



## Article

# Diversity of Diatom Algae in the Lena Delta Nature Reserve and the Adjacent Territory in the Specific Ecological Factors of the Arctic

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**Abstract:** A total of 413 diatom taxa were known for aquatic habitats of the Lena Delta Nature Reserve. We identified 385 taxa in 14 small tundra lakes near the reserve that significantly enriched the diatom diversity of the region (666 taxa including definitions to the genus level). Thus, the species composition of diatoms in the reserve and adjacent territories was increased by 278 species. We showed that the species of the genera *Pinnularia* (57) and *Eunotia* (51) have predominance at the family and generic levels. The index of intraspecific variability Ssp./Sp. for the lakes of the reserve was 1.11, and that for the lakes of the Tiksi region 1.14, which is typical for high-latitude and high-mountain communities. The number of rare or endangered species varied in different lakes from 1 to 10, totaling 42 species for the entire study area. Bioindication has shown that potentially threatened species prefer moderate temperatures, and slightly acidic or neutral environments free from organic pollution. A comparative analysis of the species composition of diatoms in the vicinity of the Lena Delta and other northern water bodies of Yakutia and the Arctic Islands showed that the species composition of each lake in the Arctic has a discernably different species distribution. The indicator characteristics show a certain response of the species composition of diatoms to changes in salinity, pH, and organic pollution. Regularities in the spatial distribution of diatoms in the study area were revealed in connection with the environmental variables of their habitat. Statistical mapping of diatom diversity data and bioindicators revealed a pronounced response to point pollution, and also let us assume the influence of summer northeast winds on species composition of the studied lake communities. We suggest that the high diversity inherent in the diatom lakes of the Tiksi coastal zone, which can even be updated in further studies, can be considered as a property of coastal biota inherent in ecotones. Since it is in the coastal Tiksi region that a surge in the number of species is observed, this region can be considered not only an ecotone, but also a hotspot of diatom diversity. The results of the study are important for developing the basis for monitoring biodiversity under the conditions of anthropogenic and climatic changes in the Arctic.

**Keywords:** diatoms; diversity; ecology; floristic; comparative floristics; climate; Red List; threatened species; bioindicators; statistical mapping



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## 1. Introduction

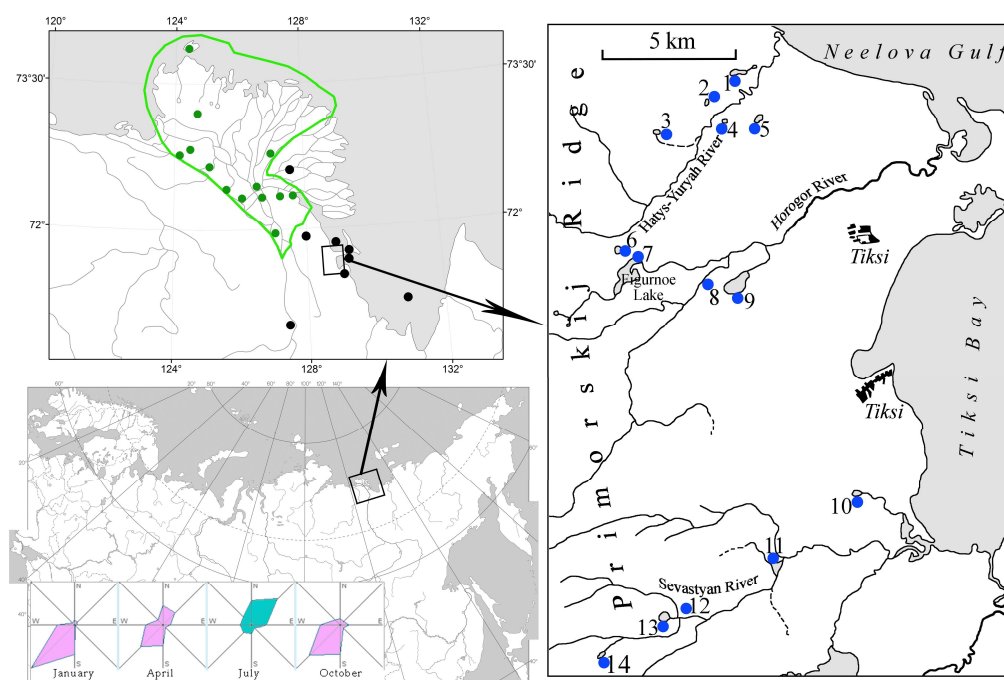
The diatom algae of Bacillariophyta Karsten are a common group of colonial or single-celled organisms characterized by an exogenous siliceous shell. The study of the ecology and species diversity of diatoms in the Arctic is of particular importance in connection with the phenomena of global climate change.

The study of diatoms of the Eurasian high Arctic aquatic ecosystems has remained in the initial stage but even now results are represented on the Eurasian northern coast

of Arctic Ocean [1,2], the Arctic Ocean islands [3–6], Chukotka [7–9], and the Yakutia continental part [10,11].

Our studies of the Northern Yakutia aquatic communities were carried out to assess the impact of anthropogenic and climatic factors on them [12–18].

The water bodies of the Lena Delta Nature Reserve (Figure 1, green dots) and adjacent territories (black dots) include the lower reaches of the Lena River, the river delta, the close places of the Laptev Sea area and the New Siberian Islands, as well as tundra reservoirs on the Kharaulakh Range. All mentioned waterbodies are located beyond the Arctic Circle in the zone of continuous occurrence of permafrost soils. Algological studies of this area were started almost 100 years ago. The latest summary, including all currently available information on the alga flora of the delta region, was previously published on the GBIF.org portal [19]. Therefore, the diatom flora of the Lena Delta Nature Reserve and the area close to its border coast (Figure 1, green and black dots) included information on 413 taxa below the genus rank before this study. Investigations of diatoms in the lakes of the coastal territory adjacent to the reserve (Figure 1, blue dots) are currently ongoing due to the potential for industrial development of the coastal territory and shelf [18].



