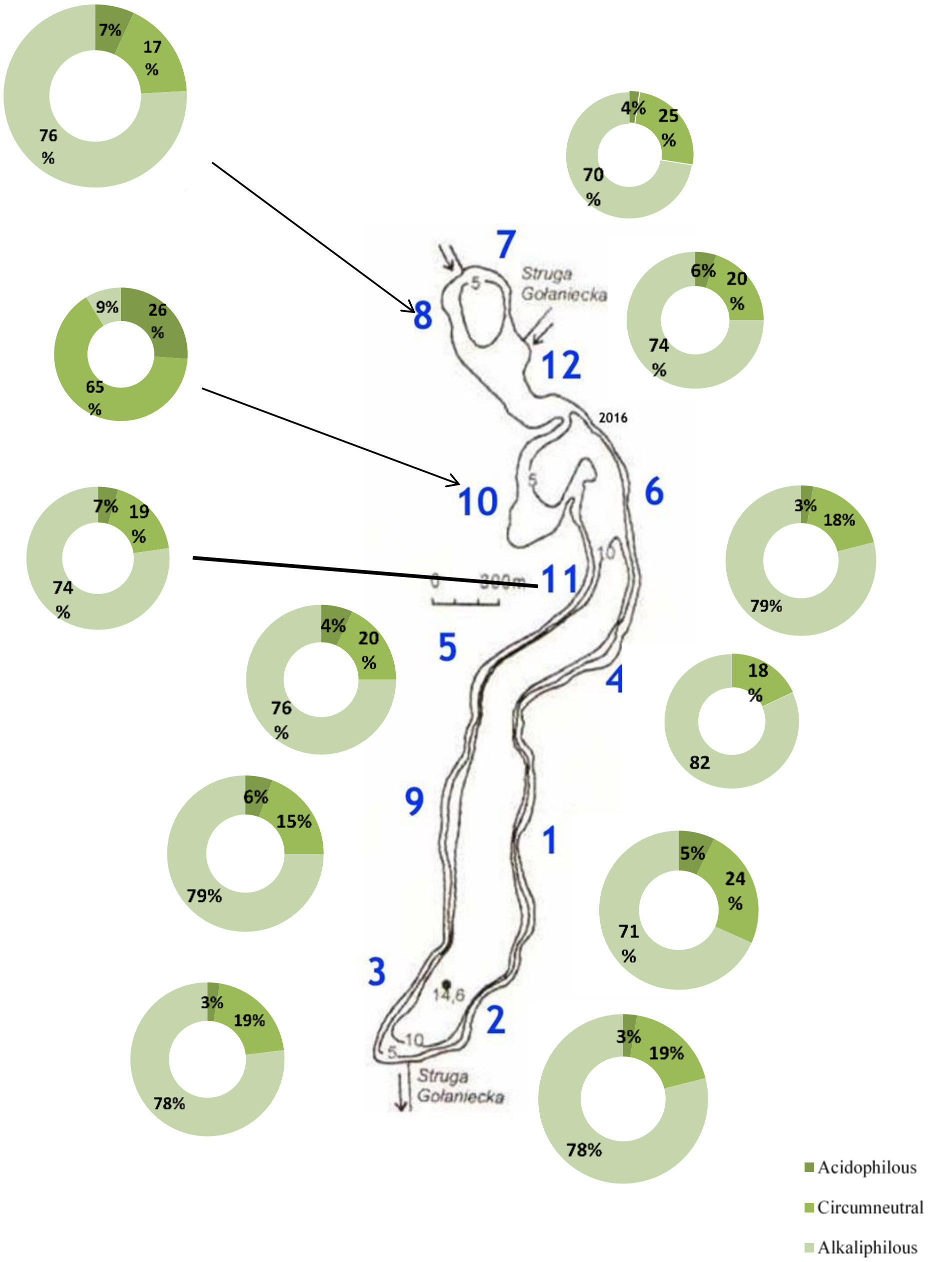
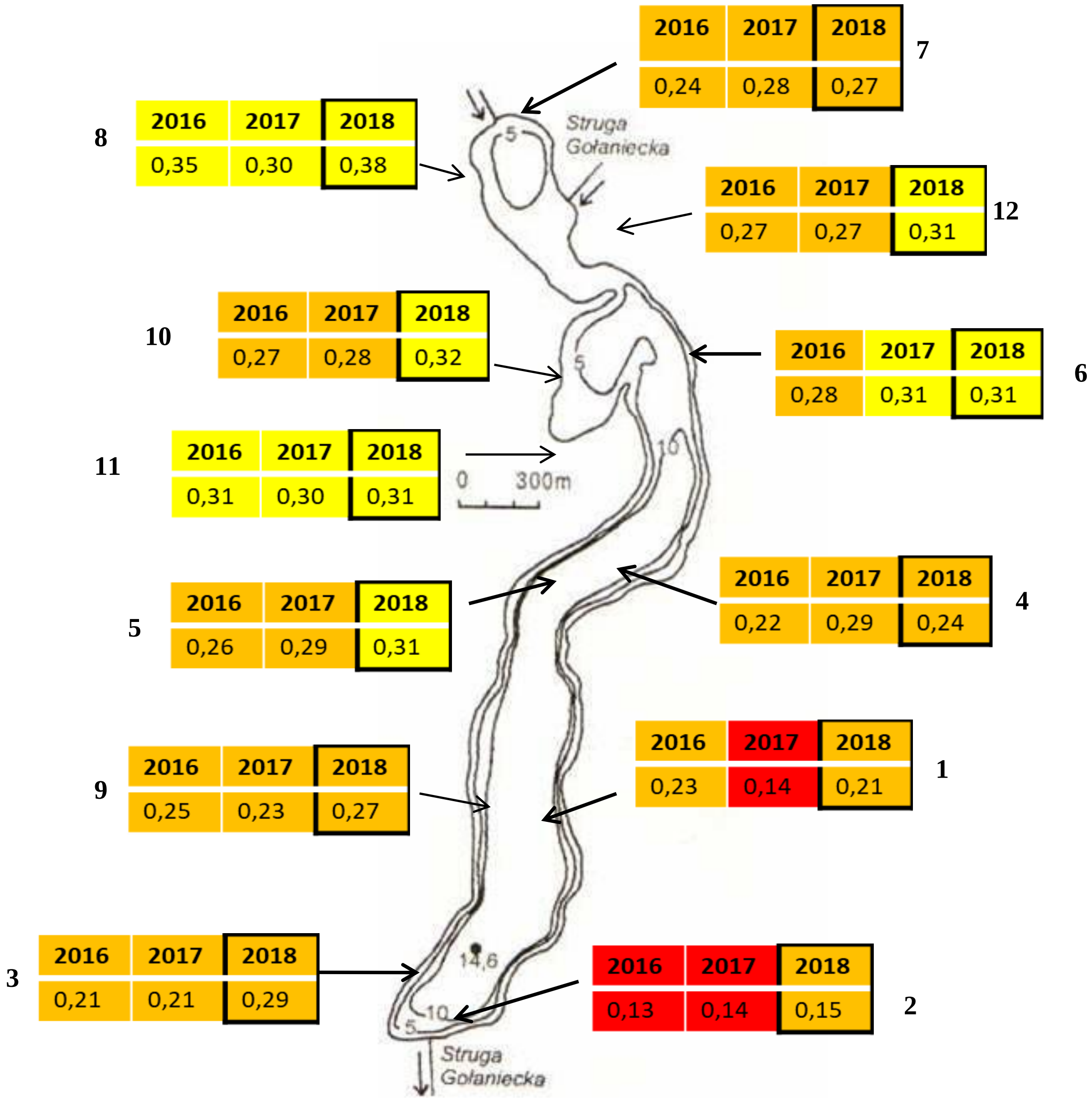


Figure 14: Periphyton pH preference for each site.

Figure 14 above shows different species indicators from acidophilous to alkaliphilous in all 12 sites were samples were taken. All results are shown as percentages. Most sites indicate alkaliphilous species; however, in site 10, majority of species in this area were noted to be circumneutral.



>0,83	Very good
0,55	Good
0,30	Moderate
0,15	Poor
<0,15	Bad

Figure 15: Periphyton Diatom Index from 2016 to 2018.

The figure above shows the diatom index and compares the periods 2016 to 2018. Overall, the diatom index shows that there are slight improvements; however, it remains within the “poor” boundaries.

Comparison

Phytoplankton

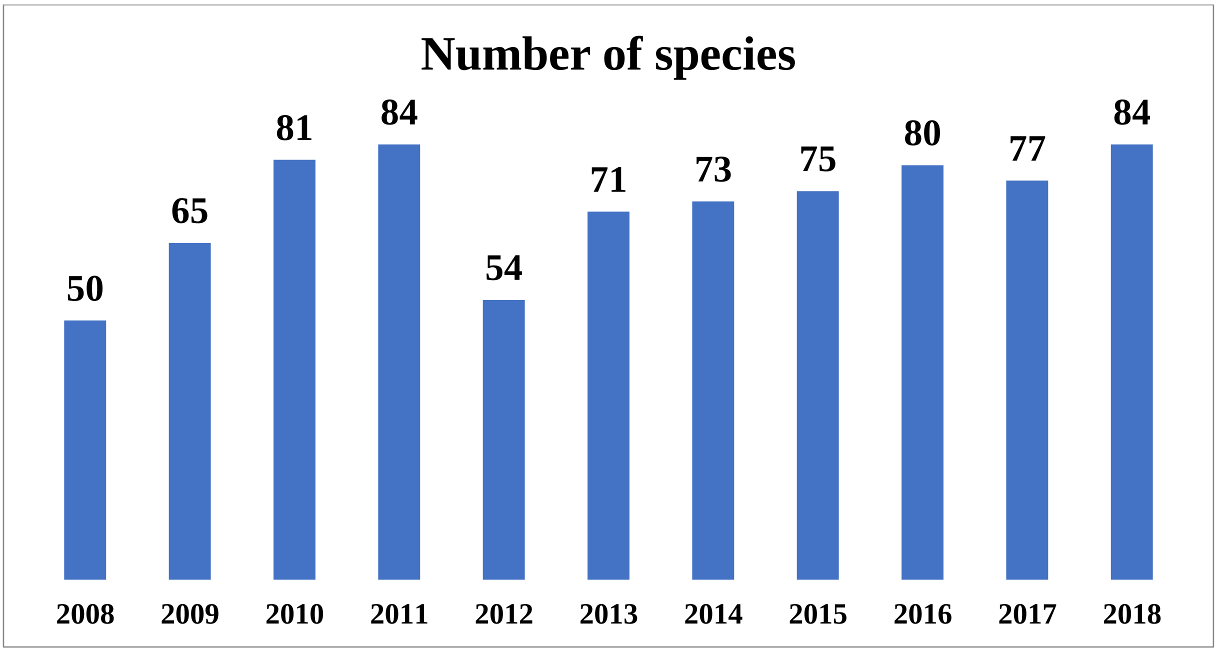


Figure 16: Total species numbers since 2008.

The total number of species between 2008 and 2018 was highest in 2018 while 2008 shows the lowest total number of species.

Table 3: Jaccard Index from 2008 to 2018.

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

According to the Table 3 above, it shows that 2018 has higher species diversity when compared to 2008 because there are less common species.

Table 4: Mixed index of Nygaard from 2009 to 2018.

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

The trophic condition of Lake Durowskie is monitored through mixed index according to Table 4. The inflow point showed high values in 2011 and 2015 while in 2018, the value dropped to 7 which still indicate the eutrophic condition of the lake.

