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Indication of Long-Term Changes of Algae Communities in a Hydrologically Transformed Estuary Sasyk, Black Sea, Ukraine

Olena P. Bilous [1,2,*], Agata Z. Wojtal [3], Natalia O. Ivanova [1], Olga V. Burova [4], Sophia Barinova [5], Nadiya V. Maystrova [1], Oleksandr Polishchuk [4], Angela Curtean-Bănăduc [6,*] and Petro M. Tsarenko [4,7]

[1] Institute of Hydrobiology, National Academy of Sciences of Ukraine, Geroiv Stalingrada 12, 04210 Kyiv, Ukraine
[2] Institute of Hydrobiology and Aquatic Ecosystem Management, Department Water-Atmosphere-Environment, University of Natural Resources and Life Sciences, Gregor Mendel Str. 33, 1180 Vienna, Austria
[3] Institute of Nature Conservation, Polish Academy of Sciences, A. Mickiewicza 33, 31-120 Kraków, Poland
[4] M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Tereshchenkivska, 2, 01601 Kyiv, Ukraine; p.tsarenko@botany.pl (P.M.T.)
[5] Institute of Evolution, University of Haifa, Mount Carmel, 199 Abba Khoushi Ave., Haifa 3498838, Israel
[6] Applied Ecology Research Center, Lucian Blaga University of Sibiu, I. Raţiu Street 5-7, RO-550012 Sibiu, Romania
[7] W. Szafer Institute of Botany Polish Academy of Sciences, Lubicz 46, 31-512 Kraków, Poland
* Correspondence: bilous_olena@ukr.net (O.P.B.); angela.banaduc@ulbsibiu.ro (A.C.-B.)

Abstract: Forty years ago, the transformation of the estuary of the Black Sea to a freshwater reservoir was started by its connection with the Danube River through the Danube–Sasyk Canal. Today, the inflow of the Danube water into the Sasyk is the main component of the water balance, affecting the internal and external water exchange, and it is, in general, responsible for the quality of the aquatic environment. In addition, the channel is a migration route for hydrobionts and the main source of invasion. We describe the changes in the composition of algal communities in Sasyk, which was converted from an estuary to a reservoir during three stages: estuary-lake in 1967–1977 (stage I), the forming of the reservoir from 1980–1990 (stage II), and the reservoir from 2013–2019 (stage III). Average salinity decreased from 7790 to 491 mg L^{-1} chlorides, and the species richness of algae increased from 259 to 289 taxa during the Sasyk transformation. Analysis of the algal communities revealed that salinity could have an effect on their composition. The species list for the Sasyk, including 586 taxa of algae and cyanobacteria (613 infraspecific taxa), is presented here for the first time. Rare marine and freshwater taxa present in the algal community at the modern stage of the reservoir and their transformation are discussed. An ecological analysis of the different stages of the Sasyk transformation from an estuary into a reservoir was conducted. The increase in species richness for stages II and III along with an increase in desalination was noted. To keep the current ecological status of the reservoir and its hydrological stability, the role of the Danube River should be considered. Bioindicators, statistical analysis of species, and environmental variables' relationships confirm salinity as a major regulating factor that can be observed by way of long-term monitoring.

Keywords: algae; diatoms; cyanobacteria; phytoplankton; anthropogenic impact; bioindication; salinity reduction; hydrological transformation

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1. Introduction

Humans engage in the transformation of nearly all of the earth's systems, including its atmosphere, hydrosphere, lithosphere, and biosphere [1]. They have extensively and intentionally modified their environments for tens of millennia, and some of these modifications have had a fundamental impact on the existence of many species [2]. At present, the intensity of anthropogenic transformations has already irreversibly altered aquatic ecosystems to levels sufficient to leave an unambiguous geological record of the existence of mankind itself. Modern humans modify aquatic ecosystems for irrigation, drainage, reservoirs, and the diversion of water for agriculture and infrastructure.

A striking example of the riverbed transformation was the creation and functioning of the cascade of reservoirs located on the Dnipro River (Ukraine). The massive hydromorphological transformations on this river started in the 1930s with the construction of the Dnipro Hydroelectric Power Plant (Dnipro HPP) and later several more hydropower plants [3]. The variety and size of the constructed reservoirs on the Dnipro River have no analogs in the world, which gives an understanding of the enormity of their size.

Anthropogenic transformations of water bodies also involve changes in salinity regimes due to the change in the mouth of freshwater rivers. Such a modification can be seen at the Razim–Sinoie Lake complex (Romania), where all measures and works were undertaken in order to forcedly desalinate the water in the lagoon system. It was originally a saltwater lagoon that was isolated from the Black Sea by sand bars and dunes. Then, continuous inflow of freshwater from the Danube River seriously affected the ecological system and caused a severe transformation of the hydrological and biological balance [4]. Another example of an extensively transformed coastal area is the Punggol–Serangoon Reservoir in Singapore. This former estuary was significantly modified so that the water slowly transformed from brackish to freshwater [5,6].

Great anthropogenic hydrological and morphological changes have occurred within the Sasyk Reservoir. The territory of the Sasyk Reservoir is highly important, as it belongs to the European Ramsar Sites [7] and is under European protection. The history of the hydrological transformations of the Sasyk started with its existence as a shallow estuary with periodic connection to the Black Sea. Then, the water body was turned into a reservoir by pumping the salt water out of it several times and then filling it with water from the Danube River through a newly constructed channel. The cause of anthropogenic transformation is the formation of a freshwater reservoir. As a result, it became a reservoir with the range of salinity that is common for freshwaters as well as brackish waters (0.49–2.31 g dm^{-3}), contrary to an estuary, with salinity about 17 g dm^{-3} [8]. Nowadays, Sasyk is categorized as being one of the largest "seaside reservoirs" or "shallow lakes" in the world.

The observed changes in the hydrological regime, including the human interventions in reservoirs, are the cause of the emergence of ecological peculiarities [9]. Significant hydrological and climate changes during the last century are reflected in the physical, chemical, and biological properties of water bodies [1,3,10]. These massive changes lead to an increase in trophic status, frequency, and recovery stages in the water bodies. Thus, the human impact on nature is usually far stronger in modified water bodies than in natural aquatic ecosystems. Therefore, human intervention reduces the efficiency and stability of the transformed aquatic ecosystem as a whole [1,2]. The transformation of the aquatic system also is reflected in the transformation of its biota. Primary producers, as the first component in the food chain, react by changing their composition to each period of the hydrological and hydrochemical transformation of the water body. Algal assemblages were reported to have changed directly after the creation of the Danube–Sasyk Canal [11]. The algal composition during the Liman Lake period was presented by the assemblage of marine and freshwater, and freshwater-brackish species were found only in the upper part, where the Kogylnik and Sarata Rivers inflow into Sasyk. A comparatively large percentage (above 50%) of assemblages was formed by algae typical for benthos and periphyton due to the low water-body depth and overgrowth of the water macrophytes. For species composition, the Black Sea had a greater impact, which is related to the estuary by one or two spills. The summer composition of algae is represented by *Nitzschia tenuirostris* Manguin, *Thalassionema nitzschioides* (Grunow) Mereschkowsky, *Chaetoceros curvisetus* Cleve, *Pseudosolenia calcar-avis* (Schultze) B.G.Sundström (=*Rhizosolenia calcar-avis* Schultze), and *Leptocylindrus danicus* Cleve [11]. However, the data to characterize the composition of the algal communities of phytoplankton and phytobenthos at that current stage of the existence of an already-stabilized ecosystem of the water body are missing.

Thereby, the focus of our investigation was to understand the algal composition, development, and alterations of the algal community in the aquatic ecosystem before, during, and after active hydrological transformation by human intervention. In turn, the relationship between the change in the composition of the algal community and the averaged hydrochemical and hydrological characteristics of the aquatic ecosystem during three periods of its existence can be investigated. We put forward a hypothesis that algal composition has changed through a 40-year time period during the stages of the Sasyk's existence, i.e., from being an estuary to becoming a reservoir, and assessed these changes. These changes can be manifested in the number of species in algae assemblages, the distribution of algae according to phyla and life forms (habitat preferences), as well as depending on changes in hydrological and hydrochemical conditions during different periods.

2. Materials and Methods

2.1. Description of the Study Area

This study is focused on the three interval (stages) of the water body's transformation (Figure 1). Today, the Sasyk is a significantly changed water body that serves undefined economic purposes. It is located in the south of Ukraine and has a length of 31 km, a width of 12 km, and a volume of 479 km^3. The Sasyk occupies an area of about 206 km^2, with a watershed area of some 5.55 km^2, and it lies, on average, 0.16 meters above sea level (according to the Baltic system of heights). Its maximum depth (from the bottom of the estuary) is 3.2 m with an average depth of 2.1 m. Two heavily mineralized steppe rivers, the Kogylnik and Sarata, flow into the Sasyk Reservoir [11].

Figure 1. Stages of transformation of the estuary-lake Sasyk: (**a**) stage I, an estuary-lake before 1979; (**b**) stage II, period of forming a reservoir from 1979–1999; (**c**) stage III, reservoir from 2000 to now.

An attempt to create a freshwater reservoir instead of a brackish estuary led to a change not only to the hydrological regime of the reservoir but also to its morphometric characteristics that allow the existence of the created reservoir for a long time in future. Until 1979, Sasyk was a Black Sea estuary; however, due to its periodic connection with the sea and proximity to the Danube Lakes, it was often called a "lake" or "estuary-lake" [12] (Figure 1a). For this study, the described hydrological characteristics allow us to differentiate this phase as stage I of the existence of the Sasyk (Table 1). The Sasyk was shallow and brackish at the stage I. The main factor influencing the salinity of the estuary-lake Sasyk was the frequency of the seawater exchange. The seasonality of mixing river water with the salts of the bottom sediments and with the groundwater as well as frequent changes to its size and depth were investigated.

Table 1. Water body changes parameters in monitoring years of the Sasyk.

Stage	I	II	III
Water-body type	Lake-estuary	Forming a reservoir	Reservoir
Monitoring years	1967–1977	1980–1990	2013–2019
Ranges of periods	1950–1979 (connected with the Black Sea)	1979–1999 (1979–1985: an active transformation; 1986–1994: irrigation; 1995–1999: stabilization)	2000–now

At the next stage II, the transformation of the Sasyk into a reservoir was based on creating channels (Figure 1b), which made changes to the shoreline and regulated the freshwater inflow. That period was characterized as heterogeneous due to the stabilization of natural processes after the anthropogenic regulation of the reservoir.

After 2000, the "reservoir" period began (stage III; Figure 1c), and the nature of the anthropogenic impact on the reservoir changed. The withdrawal of water for irrigation stopped, and the inflow of the Danube River's freshwater through the Danube–Sasyk Canal became more regulated. At the same time, stricter restrictions began to be applied to part of the water area due to its inclusion in nature.

The comparison of water salinity in the Sasyk during stage I and stage III demonstrates completely opposing changes: before the transformation, the rivers exhibited reduced salinity in the northern part of the reservoir; and now, especially in spring, they mineralize it. Most of the freshwater is in the area near the confluence of the Danube–Sasyk Canal. However, other channels that were needed originally to provide irrigation in the region are no longer used.

Anthropogenic transformation of the Sasyk indirectly affected other hydro-ecosystems. For example, the creation of a dike along the sand spit between the sea and the Sasyk led to the intensification of the coastal strip from the Black Sea seaside during 1980–2020. [10].

2.2. Environmental Data Collection

The environmental variables were collated for three periods of the Sasyk's existence: lake-estuary, formation of a reservoir, and reservoir (Table 1). Hydrological parameters (water exchange period, evaporation, inflow through the channel, and inflow of water from the sea) were gathered from literature sources or calculated by authors of published data [11–15] and are presented in Table 2. Hydrophysical parameters were measured during our periodical field studies in 2013–2019, with some additional information from literature sources [11–15] and the monitoring data of the State Water Agency and the Danube Hydrometeorological Observatory (work with unpublished data in archives). Hydrochemical parameters were also measured during our periodical field studies in 2013–2019 and also supplemented by some published data [13,16–19] (Table 2).

2.3. Algae Floristic Data Collection

To evaluate changes in the algal composition of the three stages of the existence of the Sasyk, the phytoplankton and phytobenthos data were analyzed. A species composition at stage I of the reservoir existence was made with the help of analysis of historical datasets that included period of studies in 1967–1987, presented in [11]. For stages I and II of the Sasyk's existence, it is known that the phytoplankton and phytobenthos were sampled at 24 sites of the water area in 1978–1987. Therefore, 17 deep-water sites for phytoplankton sampling and 7 coastal sites for phytobenthos sampling were chosen [11].

Table 2. Environmental variables of the Sasyk in three studied periods.

Stage	I			II			III		
	Average	**Min.**	**Max.**	**Average**	**Min.**	**Max.**	**Average**	**Min.**	**Max.**
Water exchange period, day	505	nd	nd	163	nd	nd	312	180	568
Inflow through the channel, mln m^3 $year^{-1}$	0	0	0	765	480	1260	399	127.2	796.1
Inflow of water from the sea, mln m^3 $year^{-1}$	142	nd	nd	0	0	0	0	0	0
Evaporation, mln m^3 $year^{-1}$	173	nd	nd	156	106	219	193	182	206.5
Suspended solids (sediments), mg dm^{-3}	nd	nd	nd	44.4	10	89.4	186	27.1	655
Water temperature, °C	nd	nd	nd	14.2	0	24.9	14.3	0	26.3
Water transparency, m	nd	nd	nd	0.293	nd	nd	0.136	0.02	0.31
pH	nd	nd	nd	8.19	7.9	8.3	8.04	6.9	8.8
Salinity, g dm^{-3}	nd	2.39	17.6	2.29	1.4	3.45	1.79	0.96	2.96
Cl-, mg dm^{-3}	7790	6240	9410	603.5	396	793	491	212.8	2552
O_2, mgO_2 dm^{-3}	nd	3.9	21.2	10.4	6.17	14.8	9.23	6.27	14.7
Saturation O_2, %	nd	43	150	89.7	66	114	83	52	120
BOD, mgO_2 dm^{-3}	nd	nd	nd	2.6	0.39	7.83	3.6	0.61	9.53
N-NO_3, mg dm^{-3}	nd	nd	nd	0.809	0.02	2.4	0.4	0.008	1.8
N-NO_2, mg dm^{-3}	nd	nd	nd	0.0515	0.01	0.092	0.085	0.0016	0.66

Note: nd, not determined.

To characterize the modern period of the Sasyk's existence, namely stage III, phytoplankton analysis conducted in 2013 and 2014 [19,20] was combined with the phytobenthos analysis conducted in 2018 [8]. For analysis of phytoplankton species composition, the sampling sites were evenly distributed around the Sasyk's surface area. The number of sites was 17, including those near to the Danube–Sasyk Canal. For phytobenthos investigations, sampling included seven sites that were mostly located along the shoreline of the water body to evenly cover all of its banks. The obtained lists of species for the modern period of the Sasyk's existence have already been published [8,19,20], and detailed methodological explanations of the sampling strategy and methods used for the collection and analysis of the algal material can be found in these works. In the present study, we focus on the analysis of published data for both the historical and modern periods of the Sasyk's existence.

The general list of species mentioned in the references and found by us was brought into line with the modern taxonomic system, validated by using the AlgaeBase system [21], and divided by presence–absence data into three periods.

2.4. Bioindicators and Statistical Analysis

To determine the environmental factors affecting the diversity of phytoplankton in the Sasyk, a few studies were performed. Bioindicator analyses were performed according to [22], based on species-specific ecological preferences of the revealed algae and cyanobacteria [23–25], with the combination of species with similar ecological properties to indicator groups reflecting the response of aquatic ecosystems to habitat, pH, oxygenation, water mass dynamics, salinity, trophic state, and the class of organic pollution. The analysis of bioindicators included several steps. First, the species composition was identified in each stage of the Sasyk. The available information on the autecology of the identified species was then added. Then, the number of indicators in each environmental group for each period was calculated. Finally, the dynamics of the percentage composition of indicators for each indicated environmental variable were expressed in histograms and tabular data and reflected the changes in the composition of the communities due to the changes in the environment during the three periods of the study.

Network analysis in JASP (significant only) using the botnet package in statistic R of [26] following the comparison of their distribution was performed. The statistical analysis of the species and their environmental variables' relationships was performed using the CANOCO Program 4.5 [27].

To visually present the degree of dissimilarity of the algal community structure between the stages, we built a dendrogram using the unweighted pair groups method with arithmetic mean cluster analysis (UPGMA) in the Biodiversity Pro 2.0 program based on the Bray–Curtis similarity matrix [28] calculated from species presence–absence data in the three lists that correspond to the three stages of the Sasyk's existence. The same type of analysis was performed for the species present in each stage, the number of species in indicator groups, and the current available environmental data for the Sasyk.

3. Results

3.1. Environmental Variables in Long-Term Changes

The studies conducted between the 1960s and the 1970s describe the Sasyk as a water body partially connected with the Black Sea and the Dzhantei Estuary at stage I (Figure 1a). The average period of water exchange during these years of observation of the reservoir was 505 days (Table 1). The water salinity during this described stage was similar to the marine salinity both quantitatively (on average 14–15 g dm^{-3}) and by ion composition (Table 2).

At stage II, the period of water exchange was at its shortest and amounted to just 163 days during the early 1980s. That is, the water in the reservoir was artificially renewed three times more often than naturally in stage II (Figure 1b). The first decade of the reservoir's existence was designated by the phrase "forming a reservoir", and this phase is named stage II of the Sasyk's existence.

The water exchange in stage III (Figure 1c) became less intensive with an average period of 312 days, which is less than was occurring immediately after the creation of the reservoir but more intensive than at stage I of the Sasyk's existence.

In recent times, water salinity and its distribution to the water area have changed but have not reached the level of being "freshwater". After being actively used in the 1980s, during the 1990s, the Danube–Sasyk Canal was almost non-functioning.

Modern investigations during the period from 2013–2019 at various observation posts for the aquatic zone of the reservoir revealed that the water salinity in the Sasyk ranged from 0.30 to 2.7 g dm^{-3}. According to surveillance monitoring carried out during different seasons, the content of the dissolved oxygen in the water ranged from 6.14 to 13.31 mgO_2 dm^{-3} (59.3–101.4% saturation), and at the near coastal station, it was 4.1–12.7 mgO_2 dm^{-3} (51.3–161% saturation). The average annual water temperature in the reservoir was 10.6–13.2 °C. In summer, the water could warm up to 25–30 °C. By pH values, the water in the Sasyk was weakly alkaline (8–8.11). In the northern part of the reservoir, in different years of the average annual values of the ammonium concentration range was 0.059–0.284 mg dm^{-3}; for nitrites nitrogen, 0.018–0.049 mg dm^{-3}; for nitrates nitrogen, 0.467–1.59 mg dm^{-3}; and for orthophosphates, 0.1–0.22 mg dm^{-3} [12].

3.2. Algae Composition Characteristics of the Stages of the Sasyk's Existence

The total composition of algae during the three stages of the Sasyk's existence is represented by 586 species (613 with infraspecific taxa or ssp.). However, each stage of the existence of the water body has its own species composition. At stage I, the number of species was 253 (259 ssp.) and at stage II, 281 (295 ssp.) [11]. At stage III, 278 species (287 ssp.) were found [8,19,20] (Appendix A, Table A1). Thus, we can analyze the created database of phytoplankton and phytobenthos species for tracking changes through a 40-year period covering the three stages of the Sasyk's existence from being an estuary to becoming a reservoir.