**Figure 1.** Investigated waterbodies in the Lena Delta Nature Reserve (green outline, green dots) and the adjacent territory (black dots), summarized as “delta region” and a recent survey of waterbodies (blue dots, “Tiksi region”) with the wind rose seasonality.

The species composition and diversity of diatoms in Arctic water bodies is influenced by several regional features: the area of the reservoir, the direction of the prevailing winds, water temperature, salinity, and pH, as mentioned in previous studies [1,18,20]. However, the detection of species worthy of inclusion in the Red Book of the Arctic [6,21] has not been done so far. Figure 1 shows that the region of the Arctic coast near the Lena River Delta needs to be studied more. As a basis for this study, we chose the data on the species composition of diatoms of the Lena Delta Nature Reserve and the adjacent territory (green and black dots), hereinafter referred to as “delta region” [19], and a recent survey of 14 water bodies in the vicinity of Tiksi settlement (blue dots), hereinafter referred to as “Tiksi region” [18]. Unfortunately, there is very little data available on the habitat for water bodies in “delta region” but the environmental data for “Tiksi region” were sufficient [18] to be used for the species–environment relationships analysis.

Our hypothesis was that by studying in detail the relationship between diatom biodiversity and environmental variables in the model zone of the Arctic coast, it is possible to identify the introduction of species from temperate latitudes to the Arctic coast in the context of global climate change.

The aim of this study was to compile a general list of diatoms of the Lena Delta Nature Reserve and the adjacent coastal area, characterize the diversity and species richness, conduct an ecological and geographical analysis, reveal environmental factors influencing the diatom diversity in the studied lakes, and identify potentially threatened species worthy of inclusion in the Red Book of the Arctic region.

## 2. Materials and Methods

### 2.1. Description of Study Area

The study area is located north of the Arctic Circle on the coast of the Laptev Sea of the Arctic Ocean and includes the Lena River Delta and reservoirs on the eastern spur of the Kharaulakh Range of the Verkhoysansk Mountain system. The maximum height reaches 400 m above sea level. The underlying rocks are mainly shales, sandstones, and limestones, as well as effusive rocks that were formed because of removal by the Lena River or accumulated because of catastrophic outbursts of a glacier-dammed lake in the late Pleistocene-early Holocene [22–24]. The territory belongs to the tundra and mountain-tundra natural zones. The climate is polar maritime, the average annual air temperature is  $-9$ – $-11$  °C [25], and the average frost-free period is 45 days [26]. The depth of seasonal thawing of permafrost soils is 0.2–1.2 m [27]. The average annual precipitation reaches 212 mm, of which the bulk falls from June to August. The phenomena of a polar day in summer and a polar night in winter are characteristic. Strong winds are frequent, and the warmest month of the year, July, is characterized by the lowest average hourly wind speed of the year, which is  $15.5 \text{ km h}^{-1}$  (Figure 1, wind roses). The delta and coastal areas are characterized by an abundance of small tundra reservoirs due to limited drainage due to the low thickness of the seasonally thawed permafrost layer [28]. Our work on the territory adjacent to the reserve was carried out on 14 different types of water bodies, which are shallow tundra lakes, small reservoirs, and a hollow in the swampy tundra (Table 1, Figures 1 and 2).

**Table 1.** Sampling station parameters and the geographical coordinates of recent survey of waterbodies in “Tiksi region” (blue dots according to Figure 1).

No of Station	Lake Name	Water Temperature	Altitude, m	North	East
1	Lake 1	16.7	25	71°44′44″	128°43′12″
2	Lake 2	15.1	66	71°44′12″	128°41′37″
3	Lake 3	15.0	109	71°43′31″	128°38′31″
4	Lake 4	20.4	38	71°43′48″	128°42′35″
5	Lake 5	20.6	−4	71°43′45″	128°44′36″
6	Lake 6	16.1	76	71°41′10″	128°36′50″
7	Lake 7	14.5	76	71°40′52″	128°37′11″
8	Lake-puddle 8	10.1	55	71°40′26″	128°41′21″
9	Lake 9	15.1	54	71°40′10″	128°43′27″
10	Lake 10	13.3	52	71°35′56″	128°51′70″
11	Lake 11	14.0	38	71°34′33″	128°45′51″
12	Swampy lake 12	-	105	71°33′36″	128°40′26″
13	Lake 13	14.6	85	71°33′17″	128°38′51″
14	Lake 14	14.7	154	71°32′34″	128°34′57″



**Figure 2.** Natural landscape of investigated waterbodies in the Lena Delta Nature Reserve and the adjacent area. (a) Arctic tundra with small waterbodies; (b) phytoplankton sampling.

### 2.2. Sampling

Algae sampling on 14 waterbodies of the adjacent territory was carried out between 3 and 7 July 2021. When taking samples, Apstein's plankton net (SEFAR NITEX fabric, mesh diameter 15  $\mu\text{m}$ ) was used. All samples from 14 lakes were taken by throwing the Apstein net three times. Since the lakes are shallow water bodies, the shores of which are overgrown with tundra vegetation, in the process of sampling, not only the inhabitants of the water mass, but also organisms that were disturbed and torn off from the substrate were collected in the net. So, each sample accumulated both plankton and periphyton. Fixation with 4% neutral formaldehyde solution was carried out immediately after collection. The temperature of water and the morphometric parameters of each lake were determined during the collection of phytoplankton. Coordinates and altitudes of the stations were defined by a Garmin eTrex GPS-navigator (Table 1). Water samples of 1 L were collected from each lake for chemical analysis. All samples were transported for determination to the Analytical Chemistry Laboratory of the Institute for Biological Problems of Cryolithozone SB RAS, Yakutsk, Russia.