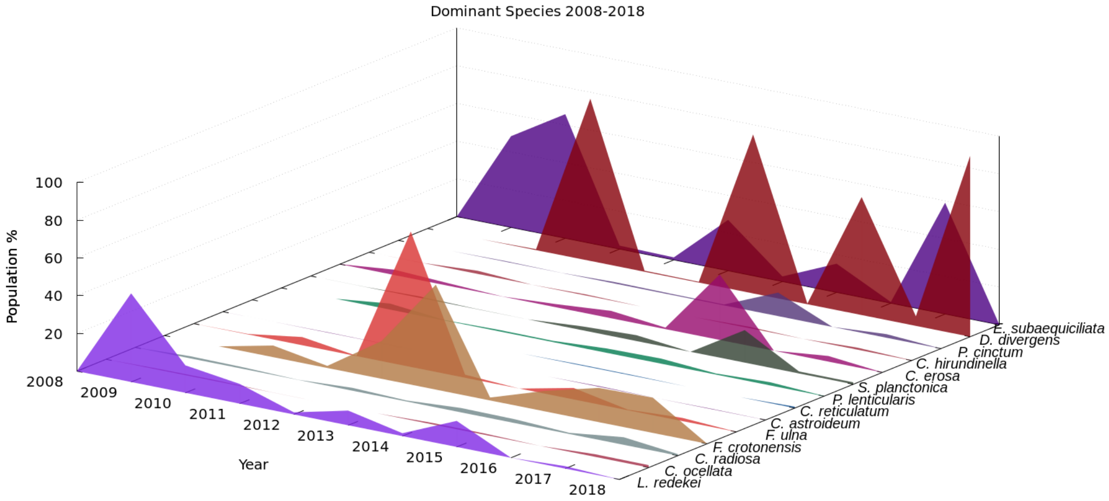


Figure 17: Phytoplankton dominant species from 2008 to 2018 at Inflow site.

In a comparative analysis of the last ten years at the inflow, *D. divergens* exhibits increasing dominance up to 90% with *C*. ocellata slightly appearing in 2018. For example, the population of *L. redekei* in 2008-2010 was on the average 60%. Presently, the population of *L. redekei* is less than 10%. There was also a significant decrease in the population of *E. subaeguicillata* between 2012 and 2016 according to the figure above.

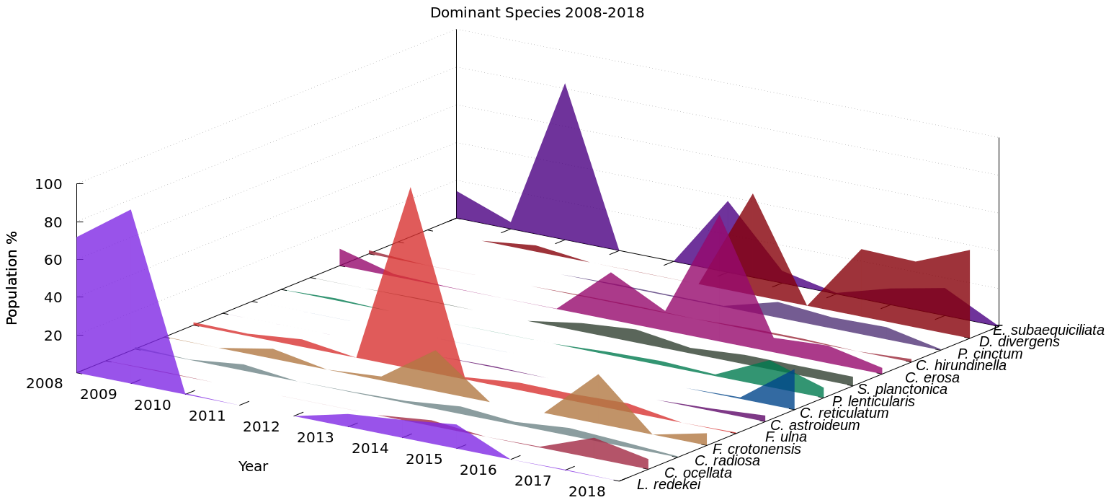


Figure 18: Phytoplankton dominant species from 2008 to 2018 at Aerator 2.

In Aerator 2, *L. redekei* and *E. subaequicilata* were dominant between 2008 and 2011. There was an increase in the following species of populations *D. divergens* and *S. planktonica* in the figure above.

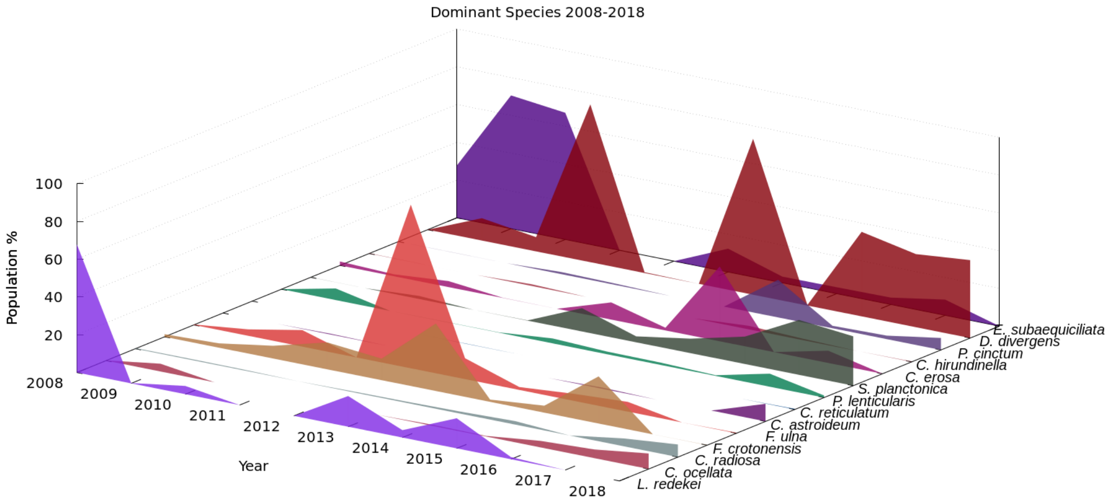


Figure 19: Phytoplankton dominant species from 2008 to 2018 at Aerator 1.

In the Figure 19 above, it was observed that at Aerator 1 over the period *D. divergens* was dominant while *F. ulna* is seen to be dominant between 2013 and 2014.

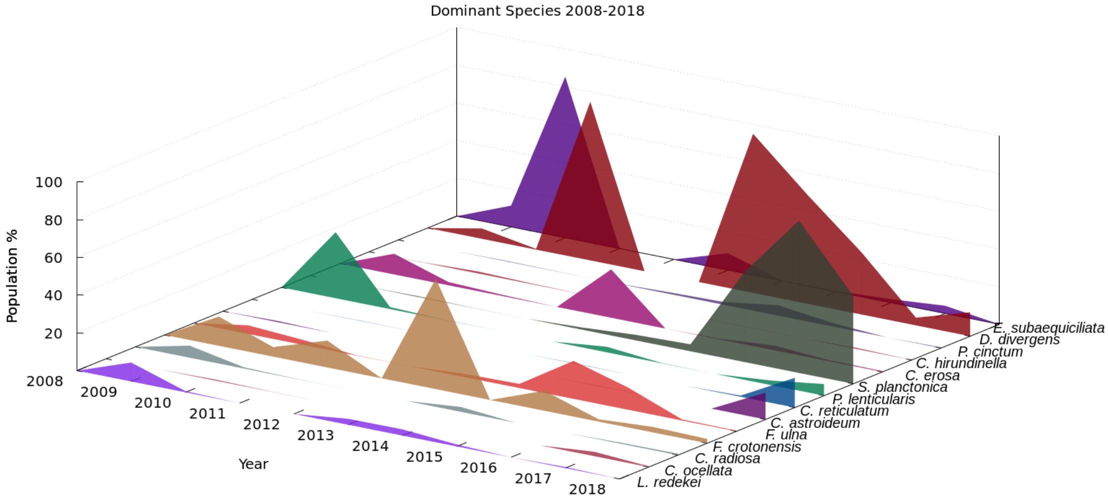


Figure 20: Phytoplankton dominant species from 2008 to 2018 at Outflow site.

The figure above shows that *S. plantonica* is most dominant over the period while *D. divergens* is seen to decrease significantly with time.

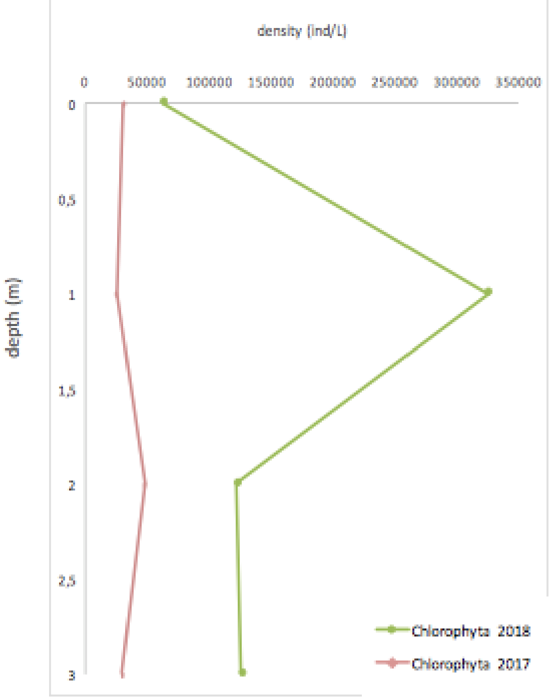
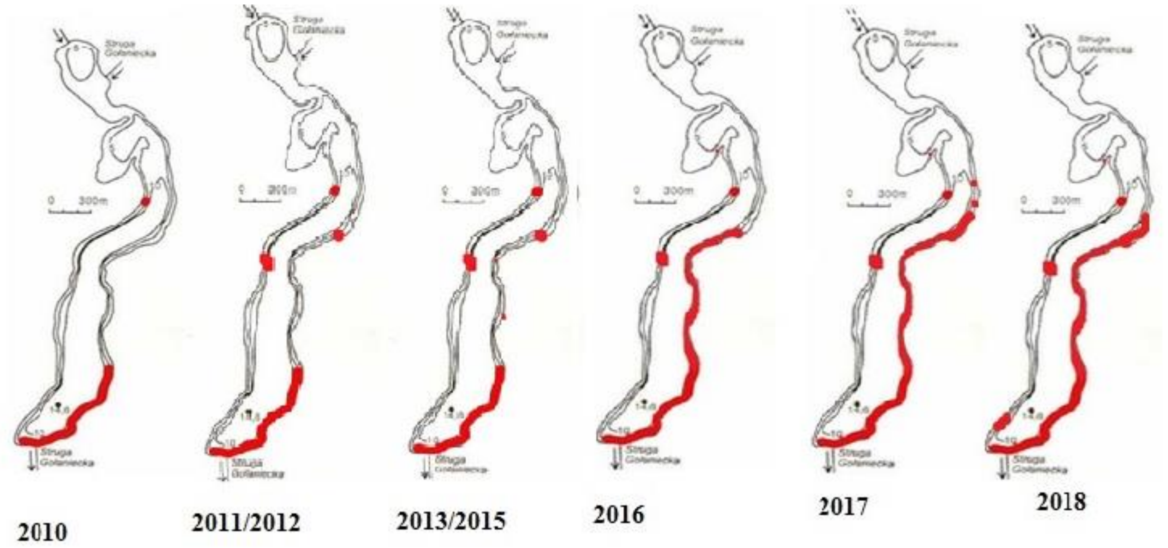


Figure 21: Comparison of Chlorophyta between 2017 and 2018 at Middle 1 site.

Figure 21 shows that a higher density of the group Chlorophyta is present in 2018 with a value of about 300000 mg/L while 2017 shows the lower values.

Periphyton



2010 2011/2012 2013/2015 2016 2017 2018

Figure 22: Maps of red algae from 2010 to 2018.