The statistically calculated dissimilarity between algal communities during the different stages of the Sasyk's existence is well illustrated in the graph (Figure 2). The algal composition at stage I was only 45% similar to that of stage II. The similarity between stage III and stages I and II is quite low at 23%. The comparison of algal species composition at all periods of the existence of the Sasyk allows us to assume that nowadays, its flora is considerably richer than during its natural stage.

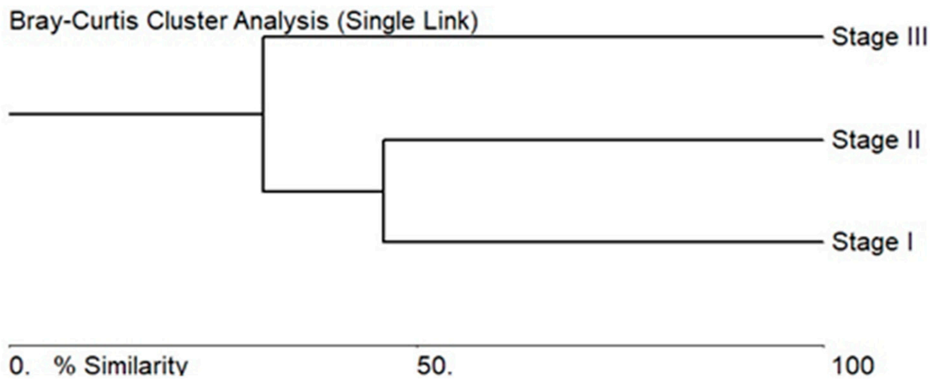

Figure 2. The tree of algae species' composition similarity (based on data in Appendix A, Table A1) between different stages of the Sasyk's existence. This figure was built based on the Bray–Curtis similarity index.

Interestingly, the modern stage III is more similar to stage II and less similar to stage I. In the first case, it has a 31.5% similarity and in the second, 23%. This suggests that in the first decade after the transformation of the water body, more than 50% of the algae composition changed, and during stage III, almost 70% of the species changed over a forty-year period. With this, one can assume that long-term and significant hydromorphological changes to the water body affected the species composition of algae.

The species composition at the studied stages was mostly formed by Bacillariophyta, Chlorophyta, Miozoa, Cyanobacteria, Euglenozoa, and Charophyta (Figure 3). Some other groups, namely Ochrophyta (Xanthophyceae), Cryptista, and Ochrophyta (Chrysophyceae), were represented by a few species.

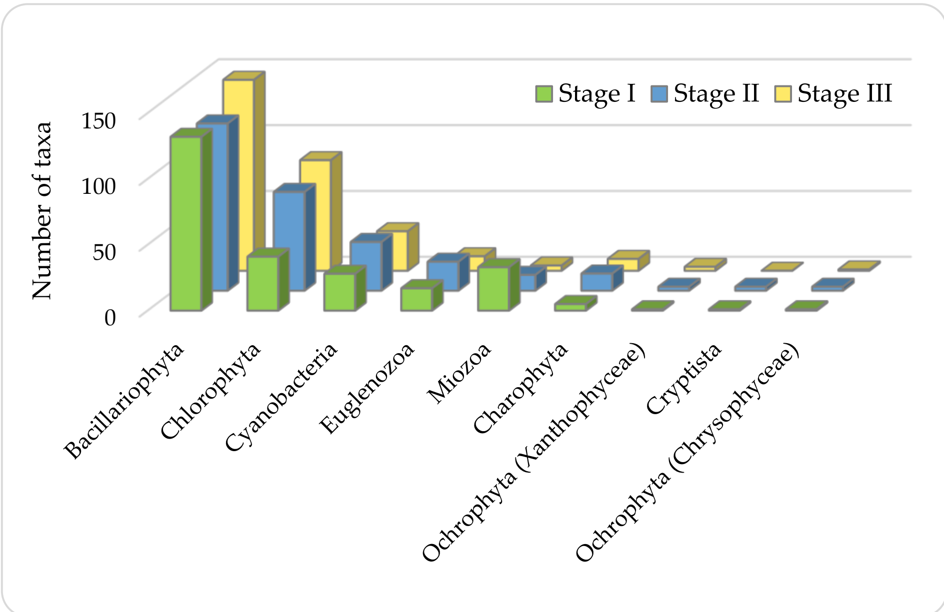

Figure 3. The changes in taxonomical composition during three stages of the Sasyk's existence.

The number of Bacillariophyta species markedly increased at stage III in comparison to stages I and II. The number of Chlorophyta species increased after stage I and was stable over forty years during stages II and III. The amount of Miozoa present sufficiently decreased. At stage II, the number of Cyanobacteria species increased, but in the modern period/stage III, it is at almost the same level as it was during stage I. The peak of

Euglenozoa reached its maximum during stage II, and nowadays, it is even smaller than during stage I. As for the Charophyta species, their number during stage I was low, with its maximum being during stage II and with some decrease at stage III.

It is worth mentioning that at stage I, species were found that are usually found in estuaries or lagoons and were not reported for the Sasyk during other periods of investigations (stage II and modern/stage III): *Campylodiscus clypeus*, *Chaetoceros wighamii*, *Eutreptia lanowii*, *Gyrosigma arcuatum*, *G. fasciola*, *G. strigilis*, *G. prolongatum*, *Melosira nummuloides*, *Monomorphina pyrum*, *Navicula capitatoradiata*, *Paralia sulcata*, and *Tryblionella circumsuta*.

During stage II, the cases of cyanobacterial blooms were noted quite often and were formed by *Aphanizomenon flos-aquae* and *Microcystis aeruginosa*. Furthermore, some common diatom algae should be noted for this period: *Aulacoseira granulata*, *A. italica*, *Cyclotella meneghiniana*, *Stephanodiscus hantzschii*, and *S. subtilis*. As also for the green algae, *Coelastrum microporum* and *Mucidosphaerium pulchellum* were noted.

The common species found among the Sasyk plankton during the investigation at the modern/stage III were the following: *Aphanizomenon flos-aquae, Aphanocapsa planctonica, Cocconeis placentula, Cosmarium bioculatum, Crucigenia tetrapedia, Cyclotella meneghiniana, Desmodesmus armatus, D. communis, Geitlerinema amphibium, Merismopedia punctata, M. tenuissima, M. warmingiana, Microcystis aeruginosa, Monoraphidium arcuatum, M. griffithii, M. irregulare, Mucidosphaerium pulchellum, Oocystis lacustris, O. solitaria, Pseudopediastrum boryanum, Quadricoccus ellipticus, Raphidocelis sigmoidea, Snowella lacustris, Tetradesmus lagerheimii* (=*Acutodesmus acuminatus* (Lagerheim) P. Tsarenko), *Tetraedron minimum*, *T. triangulare*, and *Woronichinia compacta*.

The characteristic species of diatoms revealed in benthos that were common over the territory of the reservoir during stage III were the following: *Amphora ovalis*, *A. pediculus*, *Belonastrum* cf. *berolinense*, *Cocconeis lineata*, *Cocconeis neodiminuta*, *C. pediculus* Ehrenberg, *Diatoma moniliformis*, *Encyonema cespitosum*, *E. sorex*, *Navicula cryptotenella*, *Nitzschia inconspicua*, *Rhoicosphenia abbreviata*, *Rhopalodia gibba*, and *Tabularia fasciculata* (Appendix A, Figures A1 and A2).

The following species of diatoms identified from benthos that have rarely been observed so far in Ukrainian waters were noted during stage III: *Amphora copulata*, *A. inariensis*, *Cymbella neocistula*, *C. compacta*, *Fallacia clepsidroides*, *Gomphonema utae*, *Navicula recens*, *Nitzschia filiformis* var. *conferta*, *N. archibaldii*, *Paraplaconeis minor*, and *Rhaphoneis amphiceros* (Appendix A, Figure A3).

Our investigations revealed that the following new species were found in the Ukrainian territory [7]: *Fragilaria microvaucheriae, F. nevadensis, Mastogloia pseudosmithii, Navicula germainii, N. cf. vandamii, Nitzschia angustata var. minuta, N. sociabilis,* and *Planothidium lacustre* (Appendix A, Figure A4). Some additional photos of diatoms from the modern period were not included during the preparation of the paper about phytobenthos [8] and are presented in this work (Appendix A, Figures A1–A4).

3.3. Ecological Assessment Based on Bioindicators for the Different Stages of the Sasyk's Existence

The congeneric coverage of all phyla of algae during the three stages of the existence of the Sasyk (stage I, stage II, and stage III) (Figure 4a) provides us with the opportunity to analyze species composition according to their ecological preferences (Figures 4 and 5).

During the studied stages, the plankto-benthic (P-B) taxa prevailed, even considering that the species composition was different. However, the hydrological transformation of the Sasyk during stage II revealed the changes that were reflected in the floristic composition. Habitat preferences indicated the increased proportion of planktonic (P) taxa and decline of the benthic (B) taxa during stage II. Now, at stage III, the proportion has become similar to that at stage I (Figure 4b).

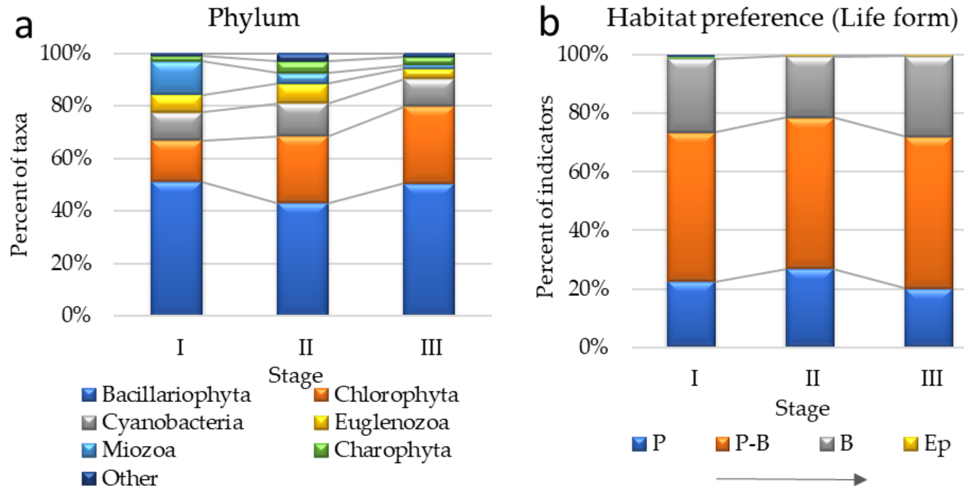

Figure 4. The distribution of algae according to phyla and life forms (habitat preference) for the studied stages of the Sasyk's existence. (**a**) Taxonomic phyla. (**b**) For the life forms, the following abbreviations were used: P, planktonic; P-B, plankto-benthic; B, benthic; Ep, epiphytic and soil.

The pH indicators during different stages of the Sasyk's hydrological transformations were represented by acidophiles (acf), alkaliphiles (alf), alkalibiontes (alb), and indifferents (ind) [29]. Comparisons of their proportion between the stages revealed that at stage I, the water contained proportionally greater amounts of alkalibiontes, indicating more alkaline conditions compared to stages II and III. Acidification was observed at stage II, but at stage III, the pH of the reservoir almost returned to the values of stage I (Figure 5a).

Water mass dynamics and oxygen regime revealed prevailing low-streaming (standing-streaming) water (st-str) taxa during all periods of the hydrological transformations of the Sasyk. The percentage of indicators of standing water with low oxygenation decreased during stage II. In stage III, the situation has become more stable, and the proportion of indicators for streaming water (str) with a high amount of oxygen has increased (Figure 5b).

As for the salinity changes during the different stages of the hydrological transformations of the Sasyk, oligohalobe-indifferent (i) taxa were prevailing, with the number of mesohalobes (mh) and halophiles (hl) significantly changed [30]. As for the oligohalobe-halophob (hb) taxa that live exclusively in freshwater, their proportion was at its lowest during stage I (Figure 5c).

To understand the trophic changes during the three stages of the Sasyk Reservoir's existence, trophic status indicators [23,31,32] were analyzed. Mesotraphentic (m) and eutraphentic (e) taxa prevailed during all the stages, which characterizes the water body as having mesotrophic and eutrophic status. Additionally, the percentage of the increase in oligotraphentic (ot) and oligo-mesotraphentic (o-m) taxa can be noticed at stage III in comparison to previous stages (Figure 5d).

All the described is supplemented by the analysis of the organic pollution by which the water was assigned to the corresponding quality classes. In Figure 5e, the assessment of water quality classes is presented in the EU colors' code system; we observed that during the studied stages of the Sasyk's existence, the water body was of class III water quality. However, at stages II and III, we observed that the number of indicators of the class II water quality increased, and those of class IV decreased. Our assessment yielded the same results in both assessment systems of organic pollution: Sládeček (as index saprobity S) based on all taxa and Watanabe for diatom species only (Appendix A, Table A1).

The analysis of indicators of nitrogen-uptake metabolism revealed the presence of all groups of autotrophy-heterotrophy: (ats), (ate), (hne), and (hce). The clear trend of the increasing percentage of nitrogen-autotrophic taxa tolerating very small concentrations of organically bound nitrogen (ats) and decrease in the indicators tolerating very small concentrations of organically bound nitrogen (ate) can be noted. The increase in obligately nitrogen-heterotrophic taxa (hce), needing continuously elevated concentrations of organically bound nitrogen, is also noticeable in Figure 5f.

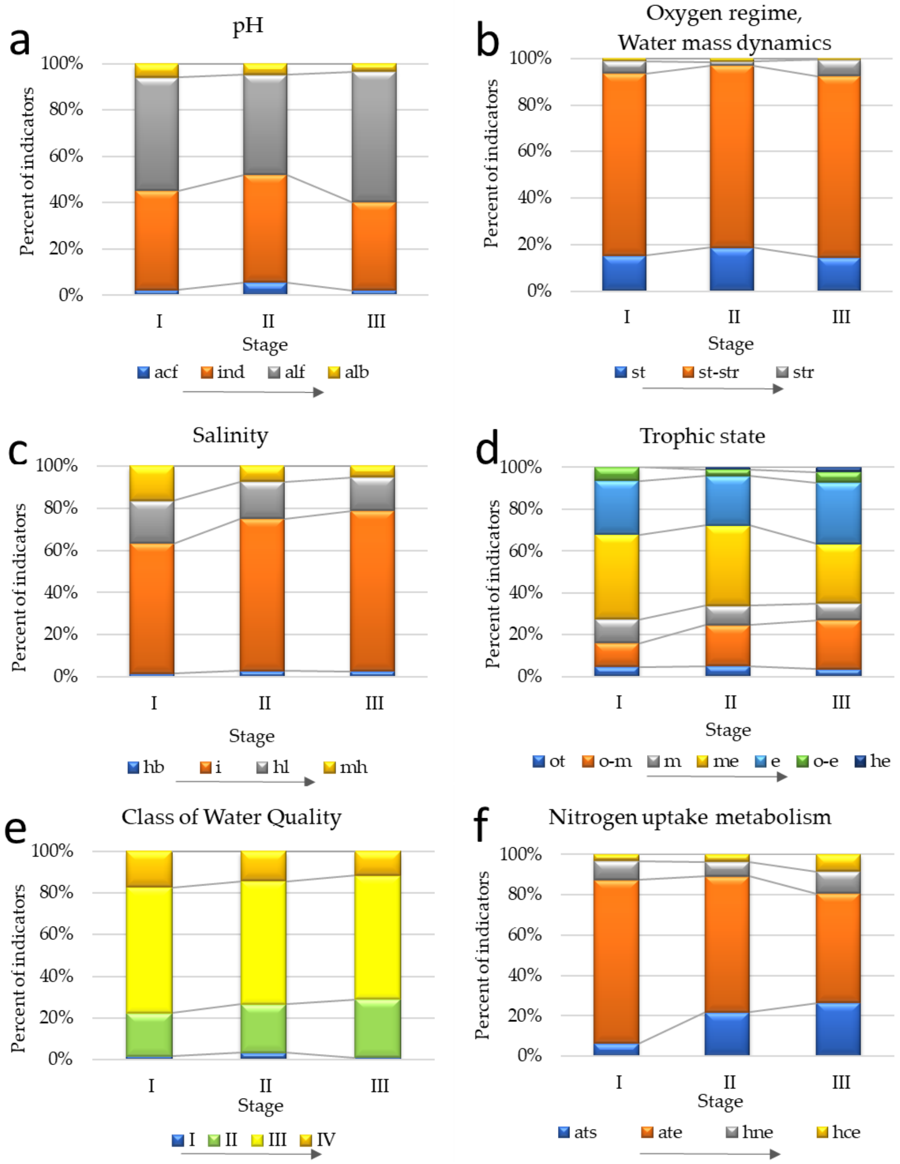

Figure 5. The ecological changes during the studied stages of the Sasyk's existence. Groups of indicators are denoted on the x-axis, and the arrows show the increase in the indicated variable. The abbreviation of the indicators of pH are as follows for (**a**): acf, acidophiles; ind, indifferents; alf, alkaliphiles; alb, alkalibiontes. Water mass dynamics (flow) and oxygen regime indicators (**b**): st, taxa that prefer standing water with low amount of oxygen; str, taxa that live in streaming water that is highly saturated by oxygen; st-str, taxa living in standing-streaming water with a medium amount of oxygen. Salinity (**c**): hb, oligohalobes-halophobes; I, oligohalobes-indifferents; hl, halophiles; mh, mesohalobes. Trophic state (**d**): ot, oligotraphentic; o-m, oligo-mesotraphentic; m, mesotraphentic; me, meso-eutraphentic; e, eutraphentic; o-e, oligo- to eutraphentic (hypereutraphentic); he, hypereutraphentic. Class 1–5 of organic pollution indicators according to species-specific index saprobity S (**e**). Nitrogen uptake metabolism (**f**): ats, nitrogen-autotrophic taxa, tolerating very small concentrations of organically bound nitrogen; ate, nitrogen-autotrophic taxa, tolerating elevated concentrations of organically bound nitrogen; hne, facultatively nitrogen-heterotrophic taxa, needing periodically elevated concentrations of organically bound nitrogen; hce, obligately nitrogen-heterotrophic taxa, needing continuously elevated concentrations of organically bound nitrogen.

3.4. Species–Environment Relationships

An analysis of the available ecological characteristics of the Sasyk as well as the dynamics of bioindicators revealed the importance of identifying the main operating factors determining the composition and prospects for the response of communities in changed conditions. Cluster analysis of the species composition alone (Figure 2) showed similarities between the communities for stages I and II, while the composition at stage III was significantly different. For the next analysis, we selected data on species representation (Appendix A, Table A1), as for the first analysis: the number of species in the phyla, the composition of bioindicators, and the main environmental characteristics for the three stages of the Sasyk's existence (Appendix A, Table A2). Thus, the complete database of available data on the environment and communities in the three stages of the Sasyk's existence were analyzed. Figure 6 shows that the inclusion of the analysis of environmental indicators and their indicators significantly changed the pattern of similarity in the same type of analysis. The indicators of stages II and III seem the most similar when the desalination of the Sasyk began. This allowed us to progress to the next step in the analysis.