### 2.3. Diatom Analysis

Cleaning of diatom shells from organic matter was carried out by burning in 30% hydrogen peroxide with 6 h heat treatment in a thermostat at 85 °C [29]. Diatoms in prepared permanent preparations were examined using a JSM-6510 LV (JEOL Ltd.; Tokyo, Japan) scanning electron microscope.

Handbooks and individual articles were used for the diatom species determinations [9,30–51]. The modern species names were adopted using [algaebase.org](http://algaebase.org) [52]. Rare and endangered species are marked based on data on the distribution of well-studied diatoms in Central Europe [53] in comparison with IUCN [54] (The International Union for Conservation of Nature) criteria (Table 2). Bioindicator analysis was performed according to [55], revealing species-specific ecological preferences [56,57]. Statistical maps were constructed as the network analysis in JASP (significant only) on the botnet package in the R Statistica package [58]. The BioDiversity Pro 2.0 program was used for similarity calculation [59].



**Table 2.** Threat categories for diatom species in the waterbodies of the Lena Delta Nature Reserve and the adjacent area.

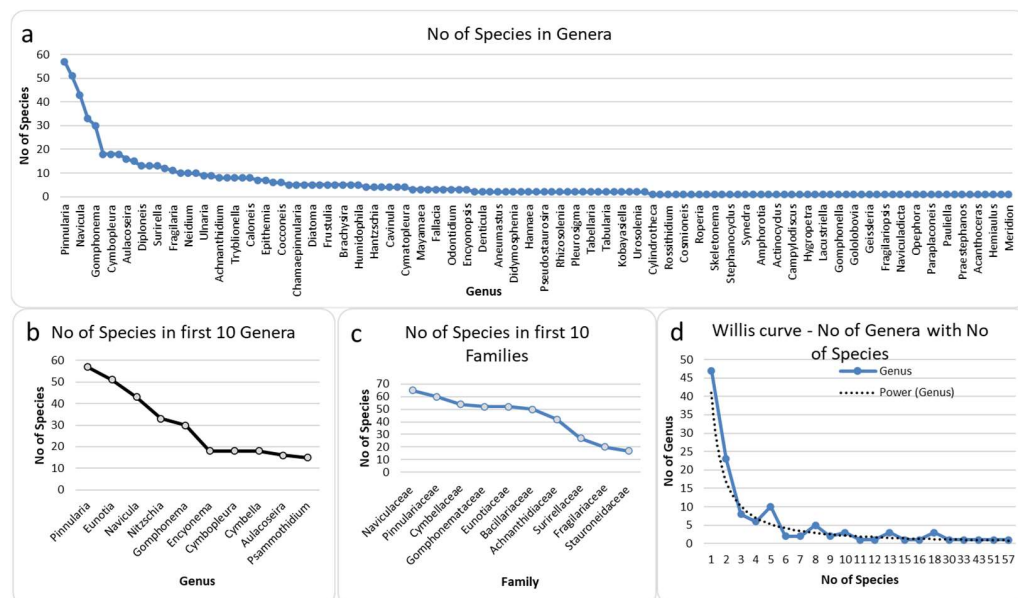
IUCN Category	IUCN Code	No of Red List Category	Red List Category	Number of Species
Extinct	EX	1	Extinct or Lost	2
Critically Endangered	CR	2, 3	Threatened with Extinction, Highly Threatened	40
Endangered	EN	4, 5	Threat of Unknown Extent	112
Vulnerable	VU	6	Extremely Rare	16
Near Threatened	NT	7	Near Threatened	28
Least Concern	LC	9	Not Threatened	198
Data Deficient	DD	8	Data Deficient	43
Not Evaluated	NE	0, 10	Not established	194

### 3. Results

#### 3.1. Taxonomical and Floristic Analysis of Diatoms

A significant diversity (385 taxa, Appendix A Figures A1 and A2) of diatoms was found for 14 small tundra shallow lakes in “Tiksi region” [18], which, together with the identified previously diatom species in the Nature Reserve itself of the “delta region” [19], makes up a general floristic list of 666 taxa (including definitions to the genus level) (Appendix A Table A1). Thus, the species composition of diatoms in the reserve and adjacent protected areas was updated by 278 species.

For the diatom flora of the habitats of this Arctic coast, a wide range of generic richness of 123 genera was revealed, including from 1 to 57 species (Figure 3a), with a predominance of species of the *Pinnularia* (57) and *Eunotia* (51) genera (Figure 3b).



**Figure 3.** Distribution of diatom species over 123 genera (a), ten richest genera (b), ten richest families (c), and Willis’s curve (d) in the Lena Delta Nature Reserve and the adjacent area.

Among the first 10 families out of 47, the *Naviculaceae* family with 65 species is the most abundant, followed by *Pinnulariaceae* and *Eunotiaceae* which move to 2nd and 5th place, respectively (Figure 3c). Floristic data were checked by us for completeness of

knowledge by constructing a Willis curve comparing the number of species in genera [60]. It was found that when the Willis curve is represented by a hyperbolic distribution, it can be used as a criterion for the completeness of the list of algoflora and, therefore, for the subsequent analysis of alpha or gamma diversity. Figure 3d shows that the distribution of the number of species over the number of genera is a smooth enough line, almost coinciding with the trend line. This is evidence that the diatom flora of the Lena Delta Nature Reserve and the adjacent area is sufficiently studied to allow a systematic and ecological analysis of its species composition. However, irregularities on the distribution line indicate that the list of species has not yet been exhausted and will be increased with further research.