Red algae (*Hidelandia rivularis*), which is an indicator of water quality, is seen to have spread across the lake in the last eight years. The spread is more significant in 2018 than in 2010. The expansion of the red algae in Lake Durowskie is an indicator of an increase in the purity of the reservoir.

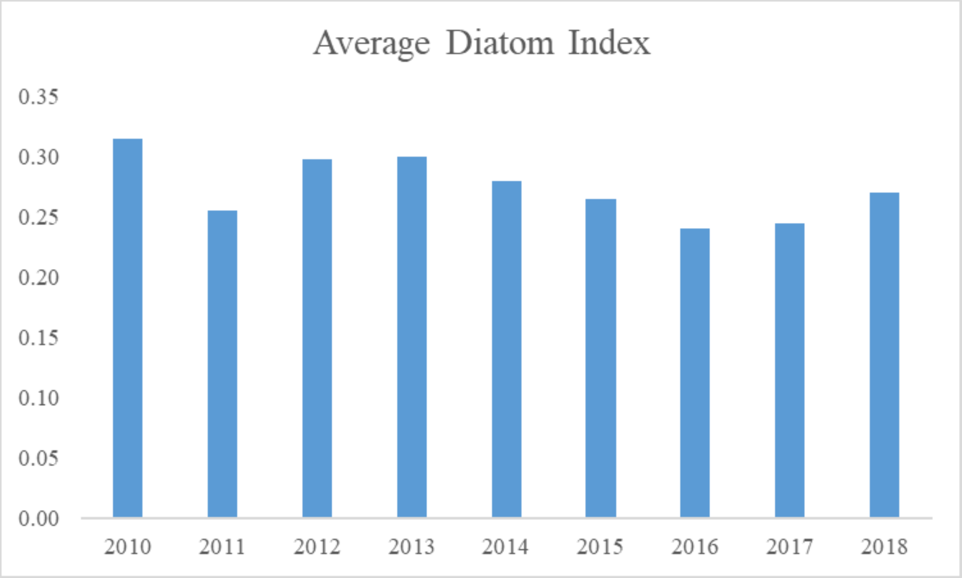
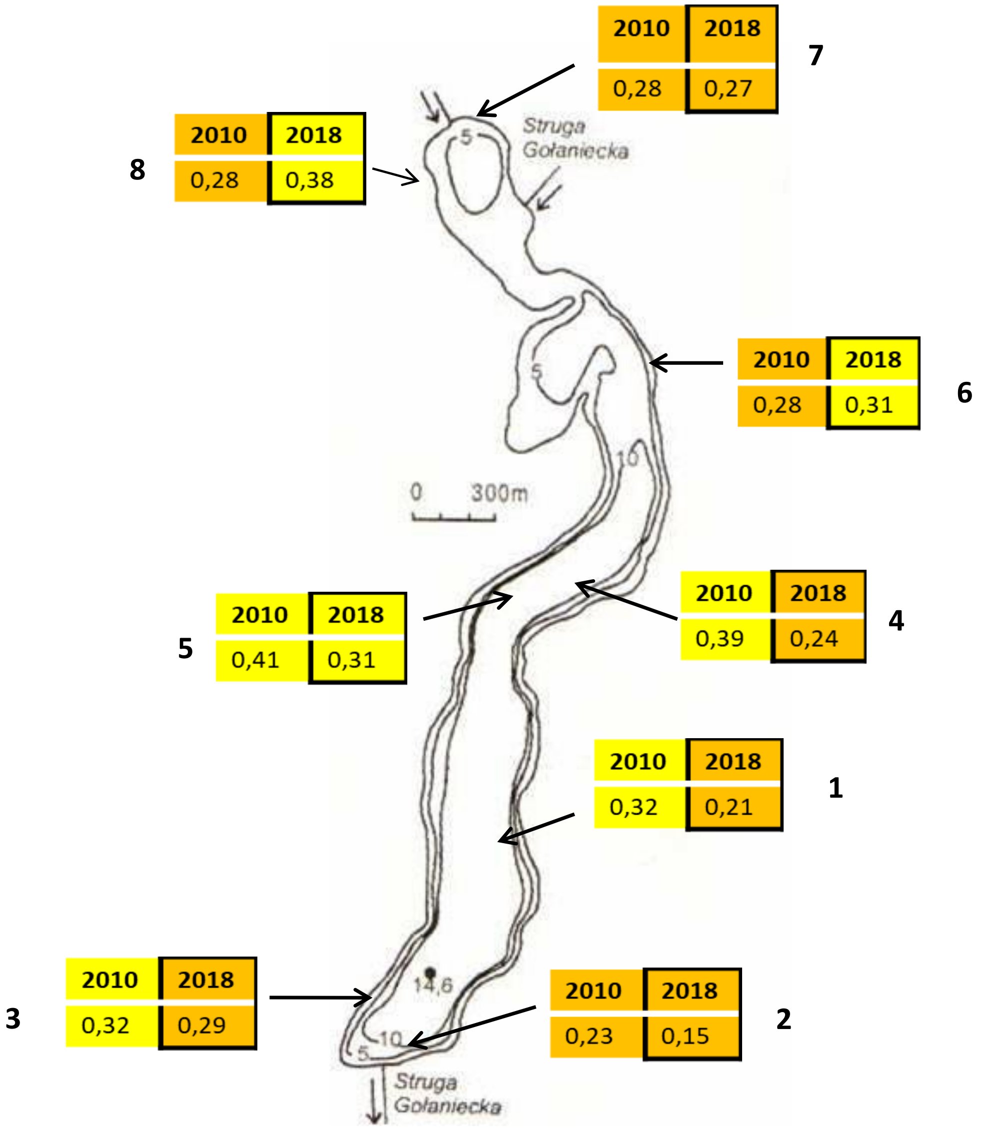


Figure 23: Average Periphyton Diatom Index from 2010 to 2018.

Figure 23 shows that the average diatom index decreased over time. As seen in 2010 which shows the highest value of average diatom index while 2016 and 2017 show the lowest average diatom index.



>0,83	Very good
0,55	Good
0,30	Moderate
0,15	Poor
<0,15	Bad

Figure 24: Periphyton Diatom Index comparison between 2010 and 2018.

From Figure 24, we see slight changes over the years when considering 2010 and 2018. The figure also indicates that the lake is still in a poor condition.

Discussion

Phytoplankton

According to the results, there was a higher number of species based on density in the inflow of Lake Durowskie. The reason for this result is because the inflow point is the connecting point for four other lakes which makes Durowskie the last Lake among five. More nutrients from agriculture and sewage are accumulating through the other four lakes connected to the Durowskie Lake and then flow into it causing a higher abundance at the inflow because algae are nutrient dependent (McCormick, 1994). It can also be seen from the results that further away from the inflow there is a decrease in algae abundance. This is because the nutrients disperse in the lake.

In contrast, to the abundance, there are less algae biomass at the inflow site. While there are more number of individuals, the species that are abundant are smaller in size. This can also be seen at sample sites near the shore. In comparison, the species in the middle of the lake are larger in biomass and this trend can be explained through the dominate species present. Species like *Sphaerocystis planctonica, Oocystis lacustris,* and *Erkenia subaequiciliata* are known for their big size and wide cell wall, which make it hard for zooplankton to eat them (Johnson, 2002). This also explains the trend where there are low number of individuals but have a higher biomass due to their big size. In addition, runoff includes a higher concentration of Silicon dioxide, SiO_2, so this condition is best for diatoms, like *Fragilaria crotonesis* that thrive in higher concentrations of Silicon (Reynolds, 2002).

The diversity indices calculated were the Shannon-Wiener Index and the Evenness Index. The results also show that overall, the Shannon-Wiener Index was around 3. An index closer to five shows a higher species diversity (Hennink and Zeven, 1990). However, the inflow had a low value of 1.5 and this could be due to cyanobacteria dominance inflow from the other lakes. Evenness was around 0.5, which means that there was an average level of evenness. If the value was closer to one, it would mean that there is more numerically equal species (Hennink and Zeven, 1990). Inflow in this calculation was also lower than the rest of the sites. This could also be due to dominance of cyanobacteria in the inflow from the other lakes.

Another trend that was observed was the increase of *Cyclotella ocellata* and the decrease of *Cyclotella radiosa*. These species are a good indicator of the water quality improvement since *Cyclotella ocellata* prefers a mesotrophic environment, while *Cyclotella radiosa* prefer a eutrophic environment. Even though there were still *Cyclotella radiosa* found, the increased presence of *Cyclotella ocellata* shows that there is a shift towards mesotrophic levels and that water quality is improving (ANNEX 5).

From this year's calculated PMPL, it is the same as the last two years. The results show that Lake Durowskie has a moderate PMPL value. This could be since there are no pools within the lake and is epilimnion. Based on the vertical distribution profile of main phytoplankton groups, most groups were evenly distributed at each depth. However, Chlorophyta group was most dominant, especially at 1m depth. This means that Chlorophyta group prefers a depth of 1 meter because there are less predators and enough sunlight for primary producers.

Periphyton

From the results, oxygen preference for periphyton species is in the high range. Figure 12 shows that the rate of high oxygen is in the 50% and 74% range. However, site 9 had the highest oxygen preference of 74%. With the overall preference for higher oxygen level for the algae species, it can be concluded that the oxygen levels are adequate. This is because with more oxygen more species of algae can thrive (Bennion, Fluin and Simpson, 2004).

Results also show that the dominant trophic level was eutrophic. From Figure 13, there is a dominance of eutrophic trophic levels because the range from all the sites is in the 60%. Although, inflow had a lower eutrophication level, 42%, and a higher mesotrophic level, 21%, than the other site. This shows that there could be less nutrients flowing into the river. The increase in mesotrophic levels from last year's result shows that there is an overall decrease in eutrophication. This change in trophic level indicates that water quality has improved from last year based on the species and other parameters observed.

The pH distribution from Figure 14, shows that most sites are in the 70% range of alkaliphilous. However, site 10 displays a dominance of circumneutral pH values. This is different than last year when site 10 had more of an alkaliphilous dominance. This shows that this site has an improvement of pH, probably due to less algae production. With more alkaliphilous sites it is indicated that the lake is eutrophic (Scott, Lucas and Wilson, 2005). Although, circumneutral levels are still prominent, similar to last year.

The diatom index shows that the overall water quality is still in the poor to moderate range. The Northern part of the lake is shallow and hence, more of a distribution of aquatic plants. Therefore, the North's diatom index is in the more moderate range than the Southern part. At site 1, there was an increase in quality and this could be attributed to the fact that two new macrophyte species were found around the site. Both *Chara contraria* and *Nitellopsidetum obtusa* help the water quality, so there is a correlation to these species found and the increase in water quality at site 1 (Van der Valk, 2012).

Comparisons

The Jaccard index provides a way to show how species diversity has changed over the last ten years of the study. In the 2008 and 2009 common species comparison, there was a high number of algae species in common, which can be correlated to low biodiversity. Over the years this Jaccard index has decreased, showing that biodiversity in algae species is increasing because there is less species in common. In the 2008 and 2018 comparison, the number of species in common was 52, which is a significant difference from the first the 2008 and 2009 comparison with 84 in common.

The Mixed Index of Nygaard shows that with all eight phytoplankton sampling sites, the dominate trophic state is eutrophic. However, there are some sites that are starting to become more mesotrophic. It can be seen at both beach sites, as well as at Middle 1. In 2017, both beach sites have the same value, but in 2018, Middle 1 is starting to become mesotrophic. This could be correlated to the increase of algae biodiversity seen in the indices calculated.