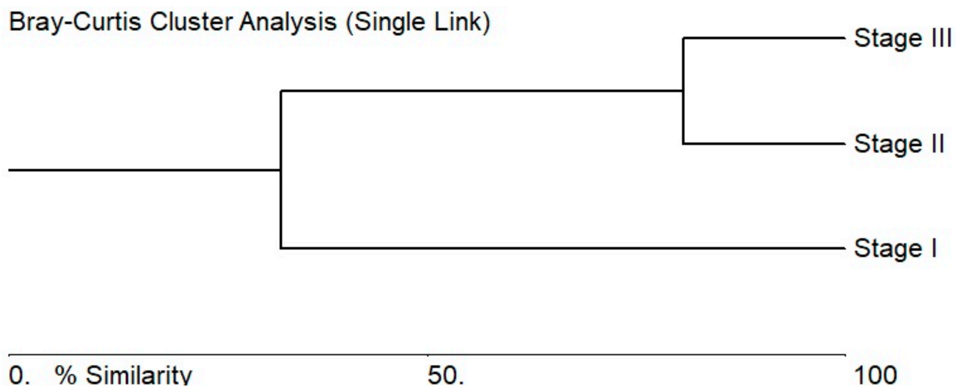

Figure 6. The similarity tree of algae species composition with bioindicator and environmental data (based on data in Appendix A, Table A2) between the different stages of the Sasyk's existence. This figure was built based on the Bray–Curtis similarity index.

Correlation relationships based on the same database as in the previous analysis, which were identified in the JASP program, appear as a significant correlation of data for stages II and III (Figure 7). Thereby, the Sasyk's desalination was revealed as having a significant role in the algal assemblages.

The next stage of the analysis included the calculation of the relationships between the environmental parameters (Tables 1 and 2) and the number of species in phyla (Appendix A, Table A2) for each stage of the Sasyk's existence. The RDA tri-plot (Figure 8) demonstrates the division of the environmental indicators into three clusters. Chlorides and the connection with the Black Sea favor the development of Miozoa species at stage 1 (cluster 1). Opposite cluster 2 combines the diversity of phyla near the inflow of the water from the Danube–Sasyk Canal during stage II, and cluster 3 includes species of the diatom phylum, for which the increase in diversity is associated with desalination and great water evaporation at stage III. Thus, the RDA analysis sharply emphasizes the influence of hydrological conditions on the composition and the flourishing of algae and cyanobacteria species at various stages during the Sasyk's existence, with the desalination factor being critical to the growth of community diversity.

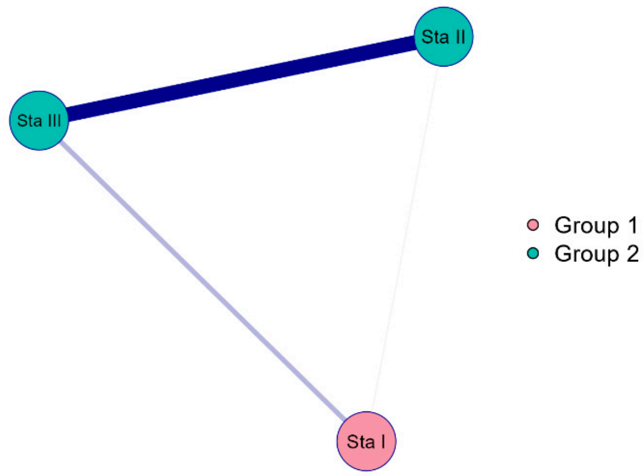

Figure 7. JASP plot of the correlation of algal species composition and environmental data (based on data in Appendix A, Table A2) between the different stages of the Sasyk's existence. Group 1 includes data of stage I with high salinity, and group 2 includes data of stage II and III, when the Sasyk had a dam and was enriched by waters from the Danube–Sasyk Canal that formed a reservoir with low salinity. Bold lines show largest similarity on type of analysis; "huge" correlation > 0.5.

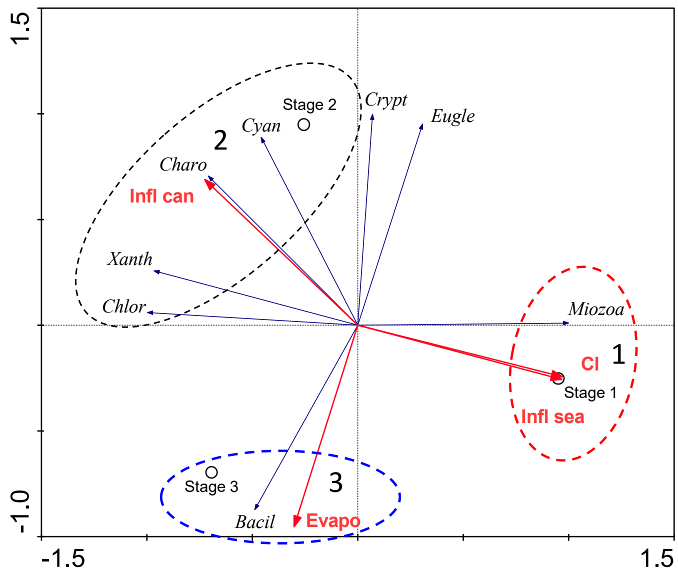

Figure 8. RDA tri-plot of species in phyla and environmental variables relationships for the Sasyk. Clusters are outlined by colored dashed lines.

4. Discussion

Changes in the algal composition reflect the forty-year hydrological transformation of the water body. In the modern stage of the Sasyk Reservoir's existence (stage III), the algal composition is at its most different when comparing it to the natural stage (stage I), which is quite reasonable. Stage II is more similar to the natural (stage I), mainly because of the short time of existence of the transformed water ecosystem. This may explain the unstable flora and reflect the hydrological transformation of the water body. This was a short time to have allowed for a hugely differentiating species composition. After that period, great changes to the hydrological regime occurred, which indeed changed almost half of the species composition (stage III).

The obtained results on the dynamics of the indicator species of the pH regime during the noted periods testify to the changes in their proportion. The increased number of alkaliphiles (alf taxa) living at pH > 7 indicate medium-alkaline waters, thereby corresponding to the existing data characterizing the modern period of the Sasyk's existence [8,19].

According to hydro-chemical data [11], the oxygen saturation of the water was sufficient at all stages of research [16,17]. Further, the stabilizing of the hydrological regime nowadays (stage III) in comparison to stage II is similar to the stable stage I and revealed the same percentage quantities of standing water (st), streaming water (str), and low-streaming (standing-streaming) water (st-str) taxa. Interestingly, the amount of standing water (st) taxa increased during stage II along with a decreasing amount of streaming water taxa (str) compared to the stage I. Considering the intensity of the water exchange during the reservoir-formation stage, one would have expected an increase in the number of the streaming water taxa (str); however, this was not the case. This could be explained firstly by the emergence of the active restructuring of the ecosystem and secondly by the large volumes of water mass that flowed through the reservoir. Therefore, it is important to consider not only the general period of water exchange but also the hydrodynamic processes, namely mixing. In this case, water masses did not have time to "replace" and saturate oxygen throughout the water area. Due to this, shallow-water stagnant zones arose, the presence of which could cause an increase in indicators of standing waters (st). Reducing the intensity of water inflow from the Danube–Sasyk Canal during the reservoir stage in this modern time has led to water masses replacing a larger area of water, therefore supporting mixing processes and thereby aeration. This is also reflected by reduced standing waters (st) and the significantly greater amount of streaming water (str) taxa. The ecosystem of the reservoir has become more stable, so the species found and consolidated in areas better met the characteristics of their ecological niches.

Nowadays, the identified dominant complex of the plankton algal species is typical for freshwater; however, the presence of mesahalobes is still registered in the benthos. This can be explained by their storage or conservation in a thick layer of silt at the bottom of the reservoir as well as possible sources of groundwater saturated with chlorides. In turn, the presence of mesahalobes and (mh) and halophiles (hl) in algal composition for the current period can be explained by the presence of shallow waters that were periodically dry as coastal zones, where salts from the bottom soils continued to be present. The probability of such a process is described in ref. [33] but still has not been sufficiently studied. Furthermore, it is worth mentioning that according to our studies of the modern period, the mh in phytoplankton were found only in a few places in the south-eastern part of the reservoir [19]. Although the water salinity did not meet the requirements for mh existence mesohalobes (mh) and halophiles (hl) in phytobenthos were found in almost every sample [8]. This once again confirms the above-mentioned assumption and emphasizes the importance of simultaneous studies of the hydro-chemical parameters and bioindication results. The presence of such species may be an indicator of a long-term effect of the salinity factor that may not be noticed in a one-off study of hydrochemical samples.

The amount of oligotraphentic (ot) and oligo-mesotraphentic (o-m) taxa reveals that the trophic state at the modern period of the reservoir is slightly improving compared to its natural state (stage I).

The decrease in indicators of class IV and increase in the number of indicators of class II reveals the improvement of the ecological status during the modern period of the existence of the water body (stage III). Moreover, the increase in the number of ats along with decrease in other indicator groups of autrotrophy-heterotrophy also testifies to the improvement of trophic status of the investigated water body.

The influence of factors that created a mosaic distribution of biota over the reservoir was reported [8,19,20]. The originality of the flora is reflected in the high variety of rare species and occurrence of species that are new to Ukraine. As the aquatic territory of the Sasyk Reservoir belongs to European Ramsar Sites and is under European protection [7], another important part of our investigation of the territory was to accurately identify some species of algae that are rare for Ukraine. The Sasyk Reservoir ecosystem nowadays is quite open for penetration by new species entering from the Danube River. Moreover, the Sasyk's hydrological regime is specific and linked with the unstable condition of the ecosystem after transformation, where the different salinity levels of water masses meet each other due to the rivers outflow, underground waters, and freshwater from the Danube–Sasyk Canal. A high variability of species composition in this water body was impacted by waters with different salinity that form the conditions inherent for transitional zones [34–37]. The importance of the salinity ranges and the forming of a transitional zone along the seaside water bodies has been explored for the Ukrainian territory and has proven to have a significant effect on the composition of algae [38]. The provided investigation of a rapidly changed coastal zone is of high importance due to the reflection of the changes induced not only by physical but also climatic and anthropogenic patterns [8,10]. Floristic and faunistic study in the Danube Delta area can give a chance to assess the differences in the nature conservation over some parts of delta and adjusted areas in Romania and Ukraine [39]. The list of the Sasyk's algae and cyanobacteria, compiled here for the first time from published and original data, presents a summary of species and their indicator properties that can be used in water quality monitoring. This type of coastal waters has always been used and transformed as a source of water and still retains its importance in the face of future climate change [40–42]. For these purposes, new methods can be used in the monitoring and assessment of long-term changes [43,44].

The importance of this conducted research is also explained by the fact that this area is one of the main migration routes for birds. The territory serves as a nature reservation for habitats of migratory birds as well as the fish population of the delta [45]. This was the reason for creation of the Danube Biosphere Reserve in recent times (Figure 1c).

Longitudinal studies of salinity regime changes were assessed with a focus on the dynamics of the structural composition of the algae in the Kuyalnik Estuary [46,47]. Following the reduction of salinity in the waters of the Kuyalnik Estuary, the mesohalobic taxa prevailed along with euhalobic, and during the drying period, the algal composition reflects the changes in the salinity regime, where euhalobes or even polyhalobes are dominant. However, the example of the Kuyalnik is a direct opposite to the Sasyk Reservoir. In the Sasyk, the process of the reduction of salinity prevails, whereas in the Kuyalnik, the process of salinization is observed. The poor management of the Velykyi Kuyal'nyk River has resulted in a decrease in the runoff and an increase in the volume of evaporation, which has led to a catastrophic shallowing and salinization [48–50]. The range of salinity in the Kuyalnik is unstable and during different periods has ranged from 5.4 to 399.9 g dm^{-3} [51,52]. The impact of the increasing salinity to the algae diversity and abundance was revealed for continental water bodies in Ukraine [53]. This problem is also relevant for the Tuzlovsky Estuaries, where catastrophic shallowing is being observed due to insufficient water inflow and a lack of water supply. The solution for such problems is to create not only hydrological transformations that result in the phytoplankton diversity and their decreasing abundance but also with increasing freshwater runoffs and connections with water bodies such as rivers and water from the sea, etc.

Thus, the state of the Sasyk Reservoir compared to the above-mentioned estuaries is relatively better. The issues of water transfer in changing the salinity level and the improvement of water exchange with the help of the Danube–Sasyk Canal are also relevant for the Sasyk Reservoir and nowadays have led to an improved condition of the reservoir. Indeed, the hydrological situation at this moment is better than if there had never been any water input at all. There is a constant flow of water and with an adjustable outflow that is characteristic of the modern stage of the hydrological transformation of the Sasyk Reservoir. Of course, it is possible to intensify water exchange, but due to the size features and hydro-dynamic processes, we can observe the effect of water mass dynamics over the whole Sasyk Reservoir water body [54]. At the same time, the channel remains the main migration corridor for new species of fish and mollusks. (For example, the first finds of *Sinanodonta* are exactly near the confluence of the Danube–Sasyk Canal [55]). The main part of allochthonous suspended matter also enters through this channel [54]. The sufficient influence of the inflow of suspended matter with the waters of Danube was revealed earlier [40], which in future exploitation of channel could have proper interest. Perhaps, if we could arrange for decantation or preliminary purification of the water that enters the Sasyk, then the quality of water in the reservoir could improve.

Despite the already-implemented hydrological changes that have taken place over the last forty years, the question of further usage for the Sasyk Reservoir remains open. An actively discussed issue is the possibility of restoring the irrigation system in the south of Ukraine and reusing the Sasyk Reservoir as a water reservoir. That would return it to the original transformation purpose. A project for tourism development in the region and the construction of a large complex on a spit between the Sasyk Reservoir and the sea have been suspended, probably for political and economic reasons. From the standpoint of an increase in freshwater demand, the idea of modifying estuaries into freshwater reservoirs may be implemented.

An example of the Sasyk transformation could serve as a showcase for artificially maintained freshwater areas. We believe that such a solution for the water body could also contribute to resolving the most urgent problem of mankind over a freshwater shortage and uneven distribution of freshwater over the planet, mainly concerning developing countries [56]. The described response of the aquatic ecosystem as well as some factors that have an impact on seaside water bodies could be considered for future human interventions in natural estuaries.

5. Conclusions

The unique Sasyk Reservoir, located on the northwest coast of the Black Sea near the Kiliya Danube Delta, is an unfortunate example of the decrease in salinity in a brackish water reservoir that was analyzed over a forty-year period. The study highlights the significant changes in algal composition due to changes in salinity during three stages of human interventions. Each period of the Sasyk's existence is characterized by specific algal communities, with the similarity of algal composition between periods ranging from 23–31.5% to 45.8%. The analysis of the algal composition at the modern stage of the Sasyk Reservoir revealed the uniqueness of the conditions that have been formed in this water body. The conducted study fulfilled our understanding of the Ukrainian flora of algae and helped us to find species of algae that are new and thus far rarely observed in Ukraine.

The study was undertaken to analyze the impact of the anthropogenic interventions in the hydrological regime that reflect the ecological changes in the Sasyk Reservoir, with an increase in algae diversity as a result of desalination. The indicator species of habitat preference, water mass dynamics, pH, salinity, trophic state, and water quality class were analyzed. Most of the analyzed indicator characteristics of algae revealed the improvement of the ecological status of the reservoir during this modern time of its existence in comparison to the earlier stages. The salinity of the Sasyk's waters in statistical calculation was revealed as the major impacting factor for the algae and cyanobacteria assemblages. The Sasyk's water masses remain considerably differentiated by the salinity characteristics; therefore, further monitoring of the state of the ecosystem must necessarily consider the study of the distribution of this parameter over the water area of the reservoir. As we can see, the increase in water exchange and the constant maintenance of the Danube water supply in the last decades (stage III) has affected the species composition of algae communities. Therefore, it makes sense to continue supporting the Danube–Sasyk Canal operation. However, this decision depends on the water level in the Danube River and the determination of specialized management bodies to maximize the ecological services of the reservoir and coastal areas. Monitoring the algae and cyanobacteria assemblages can help to assess their changes under the face of the coastal environment and climate changes. For this, carrying out complex hydrobiological, hydrochemical, and hydrological studies is highly important. All the mentioned measures will allow us to determine the anthropogenic component of the influence on the natural processes of the development of the aquatic ecosystem.

Author Contributions: Conceptualization, O.P.B., N.O.I. and P.M.T.; data curation, A.Z.W. and P.M.T.; formal analysis, O.P.B., A.Z.W., S.B., N.V.M. and O.P.; funding acquisition, O.P.B., A.Z.W. and N.O.I.; investigation, O.P.B. and O.V.B.; methodology, O.P.B., A.Z.W. and N.O.I.; project administration, N.O.I.; resources, N.O.I., O.V.B., O.P. and P.M.T.; software, O.P.B., O.V.B. and S.B.; supervision, A.Z.W., N.V.M. and P.M.T.; validation, O.P.B., A.Z.W., N.O.I., S.B., N.V.M., A.C.-B. and P.M.T.; visualization, O.V.B., S.B. and A.C.-B.; writing—original draft, O.P.B., N.O.I., S.B., O.P., A.C.-B. and P.M.T.; writing—review and editing, O.P.B., A.Z.W., N.O.I., S.B., O.P. and A.C.-B. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

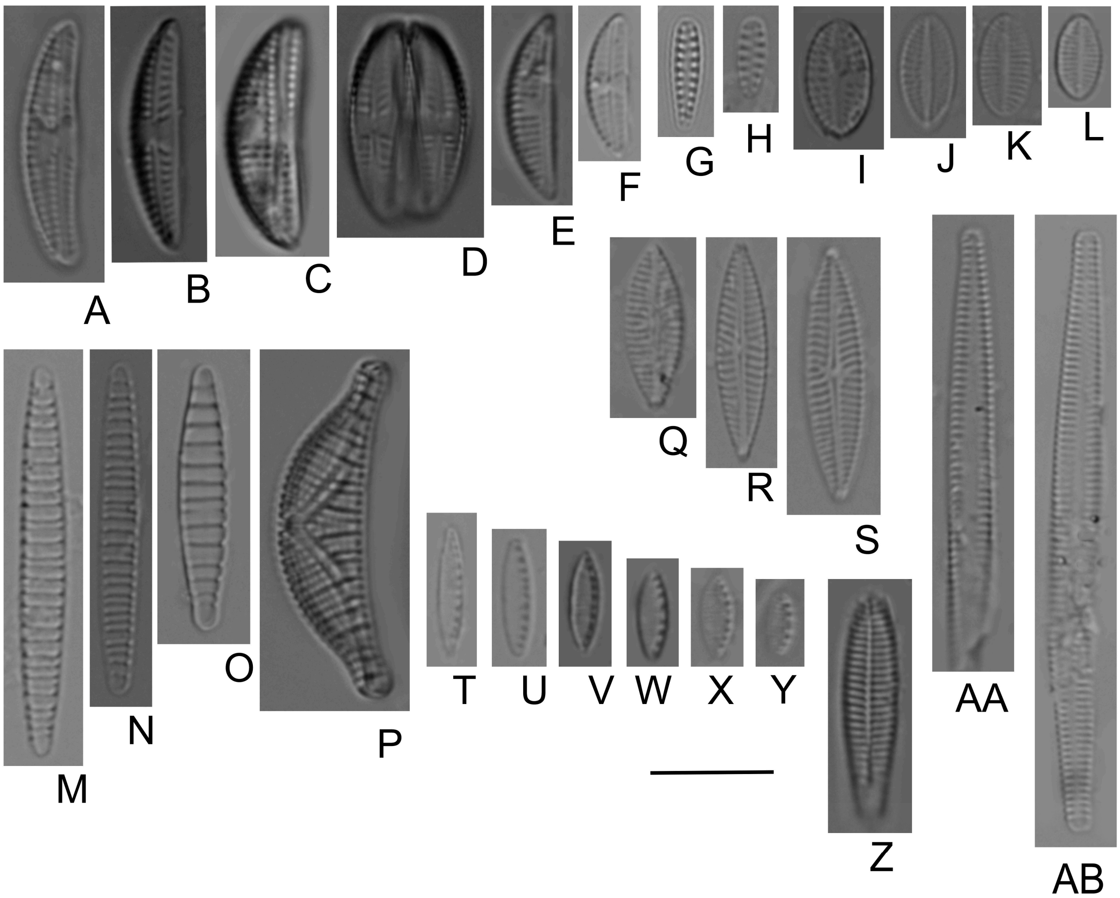

Figure A1. Micrographs of the common species in Ukraine: (**A**–**F**) *Amphora pediculus* (Kützing) Grunow, (**G**,**H**) *Belonastrum* cf. *berolinense* (Lemmermann) Round & Maidana, (**I**–**L**) *Cocconeis neodiminuta* Krammer, (**M**–**O**) *Diatoma moniliformis* (Kützing) D.M. Williams, (**P**) *Epithemia sorex* Kützing, (**Q**–**S**) *Navicula cryptotenella* Lange-Bertalot, (**T**–**Y**) *Nitzschia inconspicua* Grunow, (**Z**) *Rhoicosphenia abbreviata* (C. Agardh) Lange-Bertalot, and (**AA**,**AB**) *Tabularia fasciculata* (C. Agardh) D.M. Williams & Round. LM. Scale bar 10 μm.