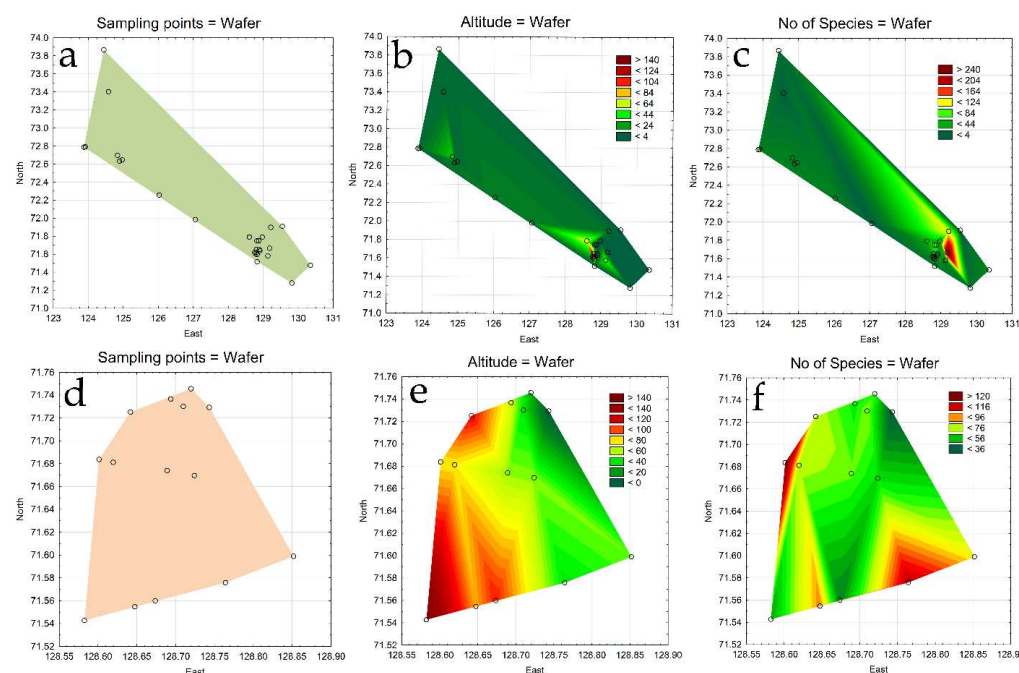
Floristic properties may be characteristic of the region under study. For this purpose, the index of intraspecific variability was calculated for the floristic composition of lakes in the Tiksi region. The index was defined as the quotient of the total number of identified taxa with a rank below the genus divided by the number of species. As it was revealed earlier [61], the index of intraspecific/species variability of diatom floras of Eurasia decreases from north to south, which may be associated with climate change and therefore can be used as a criterion for future warming. The index Ssp./Sp. for the entire Lena Delta Nature Reserve and the adjacent area, which includes the “Tiksi region” and “delta region”, was 1.11, and for the study area of the “Tiksi region”, the index was 1.14, typical for high-latitude and high-altitude communities (Table 3). The number of diatom species per area of the reserve and the “Tiksi region” differed markedly, amounting to 0.05 and 2.14 species per area, respectively.

**Table 3.** Floristic parameters of the entire Lena Delta Nature Reserve and the adjacent area as the “Delta region”, and the “Tiksi region”.

Variable	“Delta Region”	“Tiksi Region”
Area, km <sup>2</sup>	14300	180
Species with intraspecies	666	385
Taxa without sp.	631	356
Species only	569	337
Sp./Area	0.05	2.14
Ssp./Sp.	1.11	1.14

Figure 4 makes it possible to compare the distribution of the studied lakes in the “delta region” and a group of 14 lakes in the “Tiksi region”. Both studied areas have a significant number of the investigated lakes evenly distributed over the territory, the altitude of which is within 0–140 m above sea level and the number of species in individual lakes varies in a wider range on the territory of the reserve than on the territory of Tiksi. That is, environmental properties are similar, and differences are observed in the number of species in lakes. In this regard, it should be noted that the lakes in the delta were visited repeatedly over several years, while 14 lakes in the “Tiksi region” were examined only once.

The relationship between the morphometry of the studied lakes and the diatom species richness was defined by calculation data for the number of species per lake area represented in Table 4. It can be seen that highest species richness was in lake 6, but the Sp./Area index was highest in lake 4. The calculation of correlations of this index with the morphometric parameters of a group of lakes showed a significant correlation ( $p$ -value = 0.04), which is  $-0.502$  for Sp./Area and coastline length.



**Figure 4.** Distribution of the studied lakes in the territory of the “delta region” (a) and a group of 14 lakes in the “Tiksi region” (d), altitude (b,e) and the number of diatom species (c,f). The top row of graphs is Delta region and bottom row is Tiksi lakes.