The overall comparison of dominant species from the last ten years shows how algae species have changed at each site. The inflow is shallow, so it has produced a high abundance of species over the last ten years. Within the first years of the study, *Limnothrix redekei* was a dominant cyanobacteria at this site. Over the years, it has disappeared; however, it has been replaced with a new dominant cyanobacteria, *Microcystis aeruginosa.* There have been peaks of the dominant species over the years, depending on what the conditions were for that year. Golden algae however have been dominant in the last 10 years.

At Aerator 2, *Limnothrix redekei,* decreases from 2008 until 2011, with very low numbers until 2013. There was an increase in 2013 to 2016 due to higher motorboat activity in the lake. The species have different dominances over the ten years of research, peaking at different years.

At Aerator 1, *Limnothrix redekei* species is similar to Aerator 2, where it peaks again between 2013 and 2016 due to motor boat activity. This site has had different dominant species over the years, as well as different peaks. However, there are more green algae present at Aerator 1 since 2014. From our result in species abundance, there is an increase of *Cyclotella radiosa* within the last few years.

At the outflow, *Limnothrix redekei* decreased, only peaking during 2013 through 2016, like Aerator 1 and Aerator 2. The outflow is where species exit the lake, so within the last few years mainly green algae have been leaving. This means cyanobacteria is not entering the rivers south of the lake.

For the comparison of the last two years of the Chlorophyte vertical profile, there is a more significant number in 2018 than in 2017. The is more than five times the amount this year than last year. This means that there is a good sign that there is an establishment of green algae is increasing. However, the high peak this year could be correlated with the warm weather because green algae thrive in these conditions.

Biomanipulation

Top-down method is a form of bio-manipulation, which involves the introduction of pikes. The reason for this method is to control the activities of perch which consume zooplanktons and to increase the zooplankton community. To assess the effectiveness of this method, it is important to analyze the vertical distribution. The last stocking of pike into the lake was in May 2018; however, it was not effective like in past years. This is because of the sizes which made them preys to bigger fish. Also, because pikes are not adapted to deep waters, they tend to migrate to other lakes, which are shallow and less eutrophic.

Conclusion

After 10 years of research, Lake Durowskie is still majorly eutrophic. This can be seen in both analyses of periphyton and phytoplankton as indicators. However, there are indications that show that the lake is becoming slightly mesotrophic, shown through the periphyton indicators. Also, this year there were new species of macrophytes, *Chara contraria* and *Nitellopsis obtusa*, which indicate good water quality. Oxygen levels were in the high range, which is good for species abundance. The decrease of cyanobacteria from the inflow and the outflow, also shows a good sign for the ecological state of the lake. Overall, after analyzing species of algae, it can be concluded that the water quality has slightly increased.

There are many methods to help reduce the eutrophication of Lake Durowskie and increase the water quality. First, the creation environmental conditions suitable for desmids to thrive since they show improvement of the water quality. Currently, Lake Durowskie only has two species of desmids, so the more species are present, the higher the quality of water will be. There should be a reduction of boat activities to reduce the turbulence and spread of cyanobacteria in the ecosystem. The pikes that are introduced should be bigger in size, so they do not get eaten by larger fish or migrate to other lakes. Lastly, education of both locals and tourist about the condition of the lake should be implemented. This could decrease the effects of anthropogenic activity.

References

Bennion, H., Fluin, J., & Simpson, G. L. (2004). Assessing eutrophication and reference conditions for Scottish freshwater lochs using subfossil diatoms. Journal of applied Ecology, 41(1), 124-138.

Hennink, S., & Zeven, A. C. (1990). The interpretation of Nei and Shannon-Weaver within population variation indices. Euphytica, 51(3), 235-240.

Johnson, L. R. (2002). The freshwater algal flora of the British Isles: an identification guide to freshwater and terrestrial algae (Vol. 1). Cambridge University Press.

McCormick, P. V., & Cairns, J. (1994). Algae as indicators of environmental change. *Journal of Applied Phycology*, *6*(5-6), 509-526.

Reynolds, C. S., Huszar, V., Kruk, C., Naselli-Flores, L., & Melo, S. (2002). Towards a functional classification of the freshwater phytoplankton. Journal of plankton research, 24(5), 417-428.

Scott, D. M., Lucas, M. C., & Wilson, R. W. (2005). The effect of high pH on ion balance, nitrogen excretion and behaviour in freshwater fish from an eutrophic lake: a laboratory and field study. Aquatic Toxicology, 73(1), 31-43.

Van Dam H, Merten A. & Sinkeldam J. 1994. A coded checklist and ecological indicators values of freshwater diatoms from the Netherlands. Neth. J. Aquat. Ecol. 28(1): 117-133.

van der Valk, A. (2012). The biology of freshwater wetlands. Oxford University Press.

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**
***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.	.	.	+	+	.	.	.	.	.	.	.
Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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											
Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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	.	.	.	.	.	.	.	.	.	+	.

Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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.	.	.	.	+	.	.	.	.	+	.	.
Melosira varians Ag.	+	.	.	.	.	.	.	.	.	.	.
Meridion circulare (Greville) Agardh	.	.	.	.	.	.	.	.	.	.	+
Hippodonta capitata (Ehr.) L-B. Metz. et Witk.	.	.	.	.	.	+	.	+	+	.	.

Navicula cincta (Ehr.) Ralfs	+	+	+	.	.	+	+	+	.	+	.
Navicula mensiculus Schumann	+	.	.	.	.	.	.	.	.	.	.
Navicula radiosa Kützing	.	.	+	+	+	+	+	.	+	+	+
Navicula lanceolata Ehr.	.	.	.	.	.	.	.	.	+	.	.

Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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 falcatus (Corda) Ralfs	.	+	.	.	.	.	.	.	.	+	+

Botryococcus braunii Kütz.	.	.	.	.	.	+	+	+	+	+	+
Characium aqngustatum A. Braun	.	+	.	+	+	+	+	+	+	.	+
Chlamydomonas globosa Snow	+	+	+	+	.	+	.	.	.	.	.
Chlamydomonas passiva Skuja	.	.	+	.	.	+	+	+	.	.	.
Chlamydomonas reinchardtii Dangeard	.	+	.	.	.	.	.	+	.	.	.

Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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 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.	.	.	+	.	.	.	.	.	.	.	.

Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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	+	.	.	.	.	.	.	.	.	.	+

Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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	.	.	.	.	.	.	.	.	.	.	+

Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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	.	.	+	.	+	.	+	+	+	+	+

Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
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											

Phytoplankton taxa	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Ceratium hirundinella (F. B. Müller) Bergh	+	+	.	+	+	+	+	+	+	+	+
Ceratium cornutum (Ehr) Clap.& Lachman	.	.	.	.	.	.	.	+	.	.	.
Gymnodinium aeruginosum Stein	+	.	.	.	.	+	.	+	.	.	.
Peridiniopsis cuningtonii Lemm.	+	+	+	+	+	+	+	+	+	+	+
Peridinium cinctum (O.F. Müller) Ehrenberg	+	+	+	+	+	+	+	+	+	+	+
Peridinium gatunense Nygaard	.	.	.	.	.	+	.	.	.	.	.
Peridinopsis berolinense (Lemm.) Bourrelly	+	+	+	+	+	+	+	+	+	+	+
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	+	.	+	+	+	+	+	+	+	+	+

Phytoplankton taxa	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
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 25th June to 29th June 2018 (Inf – inflow; A2 – Aerator 2; Mid. 2 – Middle 2; Mid.1 – Middle 1; Outf – outflow; B1 – Beach 1; B2 – Beach 2; F – frequency).

	n=1	n=4	n=4	n=4	n=4	n=1	n=2	n=1	n=21
Depth	**0m**	**0-3m**	**0-3m**	**0-3m**	**0-3m**	**0m**	**0m**	**0m**	**%**
Site	**Inf**	**A2**	**M1**	**M2**	**A1**	**Outf**	**B1**	**B2**	**F**
Cyanoprokaryota - cyanobacteria									

Aphanocapsa incerta (Lemm.) Cronberg et Komarek	+	.	+	+	+	.	.	+	63
Aphanizomenon flos-aquae (L.) Ralfs	+	.	.	.	.	.	.	.	13
Chroococcus turgidus (Kűtz.) Naeg.	.	+	.	.	.	.	.	.	13
Limnothrix redekei (Van Goor) Meffert	+	.	.	.	.	.	.	.	13
Merismopedia punctata Meyen	.	.	.	.	.	.	.	+	13
Microcystis aeruginosa Kützing	+	.	.	.	.	.	.	.	13
Microcystis wesebergii (Kom.) Kom.ex Kom.	+	.	.	.	.	.	.	.	13
Planktolyngbya limnetica (Lemm.) Kom. – Legn. Et Cronenberg	+	.	.	.	.	.	.	+	25
Planktothrix agardhii (D.C. ex Gom.) Anagn. et Kom.	.	.	.	.	.	.	.	+	13
Woronichina naegeliana (Unger) Elenkin	+	.	.	.	.	.	.	+	25
Bacillariophyceae - diatoms									
Achnanthes minutissima Kützing	+	.	.	.	.	.	.	.	13

Site	**Inf**	**A2**	**M1**	**M2**	**A1**	**Outf**	**B1**	**B2**	**F**
Amphora ovalis Kützing	+	.	.	.	.	.	.	.	13
Asterionella formosa Hasall	+	+	+	.	+	.	.	+	63
Cyclotella ocellata Pant.	+	+	+	+	+	+	+	+	100
Cyclotella radiosa (Grun.) Lemm.	+	+	+	+	+	+	+	+	100
Cymbella minuta Hilse ex Rabenhorst	+	.	+	+	+	.	+	.	63
Fragilaria crotonensis Kitton	+	+	+	.	+	+	+	+	88

Site	Inf	A2	M1	M2	A1	Outf	B1	B2	F
Fragilaria ulna (Nitzsch) Lange-Bertalot	+	+	+	+	+	+	+	+	100
Fragilaria ulna var. angustissima Sippen	+	.	.	.	.	.	.	.	13
Meridion circulare (Greville) Agardh	+	.	.	.	.	.	.	+	25
Navicula radiosa Kutz	+	+	+	.	.	+	.	+	63
Navicula cincta (Ehr.) Ralfs	+	.	.	.	.	.	.	.	13
Nitzschia sigmoidea (Ehr.) W. Smith	.	.	+	.	.	.	.	.	13
Pinnularia maior (Kutz.) Rabenhorst	+	.	.	.	.	.	.	.	13
Pinnularia viridis (Nitzsch) Ehr.	.	.	.	.	.	.	+	.	13
Stephanodiscus hantzschii Grunow	.	.	+	+	.	.	.	.	25
Staurosira construens Ehr.	+	.	.	.	.	.	.	.	13
Chlorophyta - green algae									
Ankistrodesmus falcatus (Corda) Ralfs	.	.	+	.	.	.	.	.	13
Botryococcus braunii Kutzing	.	.	+	.	.	+	+	.	38
Characium aqngustatum A. Braun	+	+	.	.	.	.	.	.	25
Chlorella oocystoides Hindak	.	.	.	.	+	.	.	.	13
Closterium acutum var. variabile (Lemm.) Krieg.	.	+	+	+	.	.	.	.	38
Coelastrum astroideum De Notaris	+	+	+	+	+	+	+	+	100
Coelastrum reticulatum (Dang.) Senn	+	+	+	+	+	+	+	+	100