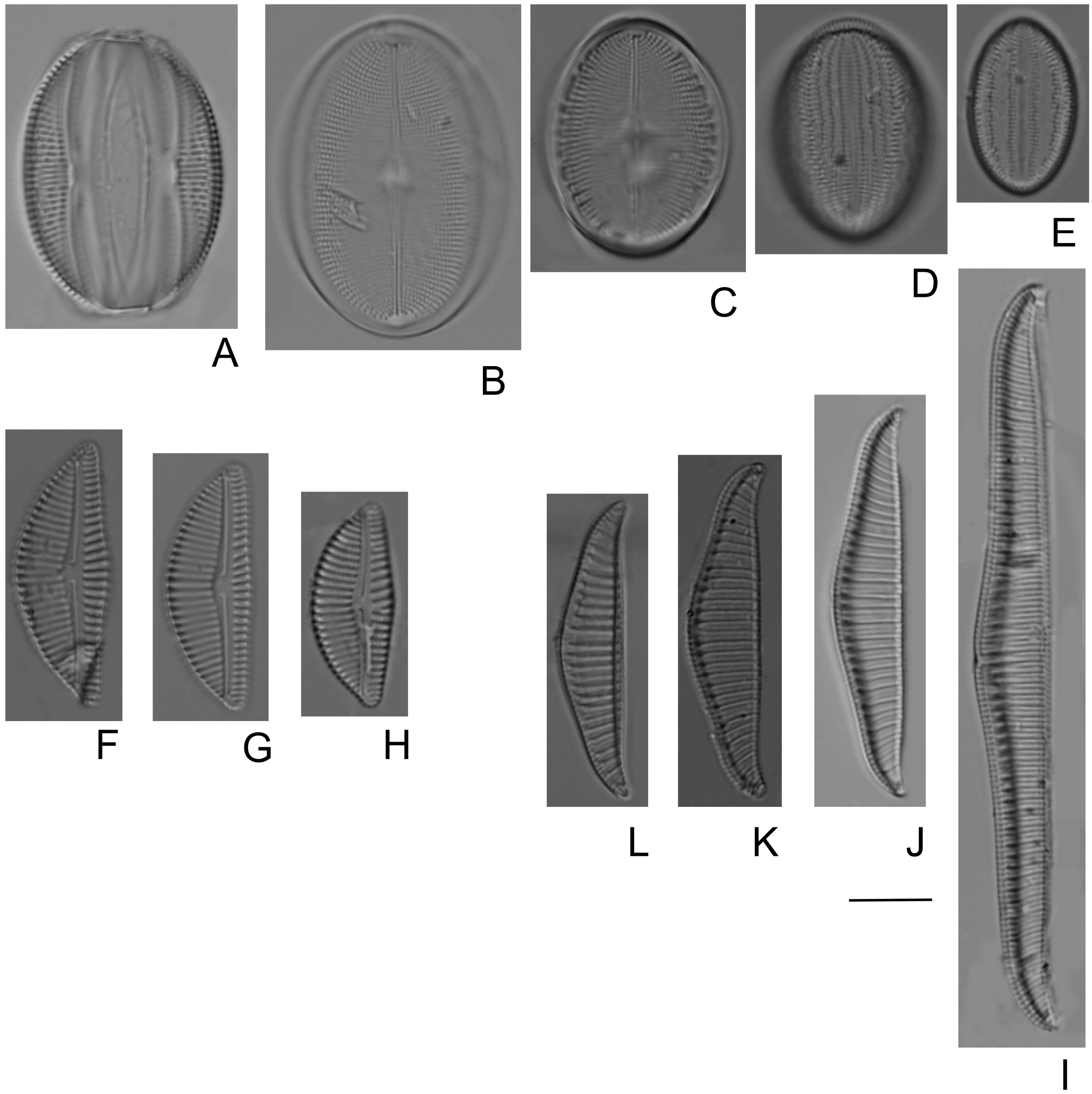

Figure A2. Micrographs of the common species in Ukraine: (**A**) *Amphora ovalis* (Kützing) Kützing, (**B**–**D**) *Cocconeis pediculus* Ehrenberg, (**E**) *Cocconeis lineata* Ehrenberg, (**F**–**H**) *Encyonema cespitosum* Kützing, and (**I**–**L**) *Rhopalodia gibba* (Ehrenberg) O. Müller LM. Scale bar 10 µm.

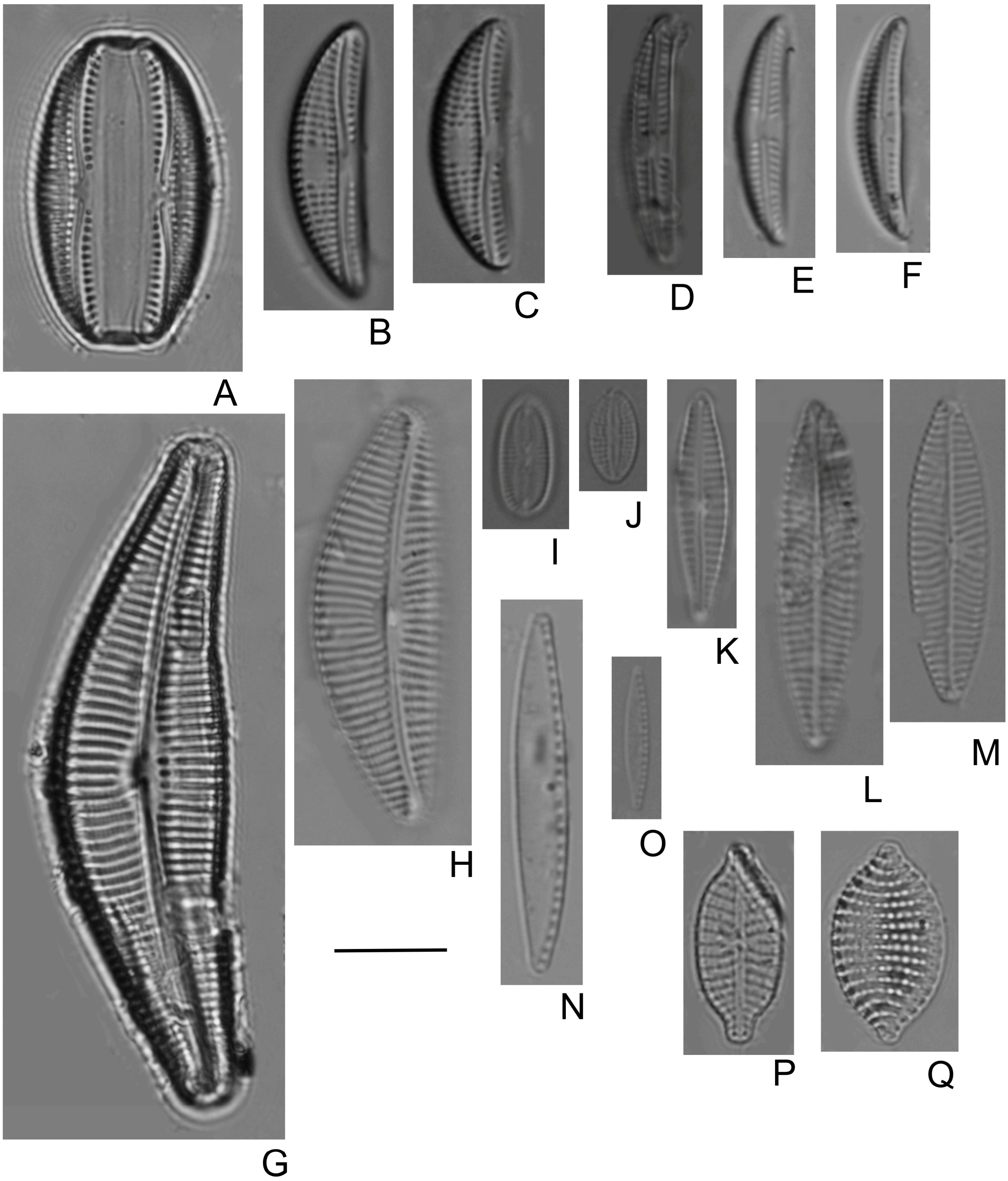

Figure A3. Micrographs of the rare in Ukraine species: (**A**–**C**) *Amphora copulata* (Kützing) Schoeman & R.E.M. Archibald, (**D**–**F**) *Amphora inariensis* Krammer, (**G**) *Cymbella neocistula* Krammer, (**H**) *Cymbella compacta* Østrup, (**I**,**J**) *Fallacia clepsidroides* Witkowski, (**K**) *Gomphonema* cf. *utae* Lange-Bertalot & E. Reichardt, (**L**,**M**) *Navicula recens* (Lange-Bertalot) Lange-Bertalot, (**N**) *Nitzschia filiformis* var. *conferta* (P.G. Richter) Lange-Bertalot, (**O**) *Nitzschia archibaldii* Lange-Bertalot, (**P**) *Paraplaconeis minor* (Grunow) Lange-Bertalot, and (**Q**) *Rhaphoneis amphiceros* (Ehrenberg) Ehrenberg. LM. Scale bar 10 μm.

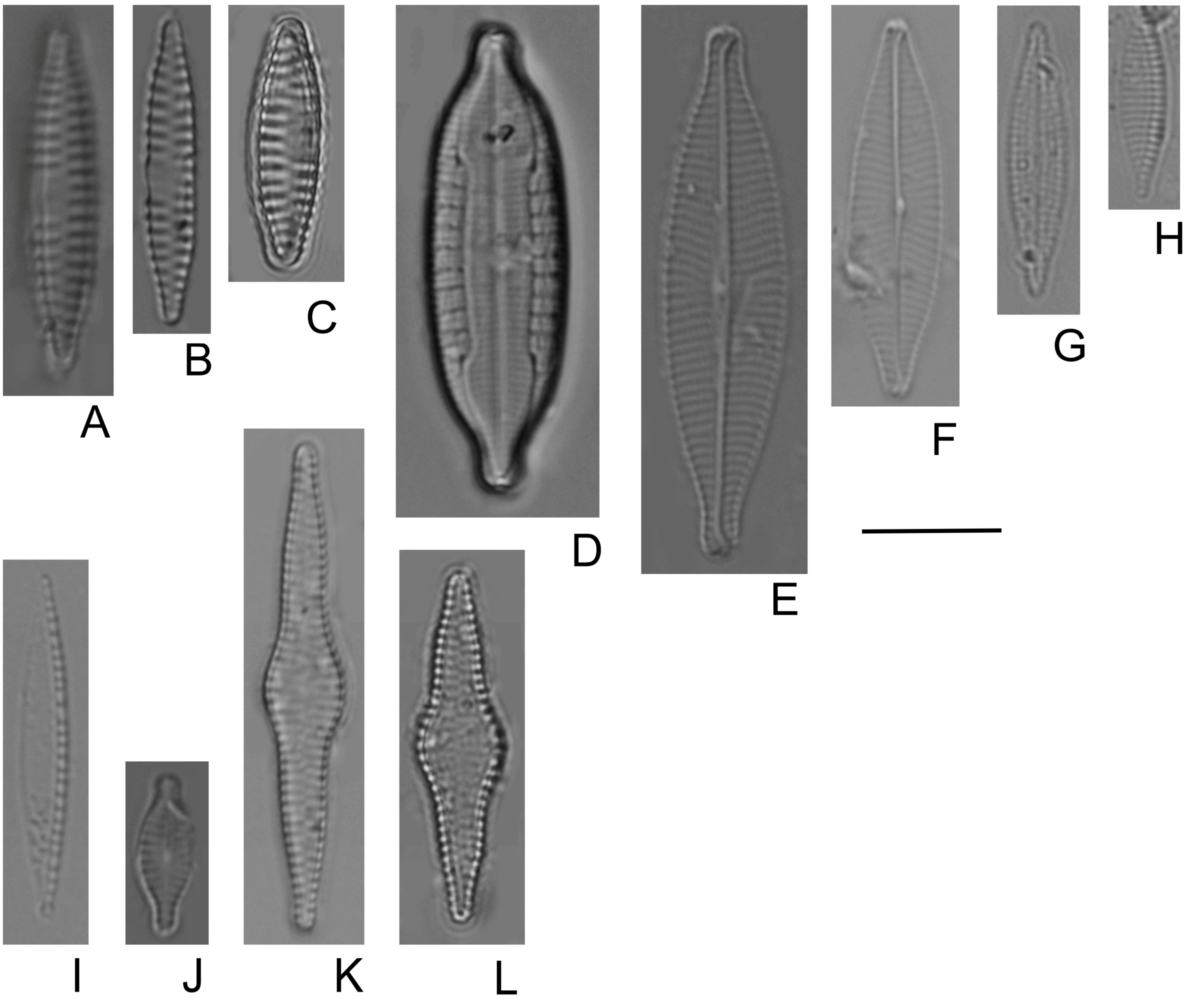

Figure A4. Micrographs of the new for Ukraine species: (**A**–**C**) *Fragilaria microvaucheriae* C.E. Wetzel & Ector; (**D**) *Mastogloia pseudosmithii* Sylvia S. Lee, E.E. Gaiser, Van de Vijver, Edlund, S.A. Spauld Hustedt; (**E**,**F**) *Navicula germainii* J.H. Wallace; (**G**) *N.* cf. *vandamii* Schoeman & R.E.M. Archibald; (**H**) *Nitzschia angustata* var. *minuta* Krasske; (**I**) *N. sociabilis* Hustedt; (**J**) *Planothidium* cf. *lacustre* Álvarez-Blanco, C.Cejudo-Figueiras & S. Blanco; (**K**,**L**) *Fragilaria nevadensis* J.E.Linares-Cuesta & P.M. Sánchez-Castillo. LM. Scale bar 10 μm.

Table A1. The species list of algae and cyanobacteria in the Sasyk during the three studied stages with indicator properties: Stage I, estuary-lake; stage II, forming a reservoir; stage III, reservoir.