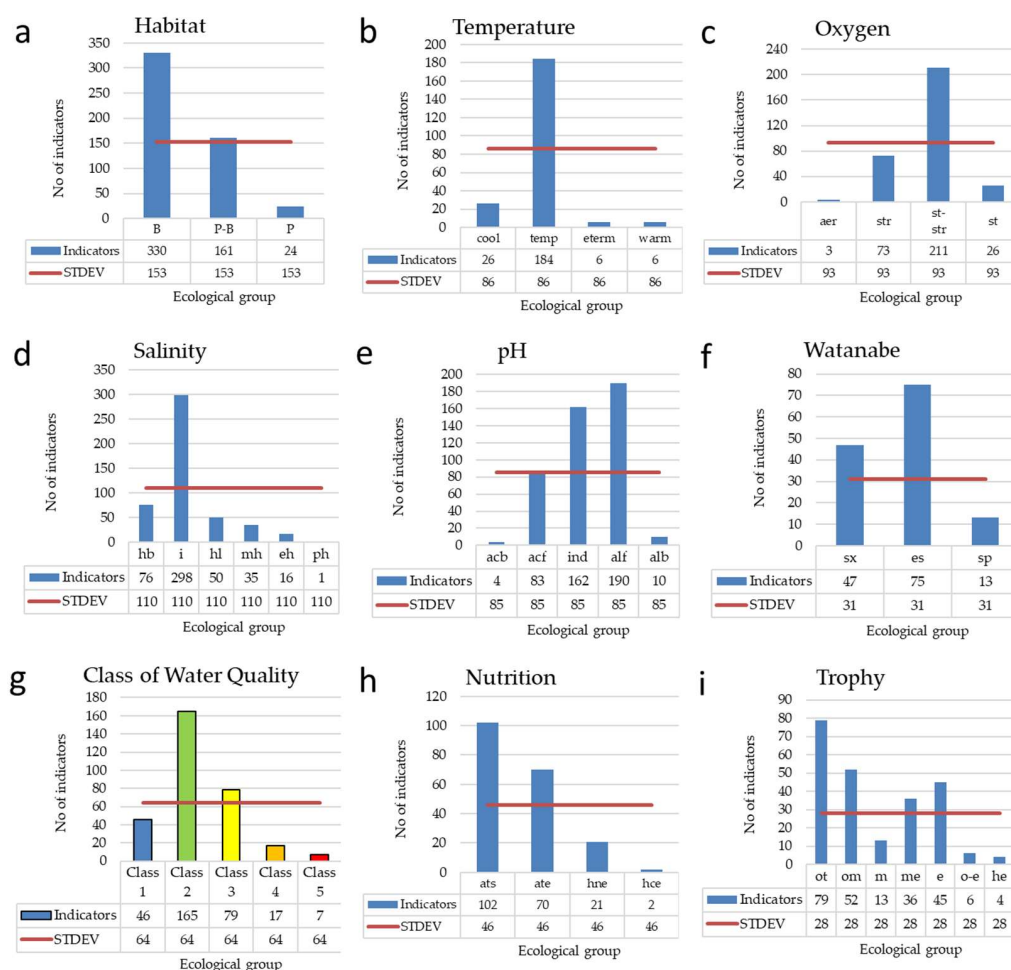
**Table 4.** Distribution of the diatom species richness of the “Tiksi region” lakes over the lake surface.

No of Station	Lake Name	Lake Surface Area, km <sup>2</sup>	Coastline Length, m	No of Species	Sp./Area
1	Lake 1	0.075	1618.42	66	881.601
2	Lake 2	0.038	894.56	62	1635.603
3	Lake 3	0.031	763.29	76	2460.437
4	Lake 4	0.008	359.76	72	8891.117
5	Lake 5	0.067	1188.51	33	493.171
6	Lake 6	0.042	902.78	137	3252.128
7	Lake 7	0.586	5716.74	75	128.074
8	Lake-puddle 8	-	-	69	-
9	Lake 9	0.486	3167.26	59	121.281
10	Lake 10	0.077	1153.85	85	1101.333
11	Lake 11	0.124	1800.36	117	946.742
12	Swampy lake 12	-	-	43	-
13	Lake 13	0.158	1639.88	96	609.365
14	Lake 14	0.023	712.85	50	2175.773

### 3.2. Bioindicators and Ecological Preferences of Diatoms

Ecological preferences of revealed species in “Tiksi region” and “delta region” are presented in Appendix A Table A2. The indicator species number distribution over the ecological categories is shown in Figure 5. Benthic and planktonic-benthic inhabitants prevail (Figure 5a). Temperate temperature species and indicators of middle oxygenated waters strongly prevail (Figure 5b,c). Indicators of low salinity group of indifferents (i) prevail in the studied area on the seacoast (Figure 5d). Indicators of water pH distribution show prevalence of groups of alkaliphiles and neutral waters (Figure 5e). Organic pollution indicators according to Watanabe demonstrated clear waters with sx and es groups, as shown in Figure 5f. Water quality was defined with the relation of the species-specific index saprobity S to 1–5 classes. Figure 5g shows the prevailing of organically unpolluted water indicators of classes 2 and 3. Between nutrition type indicators, the autotrophs (ats and ate) strongly prevail (Figure 5h). Trophic state indicator distribution was irregular, with two peaks in oligotrophic and eutrophic groups (ot and e) that reflected the impact on aquatic ecosystems, which increased the trophicity in some lakes (Figure 5i). The

detailed distribution of species indicators over ecological categories is represented in Appendix A Table A3.