Coenocystis planctonica Korshikov	.	.	+	.	.	.	.	.	13
Cosmarium phaseolus Brebisson in Ralfs	.	.	.	.	.	+	.	.	13
Cosmarium regnellii Wille	+	+	+	+	+	+	+	+	100
Cosmarium trilobulatum Reinsch	.	.	.	.	.	+	.	.	13
Crosmarium margaritatum (Turp.) Ralfs	.	.	.	.	.	.	+	.	13
Crucigenia tetrapedia (Kirchner) W. et G.S. West	.	+	.	+	.	+	.	.	38
Crucigeniella rectangularis (Naeg.) Kom.	.	.	.	+	.	+	.	.	25
Desmodesmus communis (Hegew.) Hegew.	+	+	+	+	.	.	.	.	50
Elkatothrix gelatinosa Wille	.	.	+	+	.	.	.	.	25
Eutetramorus planctonicus (Korschikov) Bourrelly	.	.	.	.	.	.	+	.	13
Golenkinia radiata Chodat	.	.	.	.	+	.	.	.	13
Kirchneriella contorta var. elegans (Schmidle) Bohlin	.	.	.	.	.	+	.		13
Kirchneriella obesa (West) West & West	.	.	+	.	.	.	.	.	13
Monoraphidium circinale (Nyg.) Nygaard	.	.	.	.	.	.	+	.	13

Site	**Inf**	**A2**	**M1**	**M2**	**A1**	**Outf**	**B1**	**B2**	**F**
Monoraphidium contortum (Thur.) Kom.-Legn.	+	+	.	.	.	.	.	.	25
Oocystidium ovale Korshikov	.	.	.	.	.	.	+	+	25
Oocystis lacustris Chodat	+	+	+	+	+	+	+	+	100
Oocystis romboides (Her.) De Toni	.	.	.	.	.	+	+	.	25

Pediastrum boryanum (Turpin) Meneg.	+	+	+	+	+	+	+	+	100
Pediastrum duplex Meyen	+	.	+	+	+	+	.	+	75
Phacotus lenticularis (Ehr.) Stein	+	+	+	+	+	+	+	+	100
Plankosphaeria gelatinosa G.M. Smith	.	.	.	.	+	.	+	.	25
Radiococcus nimbatus (De Wildeman) Schmidle	.	.	.	.	+	.	+	.	25
Scenedesmus acuminatus (Lager.) Chodat	+	.	.	.	.	.	.	.	13
Scenedesmus ecornis (Ehr.) Chod.	.	.	.	.	.	+	.	.	13
Sphaerocystis planctonica (Korsikov) Bourrelly	+	+	+	+	+	+	+	+	100
Staurastrum chaetoceras (Schroeder) Smith	.	.	.	.	+	.	+	.	25
Staurastrum gracile Ralfs	+	.	+	+	.	+	+	+	75
Staurastrum tetracerum Ralfs ex Ralfs	.	.	+	.	+	.	+	.	38
Tetraedron minimum (A. Br.) Hansgirg	+	.	.	+	.	+	.	+	50
Tetrastrum staurogeanieforme (Schroed.) Lemm.	.	+	+	+	+	.	+	.	63
Tetrastrum komarekii Hindak	.	+	.	.	.	.	.	.	13
Ulothrix zonata (Weber & Mohr) Kuetzing	.	.	.	.	+	.	.	.	13

Site	**Inf**	**A2**	**M1**	**M2**	**A1**	**Outf**	**B1**	**B2**	**F**
Dinophyta - dinoflagellates									
Peridinopsis berolinense (Lemm.) Bourrelly	+	+	.	.	.	.	.	.	25
Ceratium hirundinella (F. B. Müller) Bergh	+	+	+	+	+	+	.	+	88

Peridiniopsis cuningtonii Lemm.	+	+	+	+	+	.	.	.	63
Peridinium cinctum (O.F. Müller) Ehrenberg	+	+	.	+	+	+	+	+	88
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	+	+	+	.	.	.	.	.	38
Euglenophyta - euglenoids									
Trachelomonas hispida (Perty) Stein	+	+	+	.	.	.	.	.	38
Colacium vesiculosum Ehr.	.	+	.	.	.	.	.	.	13
Chrysophyceae - chrysophyces									
Erkenia subaequiciliata Skuja	+	+	+	+	+	+	+	+	100
Dinobryon sociale Ehrenberg	+	.	.	.	.	.	.	.	13
Dinobryon divergens Imhof	+	+	+	+	+	+	.	+	88
Chryptophyta - cryptophytes									
Cryptomonas erosa Ehrenberg	+	+	+	+	+	+	+	+	100
Cryptomonas marssonii Skuja	+	+	+	+	+	+	+	.	88
Cryptomonas ovata Ehrenberg	+	.	.	.	.	.	.	.	13
Cryptomonas rostrata Trotzskaja emend I. Kiselev	+	.	+	+	+	+	.	.	63
Rhodomonas minuta Skuja	+	+	+	.	+	+	.	+	75

ANNEX 3. Average number of phytoplankton species cells (ind./mL) from different depth in Lake Durowskie from 25th June to 30th June 2018 (Inf – inflow; A2 – Aerator 2; Mid. 1 – Middle 1; Mid.2 – Middle 2; A1- Aerator 1; Outf – outflow; B1 – Beach 1; B2 – Beach 2).

Taxon	0m	0-3m	0-3m	0-3m	0-3m	0m	0-1m	0m
	Inf	**A2**	**Mid.1**	**Mid.2**	**A1**	**Outf**	**B1**	**B2**

	28.06.18	28.06.18	26.06.18	27.06.18	29.06.18	25.06.18	25.06.18	25.06.18
Cyanoprokaryota								
Aphanizomenon flos-aquae (L.) Ralfs	18400	0	0	0	0	0	0	0
Aphanocapsa incerta (Lemm.) Cronberg et Komarek	17600	0	7800	5800	800	0	0	17600
Chroococcus turgidus (Kűtz.) Naeg.	0	200	0	0	0	0	0	0
Limnothrix redekei (Van Goor) Meffert	4800	0	0	0	0	0	0	0
Merismopedia punctata Meyen	0	0	0	0	0	0	0	800
Microcystis aeruginosa Kützing	32800	0	0	0	0	0	0	0
Microcystis wesebergii (Kom.) Kom.ex Kom.	3200	0	0	0	0	0	0	0
Planktolyngbya limnetica (Lemm.) Kom. – Legn. Et Cronenberg	18400	0	0	0	0	0	0	800
Planktothrix agardhii (D.C. ex Gom.) Anagn. et Kom.	0	0	0	0	0	0	0	2400
Woronichina naegeliana (Unger) Elenkin	9600	0	0	0	0	0	0	0
Total	**104800**	**200**	**7800**	**5800**	**800**	**0**	**0**	**21600**
Bacillariophyceae								
Achnanthes minutissima Kützing	1600	0	0	0	0	0	0	0
Amphora ovalis Kützing	800	0	0	0	0	0	0	0
Asterionella formosa Hasall	3200	1400	1600	0	1000	0	0	6400
Cyclotella ocellata Pant.	5200	30600	19200	36000	20000	3200	400	32800
Cyclotella radiosa (Grun.) Lemm.	15200	10200	5400	9600	14600	8800	800	12800
Cymbella minuta Hilse ex Rabenhorst	2400	0	400	400	200	0	400	0
Staurosira construens Ehr.	28800	0	0	0	0	0	0	0
	Inf	**A2**	**Mid.1**	**Mid.2**	**A1**	**Outf**	**B1**	**B2**
Fragilaria crotonensis Kitton	70400	2400	0	1600	200	3200	42400	4800
Fragilaria ulna (Nitzsch) Lange-Bertalot	6400	800	200	2000	2200	1600	800	800
Fragilaria ulna var. *angustissima* Sippen	1600	0	0	0	0	0	0	0
Meridion circulare (Greville) Agardh	64000	0	0	0	0	0	0	800
Navicula radiosa Kutz	3200	600	0	400	0	800	400	0

Nitzschia sigmoidea (Ehr.) W. Smith	0	0	200	0	0	0	0	0
Pinnularia maior (Kütz.) Rabenhorst	1600	0	0	0	0	0	0	0
Pinnularia viridis (Nitzsch) Ehr.	0	0	0	0	0	0	400	0
Stephanodiscus hantzschii Grunow	0	0	200	200	0	0	0	0
Total	**204400**	**46000**	**27200**	**50200**	**38200**	**17600**	**45600**	**58400**
Chlorophyta								
Ankistrodesmus falcatus (Corda) Ralfs	0	0	1000	0	0	0	0	0
Botryococcus braunii Kutzing	0	0	200	0	0	800	2800	0
Characium aqngustatum A. Braun	2400	400	0	0	0	0	0	0
Chlorela oocystoides Hindak	0	0	0	0	400	0	0	0
Closterium acutum var. *variabile* (Lemm.) Krieg.	0	400	200	400	0	0	0	0
Coelastrum astroideum De Notaris	800	12400	800	1800	17300	0	35200	2400
Coelastrum reticulatum (Dang.) Senn	0	35000	67600	77200	19000	800	17600	39200
Coenocystis planctonica Korshikov	0	0	200	0	0	0	0	0
Cosmarium phaseolus Brebisson in Ralfs	0	0	0	0	0	800	0	0
Cosmarium regnellii Wille	2400	400	3200	3400	2400	800	1600	5600
cosmarium trilobulatum Reinsch	0	0	0	0	0	800	0	0
Cosmarium margaritatum (Turp.) Ralfs	0	0	0	0	0	0	400	0
Crucigenia tetrapedia (Kirchner) W. et G.S. West	0	800	0	200	0	3200	0	0
Crucigeniella rectnagulrais (Naeg.) Kom.	0	0	0	800	0	800	0	0
Desmodesmus communis (Hegew.) Hegew.	1600	200	400	200	0	0	0	0
Elkatothrix gelatinosa Wille	0	0	600	400	0	0	0	0
	Inf	**A2**	**Mid.1**	**Mid.2**	**A1**	**Outf**	**B1**	**B2**
Eutetramorus planctonicus (Korschikov) Bourrelly	0	0	0	0	0	0	3200	0
Golenkinia radiata Chodat	0	0	0	0	400	0	0	0
Kirchneriella contorta var. *elegans* (Schmidle) Bohlin	0	0	0	0	0	800	0	0
Kirchneriella obesa (West) West & West	0	0	1000	0	0	0	0	0
Monoraphidium circinale (Nyg.) Nygaard	0	0	0	0	0	0	800	0

Monoraphidium contortum (Thur.) Kom.-Legn.	6400	800	0	0	0	0	0	0
Oocystidium ovale Korshikov	0	0	0	0	0	0	6400	800
Oocystis lacustris Chodat	1600	3400	4200	1200	7800	1600	3600	1600
Oocystis romboides (Ehr.) De Toni	0	0	0	0	0	0	400	0
Pediastrum boryanum (Turpin) Meneg.	2400	1400	1200	800	1000	800	4800	0
Pediastrum duplex Meyen	2400	0	200	600	200	800	0	1600
*Phacotus lenticularis (*Ehr.) Stein	6400	8400	16800	20600	22400	22400	8400	37600
Plankosphaeria gelatinosa G.M. Smith	0	0	0	0	3400	0	400	0
Radiococcus nimbatus (De Wildeman) Schmidle	0	0	0	0	600	0	4400	0
Scenedesmus acuminatus (Lager.) Chodat	2400	0	0	0	0	0	0	0
Scenedesmus ecornis (Ehr.) Chod.	0	0	0	0	0	0	400	0
Scenedesmus ellipticus Corda	0	0	0	0	0	9600	0	0
Sphaerocystis planctonica (Korsikov) Bourrelly	4000	28600	58000	24600	99800	59200	58000	43200
Staurastrum chaetoceras (Schroeder) Smith	0	0	0	0	200	0	400	0
Staurastrum gracile Ralfs	4800	0	1600	2200	0	1600	2000	1600
Staurastrum tetracerum Ralfs ex Ralfs	0	0	200	0	200	0	400	0
Tetraedron minimum (A. Br.) Hansgirg	800	0	0	600	0	800	0	800
Tetrastrum staurogeanieforme (Schroed.) Lemm.	0	350	1200	2000	800	0	1600	0
Tetratrum komarekii Hindak	0	200	0	0	0	0	0	0
Ulothrix zonata (Weber & Mohr) Kutzing	0	0	0	0	200	0	0	0
Total	**38400**	**92750**	**158600**	**137000**	**176100**	**105600**	**152800**	**134400**