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Achnanthes armillaris (O.F.Müller) Guiry	1	0	0	B	-	-	-	hl	-	-	-	-	-
Achnanthes brevipes C.Agardh	1	1	0	B	-	-	alf	hl	-	b	2.0	me	-
Achnanthes minima J.R.Carter	0	0	1	-	-	-	-	-	-	-	-	-	-
Achnanthes sp.	1	0	1	-	-	-	-	-	-	-	-	-	-
Achnanthidium minutissimum (Kützing) Czarn.	0	0	1	P-B	eterm	st-str	ind	i	es	x-b	0.95	o-e	ate
Amphiprora gigantea Grunow	1	0	0	-	-	-	-	-	-	-	-	-	-
Amphiprora paludosa var. *subsalina* Cleve	0	1	0	-	-	-	-	-	-	-	-	-	-
Amphora libyca Ehrenberg	0	0	1	B	temp	st	alf	i	es	o-b	1.5	o-m	-
Amphora ovalis (Kützing) Kützing	1	1	1	B	temp	st-str	alf	i	sx	o-b	1.5	me	ate
Amphora pediculus (Kützing) Grunow ex A.Schmidt	0	1	1	B	temp	st	alf	i	es	b-o	1.7	o-m	ate
Amphora sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Amphora copulata (Kützing) Schoeman et R.E.M.Archibald	0	0	1	B	temp	st	alf	i	es	o-b	1.5	e	ate
Amphora inariensis Krammer	0	0	1	B	-	-	alf	oh	-	o-x	0.7	o-m	-
Amphora recens Levkov et Nakov	0	0	1	-	-	-	-	-	-	-	-	-	-
Aneumastus tuscula (Ehrenberg) D.G.Mann et A.J.Stickle	1	0	0	P-B	-	-	alf	i	-	x-b	0.9	o-e	-
Asterionella formosa Hassal	1	1	0	P	-	st-str	alf	i	sx	o	1.35	me	ate
Asterionella formosa var. *gracillima* (Hanztsch) Grunow	1	1	0	-	-	-	-	-	-	-	-	-	-
Aulacoseira granulata (Ehrenberg) Simonsen	1	1	1	P-B	temp	st-str	ind	i	es	b	2.0	me	ate
Aulacoseira granulata var. *angustissima* (O.F.Müller) Simonsen	0	1	0	-	-	-	-	-	-	-	-	-	-
Aulacoseira italica (Ehrenberg) Simonsen	1	1	0	P-B	cool	st-str	ind	i	es	o-b	1.45	me	-
Aulacoseira italica var. *tenuissima* (Grunow) Simonsen	1	1	0	P	cool	st-str	ind	i	es	o	1.3	me	ate
Azpeitia nodulifera (A.W.F.Schmidt) G.A.Fryxell et P.A.Sims	1	0	0	-	-	-	-	-	-	-	-	-	-
Bacillaria paxillifera (O.F.Müller) T.Marsson	1	1	1	P-B	-	-	ind	hl	es	b	2.3	me	ate
Bacillaria socialis var. *baltica* Grunow	1	0	0	-	-	-	-	-	-	-	-	-	-
Belonastrum cf. *berolinense* (Lemmermann) Round & Maidana	0	0	1	P-B	-	st-str	alf	hl	-	b	2.2	he	ate
Biddulphia subaequa (Kützing) J.Ralfs	1	0	0	-	-	-	-	-	-	-	-	-	-
Brachysira exilis (Kützing) Round et D.G.Mann	1	0	0	P-B	-	-	-	-	-	o	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Brebissonia lanceolata (C.Agardh) R.K.Mahoney et Reimer	0	1	0	B	-	-	alf	hl	-	b	2.0	-	-
Caloneis amphisbaena (Bory) Cleve	0	1	0	B	-	st-str	alf	i	-	b	2.3	me	ate
Caloneis sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Campylodiscus clypeus (Ehrenberg) Ehrenberg ex Kützing	1	0	0	B	temp	-	alb	mh	-	b	2.0	e	-
Campylodiscus echensis Ehrenberg	0	1	0	P	-	st	-	hl	-	-	-	-	-
Campylodiscus fastuosus Ehrenberg	1	1	0	-	-	-	-	-	-	-	-	-	-
Cerataulina pelagica (Cleve) Hendey	1	0	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros compressus Lauder	1	0	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros curvisetus Cleve	1	0	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros dubius Proshkina-Lavrenko	1	1	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros laciniosus F.Schütt	1	0	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros lauderi Ralfs	1	0	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros lorenzianus f. *subsalinus* Proshkina-Lavrenko	1	0	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros lorenzianus Grunow	1	0	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros simplex Ostenfeld	1	0	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros socialis H.S.Lauder	1	0	0	-	-	-	-	-	-	-	-	-	-
Chaetoceros wighamii Brightwell	1	0	0	P-B	-	-	alb	mh	-	-	-	-	-
Chaetoceros willei Gran	1	0	0	-	-	-	-	-	-	-	-	-	-
Cocconeis lineata Ehrenberg	0	0	1	P-B	-	st-str	alf	i	sx	o	1.2	o-m	ate
Cocconeis neodiminuta Krammer	0	0	1	P-B	temp	st-str	alf	i	sx	x-b	0.9	me	-
Cocconeis pediculus Ehrenberg	1	1	1	B	-	st-str	alf	i	sx	o-a	1.8	me	ate
Cocconeis placentula Ehrenberg	1	1	1	P-B	temp	st-str	alf	i	es	o	1.35	me	ate
Cocconeis placentula var. *euglypta* (Ehrenberg) Grunow	0	1	0	P-B	temp	st-str	alf	i	sx	o	1.3	o-m	ate
Cocconeis pseudolineata (Geitler) Lange-Bertalot	0	0	1	-	-	-	-	-	-	-	-	-	-
Cocconeis scutellum Ehrenberg	1	1	0	B	-	-	alf	hl	-	b	2.0	me	-
Cocconeis sp.	0	1	1	-	-	-	-	-	-	-	-	-	-
Coronia daemeliana (Grunow) Ruck et Guiry	1	1	0	-	-	-	-	-	-	-	-	-	-
Coscinodiscopsis commutata (Grunow) E.A.Sar et I.Sunesen	1	0	0	-	-	-	-	-	-	-	-	-	-
Coscinodiscopsis jonesiana (Greville) E.A.Sar et I.Sunesen	1	0	0	-	-	-	-	-	-	-	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Coscinodiscus granii Gough	1	1	0	-	-	-	-	-	-	-	-	-	-
Coscinodiscus granii var. *aralensis* (Ostenfeld) Hustedt	1	0	0	-	-	-	-	-	-	-	-	-	-
Coscinodiscus janischii A.Schmidt	1	0	0	-	-	-	-	-	-	-	-	-	-
Coscinodiscus sp.	1	0	0	-	-	-	-	-	-	-	-	-	-
Craticula halophila (Grunow) D.G.Mann	1	0	1	B	-	st-str	alf	mh	es	a	3.0	e	ate
Craticula subminuscula (Manguin) C.E.Wetzel et Ector	0	0	1	B	-	-	alf	i	sp	a-o	2.6	e	hce
Ctenophora pulchella (Ralfs ex Kützing) D.M.Williams et Round	0	0	1	P-B	-	st-str	alf	i	-	b	2.3	o-m	ate
Cyclostephanos dubius (Fricke) Round	0	1	1	P-B	-	st-str	alf	i	es	b	2.0	o-m	ate
Cyclostephanos invisitatus (M.H.Hohn et Hellermann) E.C.Theriot, Stoermer et Håkasson	0	0	1	P	-	-	alf	-	es	o-a	1.9	o-m	-
Cyclotella choctawhatcheeana Prasad	1	0	0	P	-	-	-	hl	-	-	-	-	-
Cyclotella meneghiniana Kützing	1	1	1	P-B	temp	st	alf	hl	sp	a-o	2.8	e	hne
Cyclotella radiosa (Grunow) Lemmermann	0	1	0	P	-	st-str	alb	i	sx	o	1.2	o-m	ats
Cyclotella sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Cyclotella atomus Hustedt	0	0	1	P-B	-	st-str	alf	i	sp	b-a	2.5	me	ate
Cylindrotheca closterium (Ehrenberg) Reimann et J.C.Lewin	1	1	0	B	-	-	alf	i	-	b	2.0	-	-
Cylindrotheca gracilis (Brébisson ex Kützing) Grunow	1	0	0	B	-	st	-	hl	-	a-o	2.8	e	-
Cymatopleura elliptica (Brébisson) W.Smith	0	0	1	P-B	-	st-str	alf	i	-	b-o	1.7	e	ate
Cymatopleura librile (Ehrenberg) Pant.	0	1	0	P-B	-	st-str	alf	i	-	o	1.0	-	-
Cymatopleura solea var. *apiculata* (W.Smith) Ralfs	1	1	0	B	-	-	alf	i	-	x-o	0.5	-	-
Cymatopleura solea var. *gracilis* Grunow	0	1	0	B	-	-	alf	i	-	-	-	-	-
Cymatopleura sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Cymbella affinis Kützing	0	0	1	B	temp	st-str	alf	i	sx	o	1.1	ot	ats
Cymbella cistula (Ehrenberg) O.Kirchner	0	0	1	B	-	st-str	alf	i	sx	o-b	1.5	e	ats
Cymbella neocistula Krammer	0	0	1	B	-	-	ind	i	-	-	-	-	hne
Cymbella parva (W.Smith) Kirchner	0	1	0	B	-	-	ind	i	-	b	2.0	o-m	-
Cymbella proxima Reimer	0	0	1	B	-	-	alf	hb	es	o	1.0	o-m	-
Cymbella sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Cymbella cistula (Ehrenberg) O.Kirchner	0	0	1	B	-	st-str	alf	i	sx	o-b	1.5	e	ats
Cymbella compacta Østrup	0	0	1	B	-	-	-	-	-	b-a	2.4	-	-
Cymbella laevis Nägeli	0	0	1	B	cool	-	ind	i	sx	-	-	-	-
Cymbella lanceolata C.Agardh	0	0	1	B	-	st-str	alf	i	es	x-b	0.9	e	ate

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Cymbopleura lata (Grunow) Krammer	0	1	0	B	-	-	ind	i	sx	-	-	-	-
Detonula confervacea (Cleve) Gran	1	0	0	-	-	-	-	-	-	-	-	-	-
Diatoma elongata var. *actinastroides* Krieger	0	1	0	B	-	st-str	alf	hl	-	a	-	e	ate
Diatoma hiemalis (Lyngbye) Heiberg	0	1	0	P-B	cool	st-str	ind	hb	sx	b-o	1.7	-	ats
Diatoma moniliformis (Kützing) D.M.Williams	0	0	1	P-B	-	st-str	alf	i	-	-	-	o-m	-
Diatoma vulgare Bory	1	1	1	P-B	-	st-str	ind	i	sx	b	2.2	me	ate
Diploneis elliptica (Kützing) Cleve	1	0	1	B	temp	str	alf	i	sx	o-x	0.6	m	ats
Diploneis ovalis (Hilse) Cleve	0	0	1	B	-	str	alf	i	sp	x-b	0.9	o-m	ats
Diploneis subadvena Hustedt	1	0	0	-	-	-	-	-	-	-	-	-	-
Discostella stelligera (Cleve et Grunow) Houk et Klee	0	1	0	P	-	st-str	ind	i	-	b	2.3	e	ate
Ditylum brightwellii (T.West) Grunow	1	0	0	-	-	-	-	-	-	-	-	-	-
Ellerbeckia sol (Ehrenberg) R.M.Crawford et P.A.Sims	0	1	0	-	-	-	-	i	-	-	-	-	-
Encyonema caespitosum Kützing	0	0	1	B	-	-	-	i	sx	o	1.3	o-e	-
Encyonema leibleinii (C.Agardh) W.J.Silva, R.Jahn, T.A.V.Ludwig et M.Menezes	0	0	1	P-B	-	str	alb	i	es	o	1.3	e	ats
Encyonema ventricosum (C.Agardh) Grunow	1	1	0	B	-	st-str	ind	i	sx	x-o	1.3	o-e	ate
Encyonopsis microcephala (Grunow) Krammer	0	0	1	B	-	str	alf	i	es	o	1.3	me	ats
Entomoneis alata (Ehrenberg) Reimer	1	1	0	P-B	-	st	alf	mh	-	b	2.0	-	-
Entomoneis paludosa (W.Smith) Reimer	1	1	0	P-B	-	-	alf	hl	-	b-a	2.5	m	-
Epithemia adnata (Kützing) Brébisson	0	1	1	B	temp	st	alb	i	sx	o	1.2	me	ats
Epithemia gibba (Ehrenberg) Kützing	0	0	1	B	temp	-	alf	i	es	o-b	1.4	o-m	-
Epithemia parallela (Grunow) Ruck & Nakov	0	0	1	B	-	str	alf	i	es	b	2.0	o-m	ats
Epithemia sorex Kützing	0	1	1	B	temp	st-str	alf	i	sx	o	1.1	me	ats
Epithemia turgida (Ehrenberg) Kützing	0	1	1	B	temp	st	alf	i	sx	x-b	0.9	me	ats
Fallacia pygmaea (Kützing) A.J.Stickle et D.G.Mann	0	0	1	P-B	-	st-str	alf	mh	es	a-o	2.7	e	hne
Fallacia clepsidroides Witkowski	0	0	1	-	-	-	-	-	-	-	-	-	-
Fallacia reichardtii (Grunow) Witkowski, Lange-Bertalot et Metzeltin	0	1	1	P-B	-	st	alf	i	sx	b-o	1.7	o-m	ate
Fragilaria capucina Desm.	0	1	0	P-B	-	-	ind	i	es	b-o	1.6	m	-
Fragilaria capucina subsp. *rumpens* (Kützing) Lange-Bertalot	0	1	0	P-B	eterm	st-str	acf	i	-	b-o	1.6	o-m	-
Fragilaria capucina var. *mesolepta* (Rabenhorst) Rabenhorst	0	1	0	P-B	-	-	alf	i	sx	-	-	-	-
Fragilaria crotonensis Kitton	1	1	1	P	-	st-str	alf	i	es	o-b	1.5	m	ate

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Fragilaria sp.	1	1	1	-	-	-	-	-	-	-	-	-	-
Fragilaria perminuta (Grunow) Lange-Bertalot	0	0	1	-	-	-	-	-	-	-	-	-	-
Fragilaria microvaucheriae (Kützing) D.M.Williams & Round	0	0	1	-	-	-	-	-	-	-	-	-	-
Fragilaria nevadensis J.E.Linares-Cuesta & P.M.Sánchez-Castillo	0	0	1	-	-	-	-	-	-	-	-	-	-
Fragilariforma virescens (Ralfs) D.M.Williams et Round	0	1	0	P-B	-	st	ind	i	es	x-o	0.4	o-m	ats
Frustulia creuzburgensis (Krasske) Hustedt	0	0	1	B	-	-	alf	hl	-	-	-	-	-
Gomphonema acuminatum Ehrenberg	0	1	0	B	-	st	ind	i	es	o-b	1.4	o-m	ats
Gomphonema coronatum Ehrenberg	0	0	1	B	-	st	ind	i	-	o-b	1.4	o-m	-
Gomphonema italicum Kützing	0	0	1	-	-	-	-	-	-	-	-	-	-
Gomphonema olivaceum (Lyngbye) Desmazières	1	1	0	B	-	st-str	alf	i	es	o-b	1.45	e	ate
Gomphonema parvulum Kützing	0	0	1	B	temp	str	ind	i	es	b	2.35	o-m	hne
Gomphonema sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Gomphonema truncatum Ehrenberg	0	0	1	B	-	st-str	ind	i	es	o-b	1.4	me	ats
Gomphonema utae Lange-Bertalot et E.Reichardt	0	0	1	-	-	-	-	-	-	-	-	-	-
Gomphonema augur Ehrenberg	0	0	1	B	-	str	ind	i	es	o-b	1.5	me	ats
Grunowia tabellaria (Grunow) Rabenhorst	0	0	1	B	-	str	ind	i	sx	o-b	1.4	m	ats
Gyrosigma acuminatum (Kützing) Rabenhorst	1	1	1	B	cool	st-str	alf	i	es	o-a	1.95	me	ate
Gyrosigma balticum (Ehrenberg) Rabenhorst	1	0	0	B	-	-	-	hl	-	-	-	e	-
Gyrosigma distortum (W.Smith) Cleve	0	1	0	B	-	-	ind	hl	es	o	1.0	-	-
Gyrosigma fasciola (Ehrenberg) J.W.Griffith et Henfrey	1	0	0	B	-	-	alf	mh	-	o	1.0	-	-
Gyrosigma recta var. *minuta* (Donkin) Cleve	0	1	0	-	-	-	-	-	-	-	-	-	-
Gyrosigma sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Gyrosigma strigilis (W.Smith) Cleve	1	0	0	B	-	-	-	mh	-	-	-	-	-
Gyrosigma wormleyi (Sullivant) Boyer	0	1	0	B	-	-	alf	hl	-	b	2.0	o-m	-
Gyrosigma acuminatum var. *gallicum* (Grunow) Cleve	0	1	0	-	-	-	-	-	-	-	-	-	-
Gyrosigma arcuatum (Donkin) Sterrenburg	1	0	0	B	-	-	-	mh	-	-	-	-	-
Gyrosigma attenuatum (Kützing) Rabenhorst	0	0	1	P-B	-	st	alf	i	-	o-a	1.8	o-m	ate
Gyrosigma prolongatum (W.Smith) J.W.Griffith et Henfrey	1	0	0	B	-	-	-	mh	-	-	-	-	-
Hannaea arcus (Ehrenberg) R.M.Patrick	1	0	0	B	temp	str	alf	i	es	x	0.3	o-m	ats
Hantzschia amphioxys (Ehrbenb.) Grunow	0	1	1	B	temp	st-str	ind	I	es	o-a	1.9	o-e	ate

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Hantzschia vivax (W.Smith) Grunow	0	1	0	B	-	-	alf	i	-	b	2.0	-	-
Hippodonta capitata (Ehrenberg) Lange-Bertalot, Metzeltin et Witkowski	0	1	1	B	temp	st-str	alf	hl	es	b	2.1	me	ate
Hippodonta hungarica (Grunow) Lange-Bertalot, Metzeltin et Witkowski	0	1	1	B	-	st-str	alf	hl	es	b	2.3	me	ate
Hippodonta costulata (Grunow) Lange-Bertalot, Metzeltin et Witkowski	0	0	1	B	-	-	alf	hl	sx	b-a	2.5	o-m	-
Hyalodiscus ambiguus (Grunow) Tempère et Peragallo	1	0	0	-	-	-	-	-	-	-	-	-	-
Karayevia sp.	0	0	1	-	-	-	-	-	-	-	-	-	-
Leptocylindrus danicus Cleve	1	0	0	-	-	-	-	-	-	-	-	-	-
Leptocylindrus minimus Gran	1	0	0	-	-	-	-	-	-	-	-	-	-
Lindavia bodanica (Eulenstein ex Grunow) T.Nakov, Guillory, Julius, Theriot et Alverson	0	1	0	P	-	st	ind	i	-	x	1.0	ot	ats
Mastogloia pseudosmithii Sylvia S. Lee, E.E. Gaiser, Van de Vijver, Edlund, S.A. Spauld Hustedt	0	0	1	-	-	-	-	-	-	-	-	-	-
Mastogloia smithii Thwaites ex W.Smith	0	0	1	B	-	-	alf	mh	sx	o	1.3	me	-
Mayamaea atomus (Kützing) Lange-Bertalot	0	0	1	B	-	st-str	alf	i	es	a-o	2.6	he	hce
Melosira italica f. *curvata* Fäden	1	0	0	-	-	-	-	-	es	-	-	-	-
Melosira moniliformis (O.F.Müller) C.Agardh	1	1	0	P-B	-	str	-	hl	-	b	2.0	-	-
Melosira moniliformis var. *subglobosa* (Grunow) Hustedt	1	0	0	P-B	-	str	alf	hl	-	b	2.0	-	-
Melosira nummuloides C.Agardh	1	0	0	P-B	-	-	alf	mh	sp	b	2.0	-	-
Melosira sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Melosira varians C. Agardh	1	1	1	P-B	temp	st-str	ind	hl	es	b	2.1	me	hne
Navicula capitatoradiata Germain	1	0	0	P-B	-	st-str	alf	mh	sx	b	2.1	me	ate
Navicula cari Ehrenberg	0	0	1	P-B	-	str	ind	i	es	b-a	2.4	o-m	ats
Navicula cryptocephala Kützing	1	0	1	P-B	temp	st-str	ind	i	es	b	2.1	o-e	ate
Navicula cryptotenella Lange-Bertalot	0	0	1	P-B	-	-	ind	i	es	o	1.3	-	-
Navicula directa (W.Smith) Ralfs	1	0	0	-	-	-	-	-	-	-	-	-	-
Navicula distans (W.Smith) Ralfs	1	0	0	-	-	-	-	-	-	-	-	-	-
Navicula germainii J.H.Wallace	0	0	1	B	-	-	-	-	-	-	-	-	-
Navicula gracilis Lauby	1	0	0	B	-	st-str	alf	i	es	b	2.3	-	-
Navicula gregaria Donkin	0	0	1	P-B	-	-	alf	I	es	b-a	2.5	me	ate