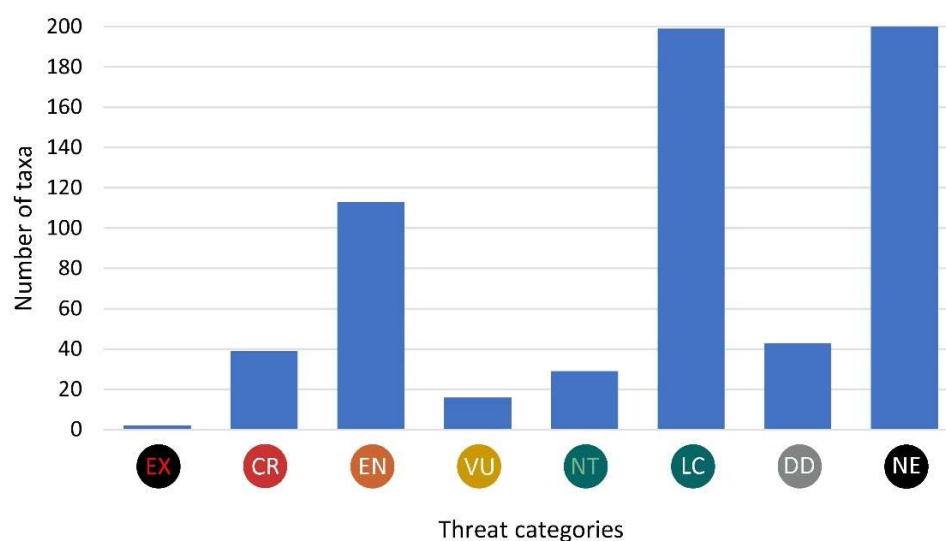


**Figure 5.** Distribution of species indicators of the waterbodies in the entire Lena Delta Nature Reserve and the adjacent areas over ecological groups. The ecological groups order on the axis x follows the increase in the related environmental indicator. (a) Habitat (P—planktonic, P-B—plankto-benthic, B—benthic). (b) Temperature preferences (cool—cool-water, temp—temperate, eterm—eurhythmic, warm—warm-water). (c) Oxygen and streaming (st—standing water, str—streaming water, st-str—low streaming water, aer—aerophiles). (d) Salinity ecological groups according to Hustedt (1938–1939) [62] (hb—oligohalobes-halophobes, i—oligohalobes-indifferent, hl—halophiles; mh—mesohalobes, eh—euhalobes, ph—polyhalobes). (e) pH preferences groups (pH) according to Hustedt (1957) [63] (alb—alkalibiontes; alf—alkaliphiles, ind—indifferent; acf—acidophiles; acb—acidobiontes). (f) Organic pollution indicators according to Watanabe et al. (1986) [64]: sx—saproxenes; es—eurysaprobates; sp—saprophiles. (g) Class 1–5 of organic pollution indicators according to species-specific Index saprobity of Sládeček, 1986 [65]. (h) Nutrition type as nitrogen uptake metabolism (Van Dam et al., 1994) [66]: 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. (i) Trophic state indicators (Van Dam et al., 1994) [66]: (ot—oligotraphentic; om—oligomesotraphentic; m—mesotraphentic; me—mesoeutraphentic; e—eutraphentic; he—hypereutraphentic; o-e—oligo- to eutraphentic (hypereutraphentic)).

### 3.3. Species in Threat Categories

Appendix A Table A1 shows that the number of diatom species in the entire Lena Delta Nature Reserve and the adjacent areas is extremely high, which forces us to analyze the degree of their endemism and rarity, as well as the threat of extinction. Unfortunately, there is no mention of endangered diatom species in the Protected Areas of Russia [6]. Therefore, we used Germany's most developed Red Data Book diatom species resource [53] as a basis for identifying potentially threatened species in the Lena Delta Nature Reserve and the adjacent areas (Table 2).

The distribution of the revealed species over Threat Categories can be seen in Figure 6. Analysis of the revealed species composition of diatoms in relation to the Threatened species categories of the highest three threat levels, 1–3, from Extinct or Lost to Highly Threatened, showed that 42 species classified as such (Table 5) can be found on the Lena Delta Nature Reserve and the adjacent areas.



**Figure 6.** Distribution of the number of diatom species in the flora of water bodies of the Lena Delta Nature Reserve and adjacent territories by IUCN Threat Categories. The order of the IUCN categories on the x-axis corresponds to threat reduction.

Most of these are species of the genus *Psammothidium* (6), and there are three species each from the genera *Brachysira* and *Navicula*. Among the list of species, there are both newly described (*Boreozonacola hustedtii*) taxa without studied ecology and distribution, and widespread species (*Neidium iridis*). We have summarized the known ecological preferences (Appendix A Table A2) of these endangered species in Table 5 and found that they inhabit waters of moderate temperature (temp), well supplied with oxygen (str), having low salinity (ind), neutral, and weakly saturated with organic substances (es, o). These species are characterized by an autotrophic type of nutrition (ats) and living in communities of oligotrophic water bodies (ot). It follows that clean, fresh, pH-neutral, and unpolluted water communities are under threat.



**Table 5.** Ecological preferences of diatom species in IUCN Threat Categories (Red Data List) of the Lena Delta Nature Reserve and adjacent areas.