	Inf	**A2**	**Mid.1**	**Mid.2**	**A1**	**Outf**	**B1**	**B2**
Cryptophyta								
Cryptomonas erosa Ehrenberg	11200	2120	800	18400	1000	800	400	800
Cryptomonas marssonii Skuja	4000	6800	400	400	200	1600	0	800
Cryptomonas ovata Ehrenberg	800	0	0	0	0	0	0	0
Cryptomonas rostrata Troitzskaja emend I. Kiselev	3200	0	200	800	600	0	800	0

Rhodomonas minuta Skuja	19200	400	1400	0	200	3200	0	1600
Total	**38400**	**9320**	**2800**	**19600**	**2000**	**5600**	**1200**	**3200**
Dinophyta								
Ceratium hirundinella (F. B. Müller) Bergh	4000	2600	200	1400	800	800	0	1600
Peridiniopsis cuningtonii Lemm.	3200	2400	400	800	200	0	0	0
Peridinium cinctum (O.F. Müller) Ehrenberg	7200	2200	0	1200	11600	800	400	3200
Peridinopsis berolinense (Lemm.) Bourrelly	1600	600	0	0	0	0	0	0
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	7200	200	400	0	0	0	0	0
Total	**23200**	**8000**	**1000**	**3400**	**12600**	**1600**	**400**	**4800**
Euglenophyta								
Colacium vesiculosum Ehr.	0	600	0	0	0	0	0	0
Trachelomonas hispida (Perty) Stein	1600	1200	2000	0	0	0	0	0
Total	**1600**	**1800**	**2000**	**0**	**0**	**0**	**0**	**0**
Chrysophyceae								
Dinobryon divergens Imhof	19200	1377400	2600	19400	110000	800	13600	44000
Dinobryon sociale Ehrenberg	372000	0	0	0	0	0	0	0
Erkenia subaequiciliata Skuja	222400	1000	27200	16300	1000	23200	0	16800
Total	**613600**	**1378400**	**29800**	**35700**	**111000**	**24000**	**13600**	**60800**

ANNEX 4. Average biomass of phytoplankton species (mg/mL) from different depth in Lake Durowskie from 24th to 29th of June 2018 (Inf – inflow; A2 – Aerator 2; Mid. 2 – Middle 2; Mid.1 – Middle 1; Outf – outflow; B1 – Beach 1; B2 – Beach 2).

Depth	**0-2m**	**0-3m**	**0-3m**	**0-3m**	**0-3m**	**0-2m**	**0-2m**	**0-2m**
Site	**Inf**	**A2**	**Mid.2**	**Mid.1**	**A1**	**Outf**	**B1**	**B2**

Cyanoprokaryota								
Aphanocapsa incerta (Lemm.) Cronberg et Komarek	0.005				0.0002			0.0033
Chroococcus turgidus (Kűtz.) Naeg.	0.036		0.0015					.
Limnothrix redekei (Van Goor) Meffert	0.001							.
Microcystis aeruginosa Kützing	0.03							0.0004
Microcystis wesebergii (Kom.) Kom.ex Kom.	0.004							.
Planktolyngbya limnetica (Lemm.) Kom. – Legn. Et Cronenberg	0.036							0.001
Planktothrix agardhii (D.C. ex Gom.) Anagn. et Kom.	.							0.002
Woronichina naegeliana (Unger) Elenkin	0.005							.
Total	**0.117**	**0.000**	**0.0015**	**0.000**	**0.0002**	**0.000**	**0.000**	**0.0067**
Bacillariophyceae								
Achnanthes minutissima Kützing	0.001					.		.
Amphora ovalis Kützing	.			0.0002		.		.
Asterionella formosa Hasall	0.001	0.0003		0.0002	0.0175	.		0.025
Cyclotella ocellata Pant.	0.005	0.032	0.004	0.02	0.028	0.0034	0.0008	0.0346
Cyclotella radiosa (Grun.) Lemm.	0.019	0.013	0.025	0.007	0.034	0.011	0.002	0.016
Cymbella minuta Hilse ex Rabenhorst	0.004		0.0005	0.0005	0.0002	.	0.0015	.
Staurosira construens Ehr.	0.053					.		.
Fragilaria crotonensis Kitton	0.032	0.001	0.0005			0.004	0.04	0.045
	Inf	**A2**	**Mid.2**	**Mid.1**	**A1**	**Outf**	**B1**	**B2**
Fragilaria ulna (Nitzsch) Lange-Bertalot	0.009	0.001	0.0025	0.0002	0.001	0.0022	0.002	0.001
Meridion circulare (Greville) Agardh	0.245					.		0.00242
Navicula radiosa Kutz.	0.008	0.001	0.0007			0.002	0.002	.

Nitzschia sigmoidea (Ehr.) W. Smith	.			0.00225		.		.
Pinnularia maior (Kütz.) Rabenhorst	0.016					.		.
Pinnularia viridis (Nitzsch) Ehr.	.					.	0.008	.
Stephanodiscus hantzschii Grunow	.		0.0002	0.00025		.		.
Total	**0.393**	**0.0473**	**0.0334**	**0.0304**	**0.0807**	**0.0226**	**0.051**	**0.12402**
Chlorophyta								
Ankistrodesmus falcatus (Corda) Ralfs	.			0.0002		.		.
Botryococcus braunii Kutzing	.			0.0007		0.014	0.029	.
Characium aqngustatum A. Braun	0.002	0.0002				.		.
Chlorela oocystoides Hindak	.				0.00002	.		.
Closterium acutum var. *variabile* (Lemm.) Krieg.	.	0.0002	0.0002	0.0002		.		.
Coelastrum astroideum De Notaris	0.002	0.07	0.184	0.074	0.056	.	0.113	0.00772
Coelastrum reticulatum (Dang.) Senn	.	0.106	0.292	0.255	0.069	0.112	0.067	0.148
Coenocystis planctonica Korshikov	.			0.0002		.		.
Cosmarium phaseolus Brebisson in Ralfs	.					0.001		.
Cosmarium regnellii Wille	0.001	0.00005	0.0009	0.002	0.001	0.001	0.001	0.002
Cosmarium trilobulatum Reinsch	.					0.001		.
Cosmarium margaritatum (Turp.) Ralfs	.					.	0.009	.
Crucigeniella rectnagulrais (Naeg.) Kom.	.		0.0001			.		.
Crucigenia tetrapedia (Kirchner) W. et G.S. West	.	0.00002	0.00002			0.0003		.
Desmodesmus communis (Hegew.) Hegew.	0.001	0.0002	0.0002	0.0002		.		.
Dicellula geminate Chodat	.		0.0002			.		.
Elkatothrix gelatinosa Wille	.		0.0002	0.0008		.		.
Golenkinia radiata Chodat	.				0.0002	.		.
Kirchneriella contorta var. *elegans* (Schmidle) Bohlin	.					0.001		.

	Inf	**A2**	**Mid.2**	**Mid.1**	**A1**	**Outf**	**B1**	**B2**
Kirchneriella obesa (West) West & West	.			0.0001		.		.
Monoraphidium contortum (Thur.) Kom.-Legn.	0.001	0.0001				.		.
Oocystis lacustris Chodat	0.004	0.008	0.003	0.011	0.02	0.0041	0.018	0.00408
Pediastrum boryanum (Turpin) Meneg.	0.071	0.041	0.023	0.035	0.029	0.024	0.141	.
Pediastrum duplex Meyen	0.071		0.017	0.006	0.006	0.024		0.0235
*Phacotus lenticularis (*Ehr.) Stein	0.005	0.039	0.016	0.013	0.018	0.018	0.0065	0.0299
Plankosphaceria gelatinosa G.M. Smith	.				*0.0015*	.	0.0005	.
Radiococcus nimbatus (De Wildeman) Schmidle	.				0.0005	.		.
Scenedesmus acuminatus (Lager.) Chodat	0.002					.		.
Scenedesmus ecornis (Ehr.) Chod.	.	.				.	0.0001	.
Scenedesmus ellipticus Corda	.	.				0.004		.
Sphaerocystis planctonica (Korsikov) Bourrelly	0.009	0.061	0.056	0.209	0.227	0.13	0.132	0.0985
Staurastrum gracile Ralfs	0.012	.	0.005	0.003		0.02	0.015	0.002
Staurastrum tetracerum Ralfs ex Ralfs	.	.		0.001	0.0002	.	0.0005	.
Tetraedron minimum (A. Br.) Hansgirg	0.0001	.	0.00005			0.001		0.001
Tetrastrum staurogeanieforme (Schroed.) Lemm.	.	0.0002	0.0003	0.0006	0.0001	.	0.0002	.
Tetrastrum komarekii Hindak	.	0.0002	.			.		.
Ulothrix zonata (Weber & Mohr) Kutzing	.	.	.		0.002	.		.
Total	**0.1811**	**0.3261**	**0.589**	**0.613**	**0.4305**	**0.3554**	**0.505**	**0.3167**
Cryptophyta								
Cryptomonas erosa Ehrenberg	0.018	0.014	0.03	0.001	0.0015	0.0013		0.0013
Cryptomonas marssonii Skuja	0.005	0.009	0.0005	0.0005		0.002		0.00106
Cryptomonas ovata Ehrenberg	0.001					.		.
Cryptomonas rostrata Troitzskaja emend I. Kiselev	0.007		0.0015	0.0005	0.013	.	0.0015	.
Rhodomonas minuta Skuja	0.03	0.0004		0.001	0.0015	0.0022		0.00113

Total	**0.061**	**0.0234**	**0.032**	**0.003**	**0.016**	**0.0055**	**0.0015**	**0.00349**
Dinophyta								
Site	**Inf**	**A2**	**Mid.2**	**Mid.1**	**A1**	**Outf**	**B1**	**B2**
Ceratium hirundinella (F. B. Müller) Bergh	0.387	0.251	0.133		0.077	0.077		0.155
Peridiniopsis cuningtonii Lemm.	0.037	0.028	0.009	0.004	0.002	.		.
Peridinium cinctum (O.F. Müller) Ehrenberg	0.191	0.106	0.031		0.308	0.0212	0.01	0.254
Peridinopsis berolinense (Lemm.) Bourrelly	0.015	0.005				.		.
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	0.058	0.016		0.003		.		.
Total	**0.688**	**0.406**	**0.173**	**0.007**	**0.387**	**0.0982**	**0.01**	**0.409**
Euglenophyta								
Colacium vesiculosum Ehr.	.	0.0001						
Trachelomonas hispida (Perty) Stein	0.002	0.001		0.002				
Total	**0.002**	**0.0011**		**0.002**				
Chrysophyceae								
Dinobryon divergens Imhof	0.009	0.624	0.0086	0.001	0.016	0.001	0.016	0.041
Dinobryon sociale Ehr.	0.199					.		.
Erkenia subaequiciliata Skuja	0.012	0.0001	0.001	0.001	0.00005	0.0013		0.001
Total	**0.220**	**0.6241**	**0.0096**	**0.002**	**0.016**	**0.0023**	**0.016**	**0.042**

ANNEX 5. Comparison of periphyton species composition in different investigated sites from 25th June to 29th 2018 in Lake Durowskie (1-12 – sites).