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Navicula grevillei var. *pararhombica* Proshkina-Lavrenko	1	0	0	-	-	-	-	-	-	-	-	-	-
Navicula longicephala Hustedt	0	0	1	-	-	-	-	-	-	-	-	-	-
Navicula menisculus Schumann	1	1	1	P-B	-	st-str	alf	i	es	o-b	1.45	o-m	ate
Navicula minima Grunow	0	0	1	B	-	-	alf	hl	es	o-b	1.4	e	hne
Navicula radiosa Kützing	1	0	0	B	temp	st-str	ind	i	es	o	1.3	me	ate
Navicula recens (Lange-Bertalot) Lange-Bertalot	0	0	1	P-B	-	-	alf	hl	-	-	-	-	-
Navicula rhynchotella Lange-Bertalot	0	0	1	B	-	-	alf	hl	es	b-a	2.55	-	-
Navicula slesvicensis Grunow	1	1	0	P-B	-	st-str	alf	hl	es	a-o	2.6	o-m	ate
Navicula sp.	1	1	1	-	-	-	-	-	-	-	-	-	-
Navicula tripunctata (O.F.Müller) Bory	0	0	1	P-B	-	st-str	ind	i	es	b-o	1.7	e	ate
Navicula cf. *vandamii* Schoeman et R.E.M.Archibald	0	0	1	B	-	-	alf	i	-	-	-	e	-
Navicula veneta Kützing	1	0	1	P-B	-	-	alf	hl	es	a-o	2.7	me	ate
Navicula viridula (Kützing) Ehrenberg	0	1	0	P-B	-	st-str	alf	hl	es	b	2.2	me	ate
Navicula anglica var. *minuta* Cleve	1	1	0	B	-	-	-	i	-	-	-	-	-
Navicula antonii Lange-Bertalot	0	0	1	B	-	-	-	-	-	-	-	-	-
Navicula recens (Lange-Bertalot) Lange-Bertalot	0	0	1	P-B	-	-	alf	i	es	o-b	-	e	-
Neidium dubium (Ehenberg) Cleve	0	0	1	B	-	str	alf	i	-	b-o	1.7	me	ats
Nitzschia acicularis (Kützing) W. Sm.	1	1	1	P-B	temp	-	alf	i	es	a-o	2.7	e	hce
Nitzschia amphibia Grunow	0	1	0	P-B,S	temp	st-str	alf	i	sp	b	2.1	e	hne
Nitzschia angustata var. *minuta* Krasske	0	0	1	-	-	-	-	-	-	-	-	-	-
Nitzschia archibaldii Lange-Bertalot	0	0	1	-	-	-	-	-	-	-	-	-	-
Nitzschia capitellata Hustedt	0	0	1	B	-	-	ind	i	es	a	3.0	he	-
Nitzschia dissipata (Kützing) Rabenhorst	0	0	1	B	-	st-str	alf	i	sx	b-o	1.7	me	ate
Nitzschia filiformis (W.Smith) Van Heurck	0	0	1	P-B	-	st-str	alf	hl	es	b-a	2.5	e	hne
Nitzschia filiformis var. *conferta* (P.G.Richter) Lange-Bertalot	0	0	1	-	-	-	-	-	-	-	-	-	-
Nitzschia frustulum (Kützing) Grunow	0	0	1	P-B	temp	st-str	alf	i	sp	b	2.3	e	hce
Nitzschia hantzschiana Rabenhorst	0	1	0	P-B	-	str	alf	i	es	x-o	0.5	m	ats
Nitzschia holsatica Hustedt	1	1	0	P-B	-	-	ind	i	es	b	2.3	-	-
Nitzschia incerta (Grunow) M.Peragallo	0	1	0	P-B	-	-	alf	hl	-	b-a	2.5	me	-
Nitzschia intermedia Hantzsch	0	0	1	P-B	-	-	ind	i	es	b	2.0	e	-
Nitzschia longissima (Brébisson) Ralfs	1	1	0	-	-	-	-	mh	-	-	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Nitzschia lorenziana var. *subtilis* Grunow	0	1	0	B	-	-	-	mh	-	-	-	-	-
Nitzschia microcephala Grunow	0	0	1	P-B	-	st-str	alf	i	sx	b	2.3	e	hce
Nitzschia palea (Kützing) W. Sm.	0	0	1	P-B	temp	-	ind	i	sp	a-o	2.8	he	hce
Nitzschia palea var. *debilis* (Kützing) Grunow	0	0	1	B	-	-	neu	i	es	a-o	2.8	ot	-
Nitzschia paleacea (Grunow) Grunow	0	1	1	P-B	-	st-str	alf	i	es	b	2.2	e	hce
Nitzschia pusilla Grunow	0	0	1	P-B,S	-	st-str	alf	i	es	b-o	1.7	o-e	ate
Nitzschia reversa W.Smith	1	1	1	P	-	-	-	hl	-	-	-	-	-
Nitzschia scalpelliformis Grunow	0	1	0	B	-	-	alf	hl	sp	b	2.0	me	-
Nitzschia sigma (Kützing) W.Smith	1	1	0	B	temp	st-str	alf	mh	es	a	3.0	e	ate
Nitzschia sigmoidea (Nitzsch) W.Smith	1	1	1	P-B	-	st-str	alf	i	-	b-a	2.5	e	ate
Nitzschia sociabilis Hustedt	0	0	1	B	-	st-str	neu	hl	-	a-b	-	e	ate
Nitzschia sp.	1	1	1	-	-	-	-	-	-	-	-	-	-
Nitzschia sublinearis Hustedt	1	1	0	P-B	-	-	alf	i	es	a	3.0	me	-
Nitzschia tenuirostris Mer.	1	1	0	-	-	-	-	-	-	-	-	-	-
Nitzschia thermalis (Ehrenberg) Auerswald	0	1	0	P	-	-	ind	i	es	x	0.3	-	-
Nitzschia umbonata (Ehrenberg) Lange-Bertalot	0	0	1	P	-	st-str	ind	i	es	a-o	2.8	me	-
Nitzschia vermicularis (Kützing) Hantzsch	1	1	0	P-B	-	str	alf	i	-	b	2.2	m	-
Nitzschia inconspicua Grunow	0	0	1	B	-	st-str	alf	i	es	a-o	2.7	e	hne
Nitzschia reversa f. *parva* (Grunow) Bukhtiyarova	1	1	0	-	-	-	-	-	-	-	-	-	-
Paralia sulcata (Ehrenberg) Cleve	1	0	0	B	-	-	alf	mh	-	a	3.0	-	-
Paraplaconeis minor (Grunow) Lange-Bertalot	0	0	1	-	-	-	-	-	-	-	-	-	-
Paraplaconeis placentula (Ehrenberg) Kulikovskiy et Lange-Bertalot	1	0	0	B	temp	st-str	alf	i	sx	o-b	1.5	e	ate
Pinnularia sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Placoneis clementis (Grunow) E.J.Cox	0	0	1	B	-	str	alf	i	es	b	2.0	me	ate
Placoneis elginensis (Gregory) E.J.Cox	0	1	0	B	-	st-str	ind	i	sx	o-b	1.4	me	ate
Placoneis exigua (Gregory) Mereschkovsky	0	0	1	B	-	-	ind	i	es	o-b	1.4	o-m	-
Placoneis placentula (Ehrenberg) Mereschkowsky	0	0	1	B	temp	st-str	alf	i	sx	o-b	1.5	e	ate
Planothidium delicatulum (Kützing) Round et Bukht.	0	0	1	P-B	-	st	alb	hl	es	b	2.0	o-m	-
Planothidium lacustre Álvarez-Blanco, C. Cejudo-Figueiras & S. Blanco	0	0	1	-	-	-	-	-	-	-	-	-	-
Planothidium lanceolatum (Bréb. ex Kützing) Lange-Bert.	0	0	1	P-B	warm	st-str	ind	-	sx	o	1.6	e	ate
Planothidium minutissimum (Krasske) E.A.Morales	0	0	1	-	-	-	-	-	-	-	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Pleurosigma angulatum (Queckett) W.Smith	1	0	0	B	-	st-str	alf	hl	-	b	2.0	-	-
Pleurosigma elongatum W.Smith	1	1	1	B	-	-	alf	hl	-	b	2.0	-	-
Pleurosigma formosum W.Smith	1	0	0	-	-	-	-	-	-	-	-	-	-
Pleurosigma sp.	1	0	0	-	-	-	-	-	-	-	-	-	-
Pleurosira laevis (Ehrenberg) Compère	0	0	1	B	temp	-	alf	mh	-	o	1.0	e	-
Podosira hormoides (Mont.) Kützing	1	0	0	-	-	-	-	-	-	-	-	-	-
Pseudo-nitzschia delicatissima (Cleve) Heiden	1	0	0	-	-	-	-	-	-	-	-	-	-
Pseudo-nitzschia seriata (Cleve) H.Peragallo	1	0	0	-	-	-	-	-	-	-	-	-	-
Pseudostaurosira parasitica (W.Smith) E.Morales	0	0	1	P-B	-	str	alf	i	es	o-a	1.9	me	ats
Pseudostaurosira brevistriata (Grunow) D.M.Williams et Round	0	0	1	P-B	-	st-str	alf	i	-	o	1.2	o-e	ats
Rhizosolenia calcar-avis Schultze	1	0	0	-	-	-	-	-	-	-	-	-	-
Rhoicosphenia abbreviata (C.Agardh) Lange-Bertalot	0	1	1	B	-	st-str	alf	i	es	o-a	1.9	me	ate
Sellaphora pupula (Kützing) Mereschk.	0	0	1	B	eterm	st	ind	hl	sx	o-a	1.9	me	ate
Skeletonema costatum (Greville) Cleve	1	0	0	-	-	-	-	-	-	-	-	-	-
Skeletonema subsalsum (Cleve-Euler) Bethge	1	0	0	P	-	-	ind	i	-	o	1.0	me	-
Stauroforma exiguiformis (Lange-Bertalot) R.J.Flower, V.J.Jones et Round	0	0	1	-	-	-	-	i	-	o	1.0	o-m	-
Stauroneis acuta W.Smith	0	0	1	B	-	st-str	alf	i	-	o	1.0	o-m	-
Stauroneis anceps Ehrenberg	0	1	0	P-B	-	st-str	ind	i	sx	o	1.3	me	ate
Staurosira construens Ehrenberg	0	1	1	P-B	temp	st-str	alf	i	sx	o	1.3	me	ats
Staurosira leptostauron (Ehrenberg) Kulikovskiy et Genkal	0	0	1	P-B	-	st	alf	hb	es	o	1.1	me	ats
Staurosira venter (Ehrenberg) H.Kobayasi	0	1	1	P-B	warm	st-str	alf	i	sx	o	1.3	me	ate
Staurosira construens Ehrenberg	0	0	1	P-B	temp	st-str	alf	i	sx	o	1.3	me	ats
Staurosirella martyi (Héribaud-Joseph) E.A.Morales et K.M.Manoylov	0	0	1	P-B	-	st-str	alf	i	es	o	1.1	o-m	-
Stephanodiscus astraea (Ehrenberg) Grunow	1	1	0	P	temp	st	alb	i	es	b	2.0	-	-
Stephanodiscus binderanus (Kützing) Krieger	0	1	0	P	-	-	ind	hl	-	b	2.3	e	-
Stephanodiscus hantzschii Grunow	1	1	1	P	temp	st	alf	i	es	a-o	2.7	o-m	hne
Stephanodiscus minutulus (Kützing) Cleve et Möller	1	1	1	P	temp	st	alb	i	es	b	2.2	o-m	ate
Stephanodiscus rotula (Kützing) Hendey	0	0	1	P-B	temp	st	alf	i	es	b	2.2	o-m	-
Stephanodiscus subtilis (Goor) A.Cleve	0	1	0	-	-	st-str	-	i	-	-	-	he	-
Surirella didyma Kützing	0	1	0	B	-	-	alf	i	-	o	1.0	o-m	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Surirella minuta Brébisson	1	1	0	-	-	-	-	-	-	-	-	-	-
Surirella ovalis Brébisson	1	1	0	P-B	-	st-str	alf	i	es	a	3.0	me	ate
Surirella robusta Ehrenberg	0	1	0	P-B	-	st-str	ind	i	es	x-o	0.5	ot	-
Surirella sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Surirella striatula Turpin	0	1	0	P-B	temp	-	alf	hl	-	b	2.0	e	-
Surirella librile (Ehrenberg) Ehrenberg	0	0	1	P-B	-	-	alf	i	-	b	2.1	-	-
Surirella ovata f. *constricta* (Hustedt) Cleve-Euler	0	1	0	B	-	-	ind	i	-	-	-	-	-
Surirella ovata var. *pseudopinnata* (Ant.Mayer) Proshkina-Lavrenko	0	1	0	-	-	-	-	-	-	-	-	-	-
Tabellaria fenestrata (Lyngb.) Kützing	0	1	1	P-B	-	st-str	ind	i	es	x	0.3	o-m	ats
Tabellaria fenestrata var. *asterionelloides* Grunow	1	1	0	-	-	-	-	-	-	-	-	-	-
Tabellaria flocculosa (Roth) Kützing	0	0	1	P-B	eterm	st-str	acf	i	es	o-x	0.6	ot	ats
Tabularia fasciculata (C.Agardh) D.M.Williams et Round	0	0	1	P-B	-	st	ind	mh	es	b-a	2.5	e	ate
Thalassionema frauenfeldii (Grunow) Tempère et Peragallo	1	0	0	-	-	-	-	-	-	-	-	-	-
Thalassionema nitzschioides (Grunow) Mereschkowsky	1	0	0	P	-	-	-	i	-	-	-	-	-
Thalassiosira decipiens (Grunow) E.G.Jørgensen	1	0	0	-	-	-	-	-	-	-	-	-	-
Thalassiosira eccentrica (Ehrenberg) Cleve	1	0	0	P	-	-	ind	i	-	-	-	-	-
Thalassiosira parva Proshkina-Lavrenko	1	0	0	-	-	-	-	-	-	-	-	-	-
Thalassiosira sp.	1	0	0	-	-	-	-	-	-	-	-	-	-
Thalassiosira baltica (Grunow) Ostenfeld.	1	0	0	-	-	-	-	hl	-	-	-	-	-
Tryblionella acuminata W.Smith	1	0	0	-	-	st	alf	hl	sx	a-o	2.9	me	-
Tryblionella apiculata Gregory	0	0	1	B	-	-	alf	hl	es	a-o	2.7	e	-
Tryblionella circumsuta (Bailey) Ralfs	1	0	0	B	-	-	alf	mh	-	-	-	e	-
Tryblionella compressa (Bailey) Poulin	0	0	1	B	eterm	-	-	mh	-	-	-	-	-
Tryblionella hantzschiana Grunow	0	0	1	B	-	st-str	alf	hl	-	a-o	2.6	me	ate
Tryblionella hungarica (Grunow) Frenguelli	1	1	1	P-B	-	-	alf	mh	sp	a-o	2.9	e	ate
Tryblionella levidensis W.Smith	0	1	1	P-B	-	st-str	ind	mh	sp	a-o	2.6	e	ate
Tryblionella hantzschiana Grunow.	0	1	1	B	-	st-str	alf	hl	-	a-o	2.6	me	ate
Tryblionella punctata W.Smith	1	1	0	B	eterm	-	-	mh	-	-	-	-	-
Ulnaria acus (Kütz.) Aboal	1	1	1	P	-	st-str	alb	i	es	o-a	1.8	-	-
Ulnaria capitata (Ehrenberg) P.Compère	0	1	0	P-B	-	st-str	alf	i	es	o-b	1.5	e	ats