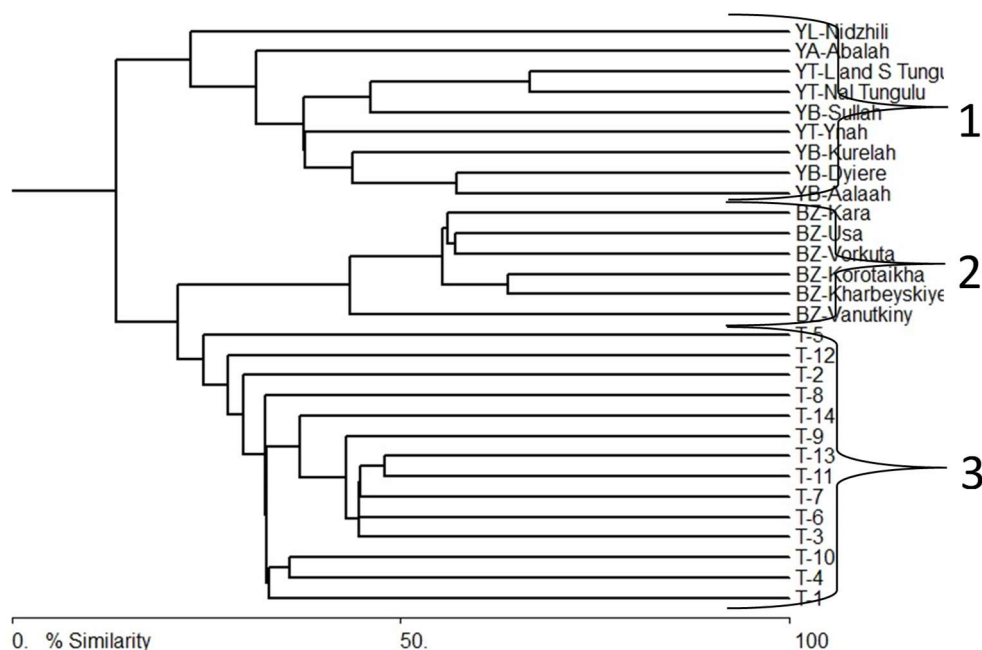
Species in Threat Categories	Hab	T	Oxy	Sal	pH	D	Index S	Sap	Aut-Het	Tro
EXTINCT (Extinct or Lost)										
<i>Cymbopleura designata</i> (Krammer) Bahls	B	temp	st-str	i	alf	-	1.8	o-a	ats	m
<i>Encyonema latens</i> (Krasske) D.G.Mann	B	-	-	-	-	-	1.0	o	ats	ot
CRITICALLY ENDANGERED (Threatened with Extinction)										
<i>Eunotia elegans</i> Østrup	P-B	-	st-str	hb	acf	-	0.2	x	ats	ot
<i>Eunotia faba</i> Ehrenberg	B	temp	st-str	-	alf	-	-	o	ats	ot
<i>Frustulia krammeri</i> Lange-Bertalot & Metzeltin	B	-	-	-	acf	-	-	-	-	e
<i>Navigeia thingvallae</i> (Østrup) Bukhtiyarova	B	-	-	-	-	-	-	-	-	-
<i>Tetracyclus glans</i> (Ehrenberg) F.W.Mills	P-B	temp	-	i	acf	-	1.0	x-o	-	ot
CRITICALLY ENDANGERED (Highly Threatened)										
<i>Boreozonocola hustedtii</i> Lange-Bertalot, Kulikovskiy & Witkowski	-	-	-	-	-	-	-	-	-	-
<i>Brachysira calcicola</i> Lange-Bertalot	B	-	-	-	-	-	1.0	o	-	-
<i>Brachysira procera</i> Lange-Bertalot & Gerd Moser	B	-	-	-	acf	-	-	-	-	-
<i>Brachysira styriaca</i> (Grunow) R.Ross	B	temp	-	i	ind	es	1.0	o	-	ot
<i>Cymbella affinis</i> Kützing	B	temp	st-str	i	alf	sx	1.1	b	ats	e
<i>Cymbella carassius</i> Skvortzov	-	-	-	-	-	-	-	-	-	-
<i>Cymbellafalsa diluviana</i> (Krasske) Lange-Bertalot & Metzeltin	B	-	-	i	alf	-	1.0	o	-	ot
<i>Cymbopleura tynni</i> (Krammer) Krammer	B	-	-	-	-	-	-	-	-	-
<i>Diploneis ovalis</i> (Hilse) Cleve	B	-	st-str	i	alf	-	0.9	x-b	ate	m
<i>Eucocconeis alpestris</i> (Brun) Lange-Bertalot	B	temp	str	hb	ind	-	-	-	-	-
<i>Eucocconeis austriaca</i> (Hustedt) Lange-Bertalot	B	-	-	i	alf	-	0.2	x	ats	ot
<i>Eucocconeis flexella</i> (Kützing) F.Meister	B	temp	str	mh	ind	-	-	-	-	-
<i>Eunotia bigibba</i> Kützing	B	-	str	i	acf	-	0.4	x-o	-	ot
<i>Eunotia flexuosa</i> (Brébisson ex Kützing) Kützing	B	temp	st-str	i	acf	-	0.4	x-o	-	-
<i>Eunotia praerupta</i> Ehrenberg	P-B	cool	st-str	hb	acf	-	0.3	x	-	-
<i>Eunotia triodon</i> Ehrenberg	B	temp	-	hb	acf	-	1.0	o	-	ot
<i>Gomphonema helveticum</i> Brun	B	-	-	i	ind	-	-	-	-	-
<i>Gomphonema lagerheimii</i> A.Cleve	B	-	str	hb	acf	-	-	-	-	m
<i>Gomphonema ventricosum</i> W.Gregory	B	cool	str	i	ind	-	1.0	o	-	-
<i>Iconella curvula</i> (W.Smith) Ruck & Nakov	B	-	str	hb	acf	-	2.0	b	-	me
<i>Kobayasiella subtilissima</i> (Cleve) Lange-Bertalot	B	temp	st-str	i	acb	-	1.6	b-o	ats	me
<i>Mayamaea disjuncta</i> (Hustedt) J.Y. Li & Y.Z.Qi	B	-	str	i	ind	sp	3.0	a	ate	he
<i>Navicula angusta</i> Grunow	B	-	st-str	i	ind	-	1.0	o	-	-
<i>Navicula gottlandica</i> Grunow	P-B	-	-	hl	alf	es	2.5	b-a	ate	e
<i>Navicula mediocostata</i> E.Reichardt	B	-	-	oh	alf	es	3.0	a	ate	e
<i>Navicula notha</i> J.H.Wallace	B	-	str	i	acf	-	-	-	-	-
<i>Neidium iridis</i> (Ehrenberg) Cleve var. <i>iridis</i>	B	temp	st-str	hb	ind	-	-	-	-	-
<i>Nitzschia frigida</i> Grunow	-	-	-	-	-	-	-	-	-	-
<i>Placoneis opportuna</i> (Hustedt) Chudaev & Golobova	B	-	-	-	-	es	-	-	-	-
<i>Psammothidium kryophilum</i> (J.B.Petersen) E.Reichardt	P-B	-	str	i	ind	sx	0.5	x-o	ats	ot
<i>Psammothidium levanderi</i> (Hustedt) Bukhtiyarova & Round	B	temp	str	i	ind	sx	2.0	b	ats	om
<i>Psammothidium rechtense</i> (Leclercq) Lange-Bertalot	B	-	str	hb	alf	-	1.0	o	ats	ot
<i>Psammothidium rossii</i> (Hustedt) Bukhtiyarova & Round	B	-	str	hb	ind	-	1.0	o	ats	ot
<i>Psammothidium scoticum</i> (R.J.Flower & V.J.Jones) Bukhtiyarova & Round	B	temp	-	-	-	-	-	-	-	-
<i>Psammothidium ventrale</i> (Krasske) Bukhtiyarova & Round	B	-	str	hb	acf	-	2.0	b	ats	om