Diatom taxa / site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**pH**	**O**	**T**
Achnanthes conspicua Mayer	.	.	.	.	.	.	.	+	.	.	.	.	-	-	-
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 rostrata Huestedt	.	.	.	+	.	.	.	.	.	.	.	.	-	-	-
Amphora ovalis Kützing	+	+	+	+	+	+	+	+	+	+	+	+	4	2	5
Amphora pediculus (Kütz.) Grunow	+	+	+	+	+	+	+	+	+	+	+	+	4	2	5
Asterionella formosa Hass	+	.	.	.	+	.	.	+	+	+	+	.	4	2	5
Aulacoseira granulata (Ehrenberg) Simonsen	.	.	.	.	.	.	.	.	+	.	.	.	4	3	5
Caloneis bacillum (Grun.) Meresz.	+	+	+	+	.	+	.	.	.	.	+	.	4	2	4
Cocconeis euglypta (Ehr.) Clevei	.	.	.	.	.	.	.	+	.	.	.	.	-	-	-
Cocconeis pediculus Ehr.	+	+	+	+	+	+	.	.	+	+	+	.	4	2	5
Cocconeis placentula Ehr.	+	+	+	+	+	+	+	+	+	+	+	+	4	3	5
Cocconeis placentula var. linearis Ehr.	.	+	+	+	.	.	.	.	.	.	.	.	-	-	-

Diatom taxa / site	1	2	3	4	5	6	7	8	9	10	11	12	pH	O	T
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
Cymatopleura solea (Breb.) W. Smith	.	.	.	.	+	.	.	.	+	+	.	.	4	3	5
Cymbella affinis Kützing	+	.	+	+	+	+	+	+	+	+	+	+	4	1	5
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
Diploneis Elliptica (Kuetzing) Cleve	.	.	.	.	+	.	.	.	+	+	+	.	4	1	3
Eunotia exigua (Breb.) Rabenh.	+	.	.	.	+	.	.	.	+	+	+	.	1	2	7
Eunotia fabia (Ehr.) Grun.	.	.	.	.	+	.	.	.	+	.	+	.	2	1	2
Eunotia intermedia (Krasske) Noerpel & Lange - Bertalot	.	.	.	.	.	.	.	.	.	.	.	.	2	-	1
Eunotia lunaris (Ehr.) Mills	.	.	.	.	.	+	.	.	.	.	.	.	-	-	-
Eunotia praerupta Ehr.	+	+	+	.	+	+	+	+	+	+	+	+	2	1	2
Eunotia tenella (Grun.) Hustedt	.	.	.	.	.	.	.	.	.	.	.	.	2	1	1

Diatom taxa / site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**pH**	**O**	**T**
Fragilaria capitata Ehr.	.	+	+	+	.	.	.	+	.	.	.	.	-	-	-
Fragilaria capucina (Desm.) Rabenhorst	+	+	+	+	+	+	.	.	+	+	+	.	3	-	3
Fragilaria capucina v. Amphicephala (Kutzing)	.	.	.	.	.	.	.	.	.	+	.	.	-	-	-
Fragilaria constricta Ehr.	.	.	.	.	.	.	.	.	.	.	.	.	2	-	1
Fragilaria construens (Ehr.) Grun.	.	+	+	+	+	.	.	.	+	.	.	.	4	1	4
Fragilaria crotonensis Kitton	+	+	+	+	+	+	+	+	+	.	+	+	4	2	3
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 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 agrestis Hustedt	.	.	.	.	+	.	.	+	.	.	.	.	3	-	-
Navicula anglica Lange-Bertalot	.	.	.	.	.	.	.	+	.	.	.	.	-	-	-
Navicula capitata Patrick in Patrick & Reimer	.	+	+	.	+	+	+	+	+	+	+	+	4	3	4
Navicula cincta (Ehr.) Ralfs	+	+	.	+	+	.	.	+	+	+	+	.	4	3	5
Navicula cryptocephala Kütz.	+	.	.	.	+	.	.	.	+	+	+	.	3	3	7

Diatom taxa / site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**pH**	**O**	**T**
Navicula dicephala (Ehr.) W. Sm.	+	.	.	.	.	.	.	.	.	.	+	.	-	-	-
*Navicula gastrum (*Ehrenberg) Kuetzing	.	.	.	.	.	.	.	.	.	+	.	.	4	4	5
Navicula gregaria Donkin	.	.	.	.	.	+	+	+	.	.	.	.	4	4	5
*Navicula oblonga (*Kützing) Kützing	.	.	.	.	.	.	.	.	.	+	.	.	-	-	-
*Navicula placentula (*Placeneis)	.	.	.	.	+	.	.	.	+	+	+	.	4	2	5
Navicula radiosa Kützing	+	+	+	+	+	+	.	+	+	+	+	+	3	2	4
Navicula reinhardtii Grun.	.	+	+	+	.	.	.	.	.	+	.	.	5	2	5
Navicula tripunctata (O. F. Müller) Bory	+	+	+	+	+	+	+	+	+	+	+	+	4	2	5
Navicula veneta (Kuetzing)	.	.	.	+	.	.	.	.	.	.	.	.	-	-	-
*Navicula viridula (*Kütz.) Ehr.	.	.	.	.	+	.	.	.	+	.	+	.	4	2	5
Nitzchia acicularis (Kützing) W. Smith	+	+	+	+	.	.	.	.	.	.	.	.	4	4	5
Nitzschia amphibia Grunow	+	.	.	+	+	.	.	.	+	+	+	.	4	3	5
Nitzschia incospicua Grun.	.	.	.	.	.	+	.	.	.	+	+	.	4	3	5
Nitzschia micropus (Kütz.)	+	.	.	.	.	.	.	.	.	.	+	.	-	-	-
Nitzschia palea (Kütz.) *W. Sm.*	+	+	+	+	+	.	.	+	.	.	+	.	3	4	6
Nitzschia paleacea Grun.	+	+	+	+	.	+	.	.	.	.	+	.	4	3	5
Nitzschia recta Hantzsch	+	.	.	.	+	+	.	+	+	.	+	+	4	2	7
Nitzschia sigmoidea (Ehr.) W. Sm.	.	+	+	+	+	.	.	.	+	+	+	.	4	3	5
Pinnularia maior (Kütz.) Cleve	.	.	.	.	.	.	.	+	.	.	.	.	-	-	-

Pinnularia viridis (Nitzsch) Ehr.	.	+	+	+	.	+	.	.	.	.	.	.	3	3	7
Rhoicosphaenia abbreviata (Ag.) Lange-Bertalot	.	.	+	.	.		.	.	.	.	.	+	4	2	5
Rhoicosphaenia curvata (Kütz.) Grun.	.	+	+	+	.	.	.	.	.	.	.	.	-	-	-
Rhopalodia gibba (Ehr.) Müller	+	.	.	.	.	.	.	+	+	+	+	.	5	3	5
Stauroneis phoenicentron Ehr.	+	+	+	+	.	+	.	+	.	.	+	.	3	3	4
Stephanodiscus astraea Hakannson-Hickel	.	.	.	.	+	.	.	+	+	+	+	.	-	-	-

Diatom taxa / site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**pH**	**O**	**T**
Stephanodiscus hantzschii Grun.	.	+	+	.	.	.	.	+	.	.	.	.	5	4	6
Surirella minuta Breb.	.	+	+	+	.	.	.	.	.	.	.	.	4	3	5
Surirella ovalis Breb.	.	.	.	.	+	.	.	.	+	.	+	.	4	4	5
Tabellaria fenestrata (Lyngb.) Kützing	+	.	.	.	.	+	+	+	.	+	.	.	3	1	2
Tabellaria flocculosa (Roth) Kütz.	.	.	.	.	.	.	.	.	.	.	+	.	2	1	3

pH*

1. acidobiontic (optimal occurrence at pH <5,5)
2. acidophilous (mainly occurrence at pH <7)
3. circumboreal (mainly occurring at pH – values about 7)
4. alkaliphilous (mainly occurring at pH >7)
5. alkalibiontic (exclusively occurring at pH >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. very low (about 10% saturation)

T*

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

ANNEX 6: Total density and biomass of dominant phytoplankton species on Lake Durowskie 25th – 30th June, 2018.

	0m	0-3m	0-3m	0-3m	0-3m	0m	0-1m	0m
	Inflow	Aerator 2	Middle 1	Middle 2	Aerator 1	Outflow	Beach 1	Beach 2
	28.06.18	28.06.18	26.06.18	27.06.18	29.06.18	25.06.18	25.06.18	25.06.18
Cyanoprokaryota								

Aphanizomenon flos-aquae (L.) Ralfs	18400	0	0	0	0	0	0	0
Aphanocapsa incerta (Lemm.) Cronberg et Komarek	17600	0	7800	5800	800	0	0	17600
Chroococcus turgidus (Kűtz.) Naeg.	0	200	0	0	0	0	0	0
Limnothrix redekei (Van Goor) Meffert	4800	0	0	0	0	0	0	0
Merismopedia punctata Meyen	0	0	0	0	0	0	0	800
Microcystis aeruginosa Kützing	32800	0	0	0	0	0	0	0
Microcystis wesebergii (Kom.) Kom.ex Kom.	3200	0	0	0	0	0	0	0
Planktolyngbya limnetica (Lemm.) Kom. – Legn. Et Cronenberg	18400	0	0	0	0	0	0	800
Planktothrix agardhii (D.C. ex Gom.) Anagn. et Kom.	0	0	0	0	0	0	0	2400
Woronichina naegeliana (Unger) Elenkin	9600	0	0	0	0	0	0	0
Total	**104800**	**200**	**7800**	**5800**	**800**	**0**	**0**	**21600**
Bacillariophyceae								
Achnanthes minutissima Kützing	1600	0	0	0	0	0	0	0
Amphora ovalis Kützing	800	0	0	0	0	0	0	0
Asterionella formosa Hasall	3200	1400	1600	0	1000	0	0	6400
Cyclotella ocellata Pant.	5200	30600	19200	36000	20000	3200	400	32800
Cyclotella radiosa (Grun.) Lemm.	15200	10200	5400	9600	14600	8800	800	12800
Cymbella minuta Hilse ex Rabenhorst	2400	0	400	400	200	0	400	0
Staurosira construens Ehr.	28800	0	0	0	0	0	0	0
Fragilaria crotonensis Kitton	70400	2400	0	1600	200	3200	42400	4800
Fragilaria ulna (Nitzsch) Lange-Bertalot	6400	800	200	2000	2200	1600	800	800
Fragilaria ulna var. *angustissima* Sippen	1600	0	0	0	0	0	0	0
Meridion circulare (Greville) Agardh	64000	0	0	0	0	0	0	800
Navicula radiosa Kutz	3200	600	0	400	0	800	400	0
Nitzschia sigmoidea (Ehr.) W. Smith	0	0	200	0	0	0	0	0
Pinnularia maior (Kütz.) Rabenhorst	1600	0	0	0	0	0	0	0
Pinnularia viridis (Nitzsch) Ehr.	0	0	0	0	0	0	400	0
Stephanodiscus hantzschii Grunow	0	0	200	200	0	0	0	0