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Ulnaria danica (Kützing) Compère et Bukhtiyarova	0	1	0	-	-	-	-	-	-	-	-	-	-
Ulnaria delicatissima (W.Smith) M.Aboal et P.C.Silva	1	0	0	-	-	-	-	-	-	-	-	-	-
Ulnaria delicatissima var. *angustissima* (Grunow) M.Aboal et P.C.Silva	0	1	0	-	-	-	-	-	-	-	-	-	-
Ulnaria oxyrhynchus (Kützing) M.Aboal	0	1	0	-	-	-	-	-	-	-	-	-	-
Ulnaria ulna (Nitzsch) Compere	1	1	1	P-B	temp	st-str	ind	i	es	b	2.25	o-e	ate
Charophyta													
Closterium acerosum (Schrank) Ehr.	0	1	0	P-B	-	st-str	ind	i	-	a-o	2.6	e	-
Closterium aciculare T.West	0	1	1	P	-	st-str	ind	-	-	b-o	1.7	me	-
Closterium acutum Brébisson	1	0	1	P-B	-	st-str	ind	-	-	b	2.05	m	-
Closterium exiguum West et G.S.West	1	0	0	-	-	-	-	-	-	-	-	-	-
Closterium gracile Brèb. ex Ralfs	0	1	0	P	-	st-str	ind	hb	-	o-b	1.5	o-m	-
Closterium parvulum Nägeli	0	0	1	P-B	-	-	ind	i	-	b	2.0	m	-
Closterium sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Closterium strigosum Brébisson	0	1	0	P-B	-	st-str	ind	-	-	o-a	1.9	e	-
Closterium tumidum L.N.Johnson	0	1	0	B	-	ae	acf	-	-	-	-	o-m	-
Closterium dianae Ehrenberg ex Ralfs	0	0	1	P-B	-	st-str	acf	-	-	x-b	0.8	m	-
Cosmarium bioculatum Brébisson ex Ralfs	0	0	1	P-B	-	st-str	ind	hb	-	x-o	0.5	m	-
Cosmarium formosulum Hoff	0	1	0	P-B	-	-	ind	-	-	o-a	1.8	me	-
Cosmarium granulatum W. West	0	0	1	-	-	-	-	-	-	-	-	-	-
Cosmarium impressulum Elfving	0	0	1	P-B	-	-	ind	hb	-	b-o	1.6	m	-
Cosmarium perforatum P.Lundell	0	1	0	B	-	-	acf	-	-	-	-	m	-
Cosmarium sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Gonatozygon monotaenium De Bary	1	1	0	B	-	st-str	acf	hb	-	x-b	0.8	me	-
Klebsormidium sp.	0	0	1	-	-	-	-	-	-	-	-	-	-
Spirogyra sp.	1	1	0	B	-	-	-	-	-	-	-	-	-
Staurastrum gracile Ralfs	0	1	0	P	-	st	acf	i	-	o	1.3	m	-
Staurastrum paradoxum Meyen ex Ralfs	0	0	1	P	-	st	ind	i	-	-	-	ot	-
Zygnema sp.	1	1	0	B	-	-	-	-	-	o	1.0	-	-
Chlorophyta													
Actinastrum aciculare Playfair	0	0	1	-	-	-	-	-	-	-	-	-	-
Actinastrum hantzschii var. *gracile* V.K.Tschernov	0	1	0	-	-	-	-	-	-	-	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Actinastrum hantzschii var. *hantzschii* Lagerh.	1	1	1	P-B	-	st-str	-	i	-	b	2.3	-	-
Acutodesmus acutiformis (Schröder) P.M.Tsarenko et D.M.John	0	0	1	-	-	-	-	-	-	-	-	-	-
Ankistrodesmus falcatus (Corda) Ralfs	0	1	0	P-B	-	st-str	-	hb	-	b	2.3	-	-
Ankistrodesmus fusiformis Corda ex Korschikov	0	0	1	P-B	-	st-str	-	i	-	b	2.0	-	-
Ankistrodesmus arcuatus Korshikov	1	1	1	P-B	-	st-str	-	i	-	b	2.1	-	-
Binuclearia lauterbornii (Schmidle) Proschkina-Lavrenko	0	1	0	-	-	-	-	-	-	-	-	-	-
Chlamydomonas acuta Korshikov	1	0	0	-	-	-	-	-	-	-	-	-	-
Chlamydomonas atactogama Korshikov	1	0	0	P	-	-	-	i	-	-	-	-	-
Chlamydomonas elliptica Korshikov	0	1	0	-	-	-	-	-	-	-	-	-	-
Chlamydomonas globosa J.W.Snow	1	0	0	P,S	-	-	-	-	-	o-a	1.9	-	-
Chlamydomonas reinhardtii P.A.Dangeard	0	1	0	P-B	-	st-str	-	oh	-	a	3.1	-	-
Chlamydomonas sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Chlorangiella basiannulata (Skuja) P.C.Silva	0	1	0	-	-	-	-	-	-	-	-	-	-
Chlorella vulgaris Beyerinck [Beijerinck]	1	0	0	P-B, pb,S	-	-	-	hl	-	a	3.1	-	-
Chlorotetraedron incus (Teiling) Komárek et Kováček	0	1	1	P-B	-	st-str	-	i	-	o-a	1.9	-	-
Chodatella subsalsa Lemmermann	0	1	0	P-B	-	st-str	-	-	-	b	2.0	-	-
Closteriopsis longissima (Lemmermann) Lemmermann	1	0	0	P	-	st-str	-	i	-	o-a	1.8	-	-
Coelastrum astroideum De Not.	0	0	1	P	-	st-str	-	-	-	b	2.2	-	-
Coelastrum microporum Nägeli	1	1	1	P-B	-	st-str	ind	i	-	b	2.3	-	-
Coelastrum pseudomicroporum Korschikov	0	0	1	P	-	-	-	-	-	o-a	1.9	-	-
Coelastrum sphaericum Nägeli	1	1	0	P-B,Ep	-	st-str	-	i	-	o-b	1.4	-	-
Coenococcus planctonicus Korschikov	0	0	1	P	-	-	-	-	-	-	-	-	-
Colemanosphaera charkowiensis (Korshikov) H.Nozaki, T.K.Yamada, F.Takahashi, R.Matsuzaki et T.Nakada	0	1	0	P	-	st-str	-	-	-	b	2.2	-	-
Crucigenia fenestrata (Schmidle) Schmidle	0	1	1	P-B,Ep	-	st-str	-	-	-	o-a	1.8	-	-
Crucigenia lauterbornei (Schmidle) Schmidle	0	0	1	P-B	-	st-str	-	-	-	b-o	1.7	-	-
Crucigenia quadrata Morren	1	1	1	P-B	-	st-str	acf	i	-	o-a	1.9	-	-
Crucigenia tetrapedia (Kirchn.) West et G.S. West	1	1	1	P-B,Ep	-	st-str	ind	i	-	b	2.0	-	-
Desmodesmus abundans (Kirchn.) E. Hegew.	1	1	0	P-B,Ep	-	st-str	-	-	-	o-a	1.9	-	-
Desmodesmus abundans var. *parvus* (G.M. Sm.) Bourr.	0	0	1	P-B,Ep	-	st-str	-	-	-	o-a	1.9	-	-
Desmodesmus aculeolatus (Reinsch) P. Tsarenko	0	0	1	-	-	-	-	-	-	-	-	-	-
Desmodesmus armatus (Chodat) E. Hegew.	0	0	1	P-B,Ep	-	st-str	-	-	-	b	2.2	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Desmodesmus bicaudatus (Dedus.) P. Tsarenko	0	0	1	P-B,Ep	-	-	-	-	-	b	2.2	-	-
Desmodesmus brasiliensis (Bohlin) E. Hegew.	0	0	1	P-B	-	st-str	-	-	-	b	2.0	-	-
Desmodesmus communis var. communis (E. Hegew.) E. Hegew.	1	1	1	P-B,Ep	-	st-str	ind	i	-	b	2.15	-	-
Desmodesmus costato-granulatus (Skuja) E. Hegew.	0	0	1	P-B	-	st-str	-	-	-	b	2.1	-	-
Desmodesmus granulatus (West et G.S. West) P. Tsarenko	0	0	1	-	-	-	-	-	-	-	-	-	-
Desmodesmus hystrix (Lagerh.) E. Hegew.	0	0	1	P-B,Ep	-	-	-	-	-	b	2.0	-	-
Desmodesmus intermedius var. *acutispinus* (Y.V. Roll) E. Hegew.	0	0	1	P-B	-	st-str	-	-	-	b	2.0	-	-
Desmodesmus intermedius var. *inflatus* (Svirenko) E. Hegew.	0	0	1	P-B	-	st-str	-	-	-	b	2.0	-	-
Desmodesmus intermedius var. *intermedius* (Chodat) E. Hegew.	1	1	1	P-B	-	st-str	-	-	-	b	2.0	-	-
Desmodesmus intermedius var. *balatonicus* (Hortob.) P. Tsarenko	0	0	1	-	-	-	-	-	-	-	-	-	-
Desmodesmus magnus (Meyen) P. Tsarenko	1	0	1	P,Ep	-	-	-	-	-	o	1.3	-	-
Desmodesmus opoliensis var. *opoliensis* (P. G. Richter) E. Hegew.	0	0	1	P-B,Ep	-	st-str	-	-	-	b	2.2	-	-
Desmodesmus protuberans (F.E. Fritsch. et Rich) E. Hegew.	0	1	1	P-B,Ep	-	st-str	-	-	-	-	-	-	-
Desmodesmus spinosus (Chodat) E. Hegew.	0	0	1	P-B	-	st-str	-	-	-	o-b	1.4	-	-
Desmodesmus subspicatus var. *subspicatus* (Chodat) E. Hegew. et A. Schmidt	0	0	1	P-B	-	st-str	-	-	-	o	1.3	-	-
Dictyosphaerium ehrenbergianum Nägeli	1	1	1	P-B,Ep	-	st-str	-	-	-	o-b	1.5	-	-
Dictyosphaerium granulatum Hindák	0	0	1	-	-	-	-	-	-	-	-	-	-
Dictyosphaerium simplex Korshikov	0	1	0	-	-	-	-	-	-	-	-	-	-
Elakatothrix gelatinosa Wille	0	1	1	P	-	st-str	-	i	-	o	1.3	-	-
Enallax costatus (Schmidle) Pascher	0	1	0	-	-	-	-	-	-	-	-	-	-
Eudorina elegans Ehrenberg	0	1	0	P	-	st-str	-	i	-	b	2.3	-	-
Eudorina illinoisensis (Kofoid) Pascher	0	1	0	P	-	-	-	hl	-	b	2.2	-	-
Golenkinia radiata Chodat	0	0	1	P	-	st-str	-	i	-	o-a	1.9	-	-
Golenkiniopsis longispina (Korschikov) Korschikov	1	0	0	P-B	-	st-str	-	-	-	-	-	-	-
Golenkiniopsis solitaria (Korschikov) Korschikov	0	0	1	P-B	-	-	-	i	-	-	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Gonium pectorale O. F. Müll.	0	1	0	P	-	st	-	i	-	a-o	2.8	-	-
Granulocystopsis decorata (Svirenko) P.M.Tsarenko	0	0	1	-	-	-	-	-	-	-	-	-	-
Hindakia tetrachotoma (Printz) C. Bock, Pröschold et Krienitz	0	0	1	P	-	st	-	i	-	b	2.3	-	-
Hyaloraphidium contortum Pascher et Korshikov ex Korshikov	0	1	0	P-B	-	-	-	i	-	b	-	-	-
Kirchnariella sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Kirchneriella irregularis (G.M.Smith) Korshikov	1	0	0	P-B,Ep	-	st-str	-	i	-	o-a	1.8	-	-
Kirchneriella lunaris (Kirchn.) Moeb.	1	0	1	P-B,Ep	-	st-str	-	i	-	o-a	1.8	-	-
Kirchneriella obesa (West) Schmidle	1	1	0	P-B,Ep	-	st-str	-	i	-	o-a	1.8	-	-
Koliella longiseta (Vischer) Hindák	1	1	0	P	-	st	-	i	-	b	2.0	-	-
Korshikoviella michailovskoensis (Elenkin) P.C.Silva	0	1	0	Ep	-	-	-	-	-	o-a	1.8	-	-
Korshikoviella sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Lacunastrum gracillimum (West et G.S.West) H.A.McManus	0	0	1	P	-	-	-	-	-	b	2.1	-	-
Lagerheimia ciliata (Lagerheim) Chodat	0	0	1	P-B,Ep	-	st-str	-	-	-	b	2.0	-	-
Lagerheimia citriformis (Snow) Collins	0	1	0	P,Ep	-	st-str	-	-	-	-	-	-	-
Lagerheimia genevensis (Chodat) Chodat	0	0	1	P	-	-	-	i	-	b	2.2	-	-
Lagerheimia longiseta (Lemmermann) Printz	0	1	1	P-B,Ep	-	st-str	-	i	-	b	2.1	-	-
Lagerheimia wratislaviensis Schröder	0	1	1	P-B	-	st-str	-	-	-	b	2.1	-	-
Lemmermannia komarekii (Hindák) C.Bock et Krienitz	0	0	1	P-B,Ep	-	st-str	-	-	-	o-a	1.85	-	-
Lemmermannia triangularis (Chodat) C.Bock et Krienitz	0	0	1	P-B,Ep	-	st-str	-	-	-	b	2.2	-	-
Messastrum gracile (Reinsch) T.S.Garcia	0	0	1	P-B,Ep	-	st-str	-	-	-	o-a	1.9	-	-
Micractinium pusillum Fresen.	0	1	1	P-B,Ep	-	st-str	-	-	-	a-o	2.6	-	-
Micractinium quadrisetum (Lemmermann) G.M.Smith	0	1	0	P	-	st-str	-	-	-	-	-	-	-
Monactinus simplex (Meyen) Corda	0	0	1	P-B,Ep	-	st-str	-	-	-	b	2.0	-	-
Monoraphidium contortum (Thuret) Komárková-Legnerová	1	1	1	P-B	-	st-str	-	i	-	b	2.2	-	-
Monoraphidium griffithii (Berkeley) Komárková-Legnerová	1	1	1	P-B	-	st-str	-	i	-	b	2.2	-	-
Monoraphidium irregulare (G.M.Smith) Komárková-Legnerová	0	1	1	P-B	-	st-str	-	i	-	-	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Monoraphidium minutum (Nägeli) Komárková-Legnerová	0	0	1	P,Ep	-	st-str	-	i	-	b-a	2.5	-	-
Monoraphidium mirabile (West & G.S.West) Pankow	1	0	0	P,Ep	-	st	-	oh	-	b-a	2.5	-	-
Mucidosphaerium pulchellum (H.C.Wood) C. Bock, Proschold et Krienitz	1	1	1	P-B	-	st-str	ind	i	-	b	2.3	-	-
Neglectella solitaria (Wittrock) Stenclová et Kastovsky	0	1	1	P-B	-	st	ind	i	-	b-o	1.7	-	-
Oocystidium ovale Korshikov	0	1	0	P	-	st	-	-	-	-	-	-	-
Oocystis borgei J.W.Snow	1	1	0	P-B,S	-	st-str	ind	i	-	o-a	1.9	-	-
Oocystis lacustris Chodat	0	0	1	P-B,Ep	-	st-str	-	hl	-	b-o	1.7	-	-
Oocystis sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Oocystis submarina Lagerheim	0	1	0	P-B,Ep	-	st	-	i	-	-	-	-	-
Pandorina morum (O.F.Müller) Bory de Saint-Vincent	1	1	0	P	-	st	-	i	-	b	2.3	-	-
Pectinodesmus pectinatus (Meyen) E.Hegewald, M.Wolf, Al.Keller, Friedl et Krienitz	1	1	1	P-B	-	st-str	-	-	-	-	-	-	-
Pediastrum duplex var. *duplex* Meyen	0	1	1	P	-	st-str	ind	i	-	b	2.1	-	-
Phacotus coccifer Korshikov	0	1	0	-	-	-	-	-	-	-	-	-	-
Pseudodidymocystis planctonica (Korshikov) E.Hegewald et Deason	0	1	0	P-B,Ep	-	-	-	-	-	o-a	1.8	-	-
Pseudopediastrum boryanum var. *boryanum* (Turpin) E. Hegew.	1	1	1	P-B	-	st-str	ind	i	-	b	2.1	-	-
Pseudopediastrum boryanum var. *cornutum* (Racib.) P. Tsarenko	0	0	1	P-B	-	-	-	-	-	-	-	-	-
Pseudopediastrum boryanum var. *longicorne* (Reinsch) P. Tsarenko	0	0	1	P-B	-	st-str	-	-	-	b	2.1	-	-
Pseudopediastrum kawraiskyi (Schmidle) E. Hegew.	0	1	0	P	-	-	-	-	-	o-b	1.4	-	-
Pseudoschroederia robusta (Korshikov) E.Hegewald et E.Schnepf	0	1	0	P-B	-	st-str	-	i	-	o-a	1.9	-	-
Pteromonas aculeata Lemmermann	0	1	0	P	-	-	-	-	-	b	2.2	-	-
Quadricoccus ellipticus Hortob.	0	0	1	P	-	-	-	-	-	-	-	-	-
Radiococcus polycoccus (Korshikov) I.Kostikov, T.Darienko, A.Lukesová et L.Hoffmann	0	1	1	P	-	-	-	i	-	-	-	-	-
Raphidocelis sigmoidea Hindak	0	0	1	P	-	st-str	-	-	-	-	-	-	-
Raphidocelis subcapitata (Korshikov) Nygaard, Komárek, J.Kristiansen et O.M.Skulberg	0	1	0	P-B,Ep	-	st-str	-	i	-	o-b	1.5	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Rhaphoneis amphiceros (Ehrenberg) Ehrenberg	0	0	1	-	-	-	-	-	-	-	-	-	-
Scenedesmus arcuatus (Lemmermann) Lemmermann	0	1	1	P-B	-	st-str	-	i	-	o-a	1.9	-	-
Scenedesmus ellipticus Corda	1	1	1	P-B,S	-	st-str	-	-	-	b-o	1.7	-	-
Scenedesmus obtusus Meyen	0	0	1	P-B	-	st-str	-	-	-	o-a	1.8	-	-
Scenedesmus obtusus var. *apiculatus* (West et G.S. West) P. Tsarenko	0	0	1	-	-	-	-	-	-	-	-	-	-
Scenedesmus papillosum Pankow	0	0	1	-	-	-	-	-	-	-	-	-	-
Scenedesmus sp.	0	0	1	-	-	-	-	-	-	-	-	-	-
Schroederia setigera (Schröd.) Lemmermann	0	1	1	P	-	st-str	-	i	-	b-o	1.7	-	-
Schroederia spiralis (Printz) Korshikov	0	1	0	P-B,Ep	-	-	-	-	-	o-a	1.8	-	-
Siderocelis ornata (Fott) Fott	1	1	0	P-B,Ep	-	st-str	-	i	-	b	2.2	-	-
Siderocystopsis punctifera (Boloch.) E. Hegew. et Schnepf	0	1	0	P-B	-	st-str	-	i	-	-	-	-	-
Sphaerocystis planctonica (Korschikov) Bourr.	0	0	1	P-B	-	-	-	i	-	-	-	-	-
Sphaerocystis schroeteri Chodat	1	0	0	-	-	-	-	-	-	-	-	-	-
Stauridium tetras (Ehrenberg) E. Hegew.	1	1	1	P-B	-	st-str	ind	i	-	b	2.1	-	-
Tetradesmus lagerheimii M.J.Wynne et Guiry	1	1	1	P-B	-	st-str	ind	i	-	b	2.15	-	-
Tetradesmus obliquus (Turpin) M.J.Wynne	0	1	1	-	-	-	-	-	-	-	-	-	-
Tetraedron caudatum (Corda) Hansg.	0	1	1	P-B	-	st-str	ind	i	-	b	2.0	-	-
Tetraedron minimum var. *minimum* f. *minimum* (A. Braun) Hansg.	1	1	1	P-B,Ep	-	st-str	-	i	-	b	2.1	-	-
Tetraedron triangulare Korschikov	0	0	1	P-B,Ep	-	st-str	-	i	-	b	2.0	-	-
Tetrastrum glabrum (Y.V.Roll) Ahlstrom & Tiffany	1	1	0	P	-	-	ind	i	-	-	-	-	-
Tetrastrum staurogeniaeforme (Schröd.) Lemmermann	1	1	1	P-B,Ep	-	st-str	-	i	-	b	2.2	-	-
Treubaria triappendiculata C. Bernard	0	0	1	P-B,Ep	-	st-str	-	-	-	-	-	-	-
Ulothrix zonata (Weber & Mohr) Kützing	1	0	0	P-B	-	st-str	ind	i	-	o-a	1.8	-	-
Volvox polychlamys Korshikov	0	1	0	P	-	-	-	hb	-	-	-	-	-
Westella botryoides (W. West) De Wild.	0	0	1	P	-	st-str	-	-	-	o-a	1.8	-	-
Willea apiculata (Lemmermann) D.M.John, M.J.Wynne et P.M.Tsarenko	0	1	1	P-B,Ep	-	st-str	-	-	-	b	2.2	-	-
Willea rectangularis (A.Braun) D.M. John, M.J. Wynne et P. Tsarenko	1	1	0	P	-	-	ind	i	-	b	2.1	-	-
Willea irregularis (Wille) Schmidle	1	0	0	P-B	-	st-str	ind	i	-	-	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Cryptista													
Cryptomonas erosa Ehrenberg	0	1	0	P	-	st-str	-	-	-	b	2.3	-	-
Cryptomonas rostrata Skuja	0	1	0	P	-	-	-	-	-	o-a	1.8	-	-
Cryptomonas sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Cyanobacteria													
Anabaena sphaerica f. *conoidea* Elenkin	0	1	0	P,S	-	-	-	-	-	o-b	1.5	-	-
Anabaenopsis arnoldii Aptekar	1	1	0	P-B	-	st-str	-	-	-	b-o	1.7	me	-
Anabaenopsis elenkinii V.V.Miller	0	1	0	P-B	-	st	-	-	-	o-b	1.5	me	-
Anabaenopsis raciborskii Woloszynska	1	1	0	-	-	-	-	-	-	-	-	-	-
Anagnostidinema amphibium (C.Agardh ex Gomont) Struneckỳ, Bohunická, J.R. Johansen et Komárek Gomont	0	0	1	P-B,S	-	st-str,H_2S	-	hl	-	a-o	2.6	m	-
Aphanizomenon flosaquae (L.) Ralfs ex Bornet et Flahault	1	1	1	P	-	-	-	hl	-	o-a	1.95	m	-
Aphanocapsa planctonica (G.M. Sm.) Komárek et Anagn.	1	1	1	P	-	-	-	i	-	-	-	ot	-
Chroococcus minutus (Kützing) Nägeli	1	0	1	P-B	-	-	ind	i	-	o-a	1.8	o-m	-
Cuspidothrix issatschenkoi (Usačev) Rajaneimi et al.	1	0	1	P	-	-	-	-	-	b	2.3	me	-
Dactylococcopsis rhaphidioides f. *falciformis* Printz	0	1	0	P	-	st-str	-	-	-	-	-	-	-
Dactylococcopsis rhaphidioides f. *pannonica* (Hortob.) Hollerbach	0	1	0	P	-	st-str	-	-	-	-	-	-	-
Dactylococcopsis rhaphidioides Hansgirg	0	1	0	P	-	st-str	-	-	-	-	-	-	-
Dolichospermum flos-aquae (Lyngb.) Wacklin, Hoffmann et Komarek	0	1	1	P	-	st	-	i	-	b	2.0	e	-
Dolichospermum sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Dolichospermum spiroides (Klebanh) Wackkin, Hoffmann et Komarek	0	1	0	P	-	st-str	-	i	-	b	2.0	e	-
Gloeocapsa gelatinosa Kützing	0	0	1	B	warm	-	-	-	-	-	-	-	-
Gloeocapsa minor (Kutzing) Hollerbach	1	1	0	-	-	-	-	-	-	-	-	-	-
Gloeocapsa punctata Nägeli	0	0	1	Ep,S	-	ae	-	hl	-	-	-	-	-
Gloeocapsa sp.	0	1	1	-	-	-	-	-	-	-	-	-	-
Jaaginema geminatum (Schwabe ex Gomont) Anagnostidis et Komárek	1	1	0	P-B	warm	st	-	i	-	-	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Jaaginema quadripunctulata (Bruhl. Eet Biswas) Anagn. et Komarek	0	0	0	-	-	-	-	-	-	-	-	-	-
Leibleinia subtilis (Holden) Anagnostidis et Komárek	0	0	1	-	-	-	-	-	-	-	-	-	-
Limnothrix planctonica (Wołosz.) Meffert	0	0	1	P	-	-	-	i	-	o-b	1.5	me	-
Lyngbya confervoides C.Agardh ex Gomont	1	0	0	-	-	-	-	-	-	-	-	-	-
Merismopedia convoluta Brébisson ex Kützing	0	1	0	P-B	-	-	-	-	-	-	-	-	-
Merismopedia glauca (Ehrenberg) Kützing	1	1	0	P-B	-	-	ind	i	-	b-o	1.75	o-m	-
Merismopedia minima Beck	1	1	0	B,S	-	ae	-	-	-	-	-	ot	-
Merismopedia sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Merismopedia tenuissima Lemmermann	1	1	1	P-B	-	-	-	hl	-	b-a	2.4	e	-
Merismopedia warmingiana Lagerh.	0	0	1	P	-	-	-	-	-	-	-	e	-
Merismopedia tranquilla (Ehrenberg) Trevisan	0	0	1	P-B	-	-	ind	i	-	o-a	1.8	me	-
Microcystis aeruginosa (Kützing) Kützing	1	1	1	P	-	-	-	hl	-	b	2.1	e	-
Microcystis firma (Bréb. et Lenorm.) Schmidle	0	0	1	P	-	-	-	-	-	o-b	1.5	-	-
Microcystis flosaquae (Wittr.) Kirchn. emend. Wesenb.-Lund.	0	0	1	P	-	-	-	i	-	b	2.0	e	-
Microcystis pulverea (Wood) Forti	0	0	1	P-B,S	-	-	-	i	-	o-b	1.5	-	-
Microcystis viridis (A.Braun) Lemmermann	0	0	1	P	-	-	-	-	-	b	2.2	e	-
Microcystis wesenbergii (Komárek) Komárek	0	0	1	P	-	-	-	-	-	o-a	1.9	e	-
Oscillatoria limosa C.Agardh ex Gomont	1	1	1	P-B	-	st-str	-	hl	-	b	2.3	e	-
Oscillatoria limosa f. *laeteaeruginosa* Kützing ex Elenkin	0	1	0	P-B,S	-	st-str	-	-	-	-	-	-	-
Oscillatoria margaritifera Kützing ex Gomont	0	1	0	-	-	-	-	-	-	-	-	-	-
Oscillatoria planctonica Woloszynska	1	1	1	P	-	-	-	i	-	o-b	1.5	me	-
Oscillatoria princeps Vaucher ex Gomont	0	0	1	P-B,S	-	st-str	-	-	-	a-o	2.8	o-m	-
Oscillatoria punctata Corda	0	0	1	-	-	-	-	-	-	-	-	-	-
Oscillatoria sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Oscillatoria tenuis C.Agardh ex Gomont	1	0	1	P-B,S	-	st-str	-	hl	-	a-o	2.6	me	-
Oscillatoria terebriformis f. *amphigranulata* Elenkin et Kossinskaja	0	1	0	B,S	eterm	st-str	-	-	-	b-p	2.9	-	-
Oscillatoria ucrainica Vladimirova	1	0	0	-	-	-	-	-	-	-	-	-	-
Phormidium chalybeum (Mertens ex Gomont) Anagnostidis et Komárek	0	1	0	P-B,S	-	st-str	-	-	-	a	3.3	e	-
Phormidium nigroviride (Thwaites ex Gomont) Anagnostidis et Komárek	1	0	0	-	-	-	-	-	-	-	-	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Phormidium nigrum (Vaucher ex Gomont) Anagnostidis et Komárek	1	0	0	P-B	warm	-	-	-	-	b	2.2	m	-
Phormidium solitare (Kützing ex Gomont) Anagnostidis et Komárek	0	0	1	-	-	-	-	-	-	-	-	-	-
Phormidium thwaitesii I.Umezaki & M.Watanabe	1	1	0	-	-	-	-	-	-	-	-	-	-
Planktothrix agardhii (Gomont) Anagnostidis et Komárek	1	1	0	P-B	-	st	-	hl	-	b	2.2	e	-
Pleurocapsa minor Hansgirg	1	1	0	B	-	st-str	-	-	-	x-b	0.9	ot	-
Pleurocapsa minuta Geitler	0	1	0	-	-	-	-	-	-	-	-	-	-
Rhabdogloea elenkinii (Y.V. Roll) Komárek et Anagn.	0	0	1	-	-	-	-	-	-	-	-	-	-
Rivularia sp.	0	1	0	-	-	-	-	-	-	-	-	-	-
Snowella lacustris (Chodat) Komárek et Hindák	0	1	1	P	-	-	-	i	-	b-o	1.6	me	-
Spirulina adriatica Hansgirg	1	1	0	-	-	-	-	-	-	-	-	-	-
Spirulina laxissima G.S.West	1	0	0	-	-	-	-	-	-	-	-	-	-
Spirulina sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Woronichinia compacta (Lemmermann) Komárek et Hindák	0	0	1	P-B	-	-	-	-	-	-	-	o-m	-
Miozoa													
Apocalathium aciculiferum (Lemmermann) Craveiro, Daugbjerg, Moestrup & Calado	0	0	1	P	-	-	-	-	-	o-b	1.5	-	-
Biceratium furca (Ehrenberg) Vanhoeffen	1	1	0	-	-	-	-	-	-	-	-	-	-
Ceratium fusus (Ehrenberg) Dujardin	1	0	0	-	-	-	-	-	-	-	-	-	-
Ceratium hirundinella (O.F.Müller) Dujardin	0	0	1	P	-	st-str	-	i	-	o	1.3	-	-
Ceratium tripos (O.F.Müller) Nitzsch	1	0	0	-	-	-	-	-	-	-	-	-	-
Dinophysis saccula Stein	1	0	0	-	-	-	-	-	-	-	-	-	-
Diplosalis acuta (Apstein) Entz	1	0	0	-	-	-	-	-	-	-	-	-	-
Diplosalis acuta var. *halophila* Er. Lindem.	1	1	0	-	-	-	-	-	-	-	-	-	-
Ellobiopsis chattonii Caullery	1	0	0	-	-	-	-	-	-	-	-	-	-
Glenodinium paululum Lindernann	1	0	0	-	-	-	-	-	-	-	-	-	-
Glenodinium rotundatum Skvortzov	0	1	0	-	-	-	-	-	-	-	-	-	-
Glenodinium sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Glochidinium pernardiforme (Lindemann) Boltovskoy	0	0	1	-	-	-	-	-	-	o-b	1.4	-	-
Gonyaulax apiculata (Pénard) Entz	0	1	0	-	-	-	-	-	-	o	1.1	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Gonyaulax polygramma Stein	1	0	0	-	-	-	-	-	-	-	-	-	-
Gymnodinium paradoxum A.J. Schill	0	0	1	P	-	-	-	-	-	o-b	1.5	-	-
Gymnodinium sp.	1	0	0	-	-	-	-	-	-	-	-	-	-
Lingulodinium polyedra (F.Stein) J.D.Dodge	1	0	0	-	-	-	-	-	-	-	-	-	-
Noctiluca scintillans (Macartney) Kofoid & Swezy	1	0	0	-	-	-	-	-	-	-	-	-	-
Peridiniella danica (Paulsen) Y.B.Okolodkov & J.D.Dodge	1	0	0	-	-	-	-	-	-	-	-	-	-
Peridiniopsis penardiformis (Lindemann) Bourrelly	0	1	0	P	-	st	-	-	-	o-b	1.4	-	-
Peridiniopsis thompsonii Bourrelly	1	1	0	P	-	-	-	-	-	-	-	-	-
Peridinium cinctum (O.F.Müller) Ehrenberg	0	1	0	P-B	-	st-str	-	i	-	b-o	1.6	-	-
Peridinium sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Prorocentrum balticum (Lohmann) Loeblich	1	0	0	-	-	-	-	-	-	-	-	-	-
Prorocentrum cordatum (Ostenfeld) Dodge	1	1	0	-	-	-	-	-	-	-	-	-	-
Prorocentrum lima (Ehrenberg) F.Stein	1	0	0	-	-	-	-	-	-	-	-	-	-
Prorocentrum micans Ehrenberg	1	1	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium bipes (Paulsen) Balech	1	0	0	P	-	st-str	-	oh	-	o	1.3	-	-
Protoperidinium crassipes (Kofoid) Balech	1	0	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium decipiens (Jörgensen) Parke & Dodge	1	0	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium depressum (Bailey) Balech	1	0	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium divergens (Ehrenberg) Balech	1	0	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium granii (Ostenfeld) Balech	1	0	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium ovatum Pouchet	1	0	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium pallidum (Ostenfeld) Balech	1	0	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium quarnerense (B.Schröder) Balech	1	0	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium steinii (Jørgensen) Balech	1	0	0	-	-	-	-	-	-	-	-	-	-
Protoperidinium knipowitschii (Usachev) Balech	1	0	0	-	-	-	-	-	-	-	-	-	-
Pyrophacus horologicum Stein	1	0	0	-	-	-	-	-	-	-	-	-	-
Scrippsiella acuminata (Ehrenberg) Kretschmann, Elbrächter, Zinssmeister, S.Soehner, Kirsch, Kusber & Gottschling	1	0	0	-	-	-	-	-	-	-	-	-	-
Unruhdinium penardii (Lemmermann) Gottschling	0	1	0	P	-	-	-	hl	-	o	1.3	-	-
Euglenozoa													
Astasia dangeardii Lemmermann	1	0	0	P-B	warm	st	ind	-	-	p	4.0	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Astasia sp.	1	0	0	-	-	-	-	-	-	-	-	-	-
Euglena geniculata Dujardin	1	0	0	P-B	eterm	st-str	alf	-	-	a	3.4	-	-
Euglena gracilis G.A. Klebs	0	0	1	P-B	eterm	st	ind	oh	-	b	2.25	-	-
Euglena granulata (G.A. Klebs) Schmitz	1	1	0	P-B	eterm	st-str	ind	mh	-	a-o	2.75	-	-
Euglena minima Francé	0	1	0	P-B	eterm	st	alb	mh	-	b	2.2	-	-
Euglena sp.	1	1	1	-	-	-	-	-	-	-	-	-	-
Euglena viridis Perty	1	1	1	P-B,S	eterm	st-str	ind	mh	-	i	4.0	-	-
Euglena agilis H.J.Carter	0	1	0	P-B	eterm	st-str	alf	mh	-	a	3.0	-	-
Eutreptia lanowii Steuer	1	0	0	-	-	-	-	mh	-	-	-	-	-
Lepocinclis ovum var. *ovum* (Ehrenberg) Lemmermann	0	0	1	P	eterm	st	ind	i	-	b-a	2.4	-	-
Lepocinclis sp.	0	0	1	P	warm	st	alf	-	-	-	-	-	-
Lepocinclis spirogyra Korshikov	0	1	0	P-B	-	-	-	-	-	b-a	2.4	-	-
Lepocinclis steinii Lemmermann	0	1	0	P	eterm	st	ind	i	-	b	2.2	-	-
Lepocinclis acus (O.F.Müller) B.Marin & Melkonian	1	1	1	P	eterm	st	ind	i	-	b	2.2	-	-
Lepocinclis caudata (A.M.Cunha) Pascher	1	1	1	P-B	warm	st-str	ind	mh	-	a-o	2.8	-	-
Lepocinclis gracillimoides B.Zakrys & K.Chaber	0	1	0	P	-	-	-	-	-	a-o	2.7	-	-
Lepocinclis oxyuris (Schmarda) B.Marin & Melkonian	0	1	0	P-B	-	st-str	ind	mh	-	a-o	2.6	-	-
Lepocinclis oxyuris var. *skvortzovii* (T.G.Popova) Taşkin & Alp	0	1	0	P	-	st-str	acf	-	-	a-o	2.7	-	-
Monomorphina pyrum (Ehrenberg) Mereschkowsky	1	0	0	P	eterm	st-str	ind	mh	-	b	2.35	-	-
Phacus caudatus Hübner	0	0	1	P-B	eterm	st-str	alf	i	-	b	2.3	-	-
Phacus longicauda var. *longicauda* f. *longicauda* (Ehrenberg) Dujard.	0	1	0	P-B	-	st	ind	i	-	a-o	2.8	-	-
Phacus pleuronectes (Ehrenberg) Dujard.	0	1	0	P-B	-	st-str	ind	i	-	a-o	2.7	-	-
Phacus sp.	1	0	0	-	-	-	-	-	-	-	-	-	-
Phacus limnophilus (Lemmermann) E.W.Linton & Karnkowska	0	1	0	P-B	eterm	st-str	-	-	-	o-b	1.5	-	-
Phacus tortus (Lemmermann) Skvortsov	1	1	0	P-B	-	st-str	ind	i	-	a-o	2.7	-	-
Strombomonas acuminata (Schmarda) Deflandre	0	1	1	P	-	st-str	ind	i	-	b	2.2	-	-
Strombomonas fluviatilis (Lemmermann) Deflandre	0	1	0	P-B	eterm	st-str	ind	i	-	b	2.25	-	-
Trachelomonas armata (Ehrenberg) F.Stein	0	1	0	-	-	-	-	-	-	b	2.1	-	-
Trachelomonas hispida var. *hispida* (Perty) F.F. Stein	1	1	0	P-B	eterm	st-str	-	i	-	b	2.2	-	-