Total	**204400**	**46000**	**27200**	**50200**	**38200**	**17600**	**45600**	**58400**
Chlorophyta								
Ankistrodesmus falcatus (Corda) Ralfs	0	0	1000	0	0	0	0	0
Botryococcus braunii Kutzing	0	0	200	0	0	800	2800	0
Characium aqngustatum A. Braun	2400	400	0	0	0	0	0	0
chlorela oocystoides Hindak	0	0	0	0	400	0	0	0
Closterium acutum var. *variabile* (Lemm.) Krieg.	0	400	200	400	0	0	0	0
Coelastrum astroideum De Notaris	800	12400	800	1800	17300	0	35200	2400
Coelastrum reticulatum (Dang.) Senn	0	35000	67600	77200	19000	800	17600	39200
Coenocystis planctonica Korshikov	0	0	200	0	0	0	0	0
Cosmarium phaseolus Brebisson in Ralfs	0	0	0	0	0	800	0	0
Cosmarium regnellii Wille	2400	400	3200	3400	2400	800	1600	5600
cosmarium trilobulatum Reinsch	0	0	0	0	0	800	0	0
Cosmarium margaritatum (Turp.) Ralfs	0	0	0	0	0	0	400	0
Crucigenia tetrapedia (Kirchner) W. et G.S. West	0	800	0	200	0	3200	0	0
Crucigeniella rectnagulrais (Naeg.) Kom.	0	0	0	800	0	800	0	0
Desmodesmus communis (Hegew.) Hegew.	1600	200	400	200	0	0	0	0
Elkatothrix gelatinosa Wille	0	0	600	400	0	0	0	0
Eutetramorus planctonicus (Korschikov) Bourrelly	0	0	0	0	0	0	3200	0
Golenkinia radiata Chodat	0	0	0	0	400	0	0	0
Kirchneriella contorta var. *elegans* (Schmidle) Bohlin	0	0	0	0	0	800	0	0
Kirchneriella obesa (West) West & West	0	0	1000	0	0	0	0	0
Monoraphidium circinale (Nyg.) Nygaard	0	0	0	0	0	0	800	0
Monoraphidium contortum (Thur.) Kom.-Legn.	6400	800	0	0	0	0	0	0
Oocystidium ovale Korshikov	0	0	0	0	0	0	6400	800
Oocystis lacustris Chodat	1600	3400	4200	1200	7800	1600	3600	1600
Oocystis romboides (Ehr.) De Toni	0	0	0	0	0	0	400	0
Pediastrum boryanum (Turpin) Meneg.	2400	1400	1200	800	1000	800	4800	0

Pediastrum duplex Meyen	2400	0	200	600	200	800	0	1600
*Phacotus lenticularis (*Ehr.) Stein	6400	8400	16800	20600	22400	22400	8400	37600
Plankosphaceria gelatinosa	0	0	0	0	3400	0	400	0
Radiococcus nimbatus	0	0	0	0	600	0	4400	0
Scenedesmus acuminatus (Lager.) Chodat	2400	0	0	0	0	0	0	0
Scenedesmus ecornis (Ehr.) Chod.	0	0	0	0	0	0	400	0
Scenedesmus ellipticus Corda	0	0	0	0	0	9600	0	0
Sphaerocystis planctonica (Korsikov) Bourrelly	4000	28600	58000	24600	99800	59200	58000	43200
Staurastrum chaetoceras (Schroeder) Smith	0	0	0	0	200	0	400	0
Staurastrum gracile Ralfs	4800	0	1600	2200	0	1600	2000	1600
Staurastrum tetracerum Ralfs ex Ralfs	0	0	200	0	200	0	400	0
Tetraedron minimum (A. Br.) Hansgirg	800	0	0	600	0	800	0	800
Tetrastrum staurogeanieforme (Schroed.) Lemm.	0	350	1200	2000	800	0	1600	0
Tetratrum komarekii Hindak	0	200	0	0	0	0	0	0
Ulothrix zonata (Weber & Mohr) Kutzing	0	0	0	0	200	0	0	0
Total	**38400**	**92750**	**158600**	**137000**	**176100**	**105600**	**152800**	**134400**
Cryptophyta								
Cryptomonas erosa Ehrenberg	11200	2120	800	18400	1000	800	400	800
Cryptomonas marssonii Skuja	4000	6800	400	400	200	1600	0	800
Cryptomonas ovata Ehrenberg	800	0	0	0	0	0	0	0
Cryptomonas rostrata Troitzskaja emend I. Kiselev	3200	0	200	800	600	0	800	0
Rhodomonas minuta Skuja	19200	400	1400	0	200	3200	0	1600
Total	**38400**	**9320**	**2800**	**19600**	**2000**	**5600**	**1200**	**3200**
Dinophyta								
Ceratium hirundinella (F. B. Müller) Bergh	4000	2600	200	1400	800	800	0	1600
Peridiniopsis cuningtonii Lemm.	3200	2400	400	800	200	0	0	0
Peridinium cinctum (O.F. Müller) Ehrenberg	7200	2200	0	1200	11600	800	400	3200
Peridinopsis berolinense (Lemm.) Bourrelly	1600	600	0	0	0	0	0	0

Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	7200	200	400	0	0	0	0	0
Total	**23200**	**8000**	**1000**	**3400**	**12600**	**1600**	**400**	**4800**
Euglenophyta								
Colacium vesiculosum Ehr.	0	600	0	0	0	0	0	0
Trachelomonas hispida (Perty) Stein	1600	1200	2000	0	0	0	0	0
Total	**1600**	**1800**	**2000**	**0**	**0**	**0**	**0**	**0**
Chrysophyceae								
Dinobryon divergens Imhof	19200	1377400	2600	19400	110000	800	13600	44000
Dinobryon sociale Ehrenberg	372000	0	0	0	0	0	0	0
Erkenia subaequiciliata Skuja	222400	1000	27200	16300	1000	23200	0	16800
Total	**613600**	**1378400**	**29800**	**35700**	**111000**	**24000**	**13600**	**60800**

Dominant species	0m	0-3m	0-3m	0-3m	0-3m	0m	0-1m	0m
	Inflow	Aerator 2	Middle 1	Middle 2	Aerator 1	Outflow	Beach 1	Beach 2
	28.06.18	28.06.18	26.06.18	27.06.18	29.06.18	25.06.18	25.06.18	25.06.18
Aphanocapsa incerta (Lemm.) Cronberg et Komarek	0,005	0	**0,0365**	0,006	0,001	0	0	0,0033
Asterionella formosa Hasall	0,001	0,0007	0,001	0	0,07	0	0	0,025
Cyclotella ocellata Pant.	0,005	0,032	0,02	**0,15**	0,0278	0,0034	0,0021	0,0346
Meridion circulare (Greville) Agardh	**0,245**	0	0	0	0	0	0	0,00242

Cyclotella radiosa (Grun.) Lemm.	0,019	0,0128	0,00675	0,034	0,0338	0,011	0,0065	0,016
Fragilaria crotonensis Kitton	0,032	0,004	0	0,002	0	0,004	0,0283	**0,045**
Coelastrum astroideum De Notaris	0,002	0,0705	**0,0987**	**0,231**	0,056	0	**0,113**	0,00772
Coelastrum reticulatum (Dang.) Senn	0	**0,106**	**0,255**	**0,292**	0,069	**0,112**	**0,082**	**0,148**
Oocystis lacustris Chodat	0,004	0,0113	0,01325	0,003	**0,08**	0,0041	0,01105	0,00408
Pediastrum boryanum (Turpin) Meneg.	**0,071**	0,055	**0,047**	0,031	0,0585	**0,024**	**0,1023**	0,00408
Pediastrum duplex Meyen	**0,071**	0	0,024	0,035	0,023	**0,024**	0,024	0,0235
*Phacotus lenticularis (*Ehr.) Stein	0,005	0,0393	0,01325	0,016	**0,071**	**0,018**	0,0103	0,0299
Sphaerocystis planctonica (Korsikov) Bourrelly	0,009	**0,0813**	**0,209**	0,056	**0,2275**	**0,13**	**0,1313**	**0,0985**
Cryptomonas erosa Ehrenberg	0,018	0,0186	0,001	0,0294	0,006	0,0013	0,0167	0,0013
Cryptomonas rostrata	0,03	0	0,002	0,006	0,026	0	0,001	0

Troitzskaja emend I. Kiselev								
Cryptomonas marssonii Skuja	0,005	0,0115	0,002	0,001	0	0,002	0,001	0,00106
Ceratium hirundinella (F. B. Müller) Bergh	**0,387**	**0,251**	0	**0,177**	**0,1027**	**0,077**	**0,077**	**0,155**
Peridinium cinctum (O.F. Müller) Ehrenberg	**0,191**	**0,10605**	0	**0,127**	**0,616**	**0,0212**	0,021	**0,254**
Peridiniopsis cuningtonii Lemm.	0,037	0,0555	0	0,012	0,009	0	0	0
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	0,058	0,064	0,006	0	0	0	0	0
Dinobryon divergens Imhof	**0,199**	**0,62425**	0	0,0115	0,0217	0,001	0,032	0,041
Dinobryon sociale Ehrenberg	0,012	0	0,00106	0	0	0	0	0

Dominant species	0m	0-3m	0-3 m	0-3 m	0-3 m	0m	0-1m	0m
	Inlow	Aerator 2	Middle 1	Middle 2	Aerator 1	Outflow	Beach 1	Beach 2
	28.06.18	28.06.18	26.06.18	27.06.18	29.06.18	25.06.18	25.06.18	25.06.18
Aphanocapsa incerta (Lemm.) Cronberg et Komarek	0,30	0,00	**1,35**	0,17	0,03	0,00	0,00	0
Asterionella formosa Hasall	0,06	0,01	0,04	0,00	1,88	0,00	0,00	2,77
Cyclotella ocellata Pant.	0,30	0,56	0,74	**4,30**	0,75	0,70	0,18	3,84
Meridion circulare (Greville) Agardh	**14,74**	0,00	0,00	0,00	0,00	0,00	0,00	0,27
Cyclotella radiosa (Grun.) Lemm.	1,14	0,22	0,25	0,97	0,91	2,27	0,56	1,77
Fragilaria crotonensis Kitton	1,93	0,07	0,00	0,06	0,00	0,83	2,43	**4,99**
Coelastrum astroideum De Notaris	0,12	1,23	**3,64**	**6,62**	1,50	0,00	**9,71**	0,86
Coelastrum reticulatum (Dang.) Senn	0,00	**1,85**	**9,41**	**8,36**	1,85	**23,14**	**7,04**	**16,41**

Oocystis lacustris Chodat	0,24	0,20	0,49	0,09	**2,15**	0,85	0,95	0,45
Pediastrum boryanum (Turpin) Meneg.	**4,27**	0,96	**1,73**	0,89	1,57	**4,96**	**8,79**	0,45
Pediastrum duplex Meyen	**4,27**	0,00	0,89	1,00	0,62	**4,96**	2,06	2,61
*Phacotus lenticularis (*Ehr.) Stein	0,30	0,69	0,49	0,46	**1,91**	**3,72**	0,88	3,32
Sphaerocystis planctonica (Korsikov) Bourrelly	0,54	**1,42**	**7,71**	1,60	**6,11**	**26,86**	**11,28**	**10,92**
Cryptomonas erosa Ehrenberg	1,08	0,32	0,04	0,84	0,16	0,27	1,43	0,14
Cryptomonas rostrata Troitzskaja emend I. Kiselev	1,80	0,00	0,07	0,17	0,70	0,00	0,09	0,00
Cryptomonas marssonii Skuja	0,30	0,20	0,07	0,03	0,00	0,41	0,09	0,12
Ceratium hirundinella (F. B. Müller) Bergh	**23,28**	**4,38**	0,00	**5,07**	**2,76**	**15,91**	**6,61**	**17,19**

Peridinium cinctum (O.F. Müller) Ehrenberg	**11,49**	**1,85**	0,00	**3,64**	**16,54**	**4,38**	1,80	**28,16**
Peridiniopsis cuningtonii Lemm.	2,23	0,97	0,00	0,34	0,24	0,00	0,00	0,00
Peridinopsis elpatiewskyi (Ostenf.) Bourrelly	3,49	1,12	0,22	0,00	0,00	0,00	0,00	0,00
Dinobryon divergens Imhof	**11,97**	**10,90**	0,00	0,33	0,58	0,21	2,75	4,55
Dinobryon sociale Ehrenberg	0,72	0,00	0,04	0,00	0,00	0,00	0,00	0,00