Table A1. *Cont.*

Taxa	Estuary-Lake	Forming a Reservoir	Reservoir	Hab	T	Oxy	pH	Sal	Wat	Sapro	Index S	Tro	Aut-Het
Bacillariophyta													
Trachelomonas intermedia f. *intermedia* P.A. Dang.	1	0	0	P-B	eterm	-	-	i	-	b	2.2	-	-
Trachelomonas nigra Svirenko	0	0	1	P	cool	st-str	-	hl	-	b	2.2	-	-
Trachelomonas oblonga Lemmermann	1	0	0	P	eterm	st-str	-	i	-	b-a	2.4	-	-
Trachelomonas sp.	1	1	0	-	-	-	-	-	-	-	-	-	-
Trachelomonas volvocina var. *volvocina* Ehrenberg	1	1	1	B	eterm	st-str	ind	i	-	b	2.0	-	-
Ochrophyta (Chrysophyceae)													
Dinobryon divergens O.E. Imhof	0	1	0	P	-	st-str	ind	i	-	o-b	1.45	-	-
Dinobryon sertularia Ehrenberg	1	0	0	P	-	-	-	i	-	o	1.3	-	-
Kephirion sp.	0	0	1	B	-	-	-	-	-	o-b	1.5	-	-
Synochromonas gracilis Korshikov	0	1	0	-	-	-	-	-	-	-	-	-	-
Synochromonas pallida Korshikov	0	1	0	-	-	-	-	-	-	-	-	-	-
Ochrophyta (Xanthophyceae)													
Goniochloris fallax Fott	0	1	0	P	-	st-str	-	-	-	b	2.1	-	-
Goniochloris smithii (Bourr.) Fott	0	0	1	P,S	-	st-str	-	hb	-	b-o	1.7	-	-
Goniochloris spinosa Pascher	0	0	1	P	-	-	-	-	-	o-a	1.8	-	-
Ophiocytium capitatum Wolle	0	1	1	P	-	st	-	oh	-	o	1.2	-	-
Pseudostaurastrum subglobosum (Pascher) Bourrelly	0	1	0	-	-	-	-	-	-	x-b	0.9	-	-
Tribonema affine (Kützing) G.S.West	1	0	0	B	-	-	-	hb	-	x-b	0.8	-	-
Total: 613	259	295	289										

Note: 1, present; 0, absent; "–", unknown. Habitat (Hab): P, planktonic; P-B, plankto-benthic; B, benthic; Ep, epiphyte; S, soil; pb, phycobiont. Temperature (T): cool, cool water; temp, temperate; eterm, eurythermic; warm, warm water. Oxygenation and water dynamic (Oxy): st, standing water; str, streaming water; st-str, low-streaming water; aer, aerophiles; H_2S, anoxia with sulfides. pH preferences groups (pH) according to Hustedt (1957) [30]: alb, alkalibiontes; alf, alkaliphiles; ind, indifferent; acf, acidophiles; neu, neutrophiles as a part of pH-indifferent taxa. Salinity ecological groups (Sal) according to Hustedt (1938–1939) [29]: hb, oligohalobes-halophobe; i, oligohalobes-indifferent; hl, halophiles; mh, mesohalobes; oh, undifferentiated oligohalobes with optimum as oligohalobes-indifferent. Organic pollution indicators according to Watanabe et al. (1986) [57]: sx, saproxenes; es, eurysaprobes; sp, saprophiles. Self-purification zone with index of saprobity (Sap): x/0.0, xenosaprobe; x-o/0.4, xeno-oligosaprobe; o-x/0.6, oligo-xenosaprobe; x-b/0.8, xeno-betamesosaprobe; o/1.0, oligosaprobe; o-b/1.4, oligo-betamesosaprobe; b-o/1.6, beta-oligosaprobe; o-a/1.8, oligo-alphamesosaprobe; b/2.0, betamesosaprobe; b-a/2.4, beta-alphamesosaprobe; a-o/2.6, alpha-oligosaprobe; b-p/2.8, beta-polysaprobe; a/3.0, alphamesosaprobe; a-b/3.6, alpha-betamesosaprobe; p/4.0, polysaprobe; i/>4.0, i-eusaprobe. Species-specific index saprobity S according to Sládeček [58] related to Class 1–5 of organic pollution. Nitrogen uptake metabolism (Aut-Het) [31]: ats, nitrogen-autotrophic taxa, tolerating very small concentrations of organically bound nitrogen; ate, nitrogen-autotrophic taxa, tolerating elevated concentrations of organically bound nitrogen; hne, facultative nitrogen-heterotrophic taxa, needing periodically elevated concentrations of organically bound nitrogen; hce, obligate nitrogen-heterotrophic taxa, needing continuously elevated concentrations of organically bound nitrogen. Trophic state indicators (Tro) [31]: ot, oligotraphentic; o-m, oligomesotraphentic; m, mesotraphentic; me, mesoeutraphentic; e, eutraphentic; he, hypereutraphentic; o-e, oligo- to eutraphentic (hypereutraphentic).

Table A2. Distribution of species number in taxonomic phyla, quantity of indicators within ecological groups, and major environmental variables for tree stages of long-term Sasyk monitoring.

Variable	Stage I	Stage II	Stage III
Phylum			
Bacillariophyta	132	127	145
Chlorophyta	41	75	84
Cyanobacteria	28	37	30
Euglenozoa	17	22	11
Miozoa	33	12	4
Charophyta	5	13	9
Ochrophyta (Xanthophyceae)	1	3	3
Cryptista	1	3	0
Ochrophyta (Chrysophyceae)	1	3	1
No. of Species	259	295	289
Habitat			
P	33	59	49
P-B	75	114	128
B	37	46	64
Ep	0	1	1
Oxygen and water moving			
H_2S	0	0	1
st	14	30	25
st-str	72	126	131
str	5	3	12
aer	1	2	1
Water pH			
acf	2	7	3
ind	36	59	54
alf	41	**55**	80
alb	**5**	6	5
Water salinity			
hb	2	5	5
i	79	126	139
hl	26	31	30
mh	21	13	10
Nitrogen metabolism			
ats	2	12	22
ate	26	37	45
hne	3	4	9
hce	1	2	7
Class of Water Quality			
Class I	2	6	2
Class II	25	44	58
Class III	73	112	127
Class IV	21	27	25
Trophic state			
ot	3	5	5
o-m	7	19	31
m	7	9	11
me	25	37	38
e	16	23	39
o-e	4	3	7
he	0	1	4
Temperature			
cool	3	4	3
eterm	10	13	10
temp	17	21	29
warm	4	3	5
Environment			
Water exchange period, day	505	163	312
Inflow through the cannel, mln m^3 $year^{-1}$	0	765	399
Inflow of water from the sea, mln m^3 $year^{-1}$	142	0	0
Evaporation, mln m^3 $year^{-1}$	173	156	193
Cl-, mg dm^{-3}	7790	603.5	491

Note: Abbreviation of ecological groups as in Appendix A, Table A1.

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