Note: “-”, not found. Abbreviations: Habitat (Hab) (P-B—plankto-benthic, B—benthic); temperature (T) preferences (cool—cool-water, temp—temperate, etem—eurythermic, warm—warm-water); oxygenation and streaming (Oxy) (str—streaming water, st-str—low streaming water); pH preferences groups (pH) according to Hustedt (1957) [63] (alb—alkalibiontes; alf—alkaliphiles, ind—indifferent; acf—acidophiles; salinity ecological groups (Sal) according to Hustedt (1938–1939) [62] (hb—oligothalobes-halophobes, i—oligothalobes-indifferent, hl—halophiles; mh—mesohalobes, oh—oligothalobes of wide spectrum with optimum as indifferent); Index S, species-specific index saprobity according to Sládeček, 1986 [65]; self-purification zone with index of saprobity (Sap) (x/0.0—xenosaprobe; x-o/0.4—xeno-oligosaprobe; x-b/0.8—xeno-betamesosaprobe; o/1.0—oligosaprobe; b-o/1.6—beta-oligosaprobe; o-a/1.8—oligo-alphamesosaprobe; b/2.0—betamesosaprobe; a/3.0—alphamesosaprobe; organic pollution indicators according to Watanabe et al. (1986) [64] (D): sx—saproxenes; es—eurysaprobates; sp—saprophytes; nitrogen uptake metabolism (Aut-Het) (Van Dam et al., 1994) [66]: ats—nitrogen-autotrophic taxa, tolerating very small concentrations of organically bound nitrogen; ate—nitrogen-autotrophic taxa, tolerating elevated concentrations of organically bound nitrogen; Trophic state indicators (Tro) (Van Dam et al., 1994) [66]: (ot—oligotraphentic; om—oligomesotraphentic; m—mesotraphentic; me—mesoeutraphentic; e—eutraphentic; he—hypereutraphentic).

### 3.4. Comparative Floristic

We can see the sufficient role of climatic, morphometric, and other environmental variables in the high latitude lakes community composition because of this calculation. Therefore, we decided to compare diatom community composition in morphometrically similar lakes which were located at the north of Eurasia. Altogether 40 lakes, including 14

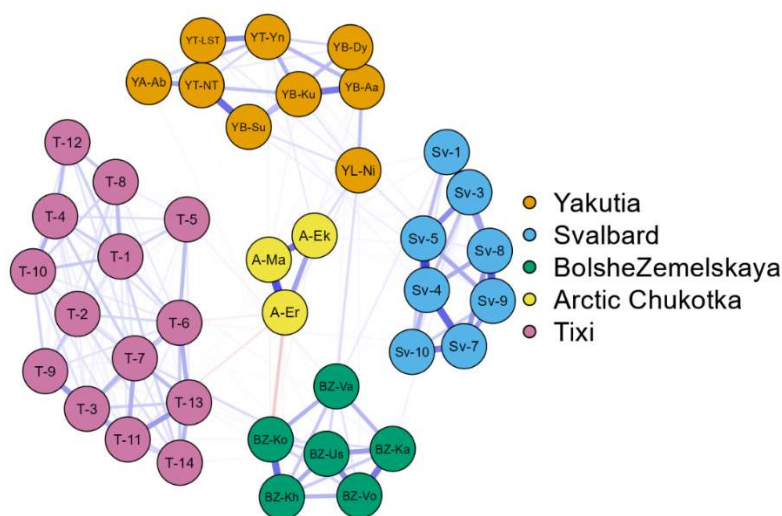
Tiksi lakes, were taken for similarity of diatom community calculation: 9 Yakutia lakes (Y) Aalaah, Kurelah, Sullah, Dyiere, Ynah, Nal Tungulu, Large and Small Tungulu, Abalah, Nidzhili [10]; Bolshezemelskaya Tundra lakes (BZ) Vanutkiny, Kharbeyskiye, Korotaikha, Vorkuta, Usa, Kara [2]; Tiksi (T), species from the “Tiksi region” 14 lakes [18] (Appendix A Table A1). The Bray–Curtis calculation of the diatom species composition similarity of the lakes above the Arctic circle latitude of Russia shows strong separation of each group of the lakes. Figure 7 demonstrates three clusters that were marked for North Yakutia (1), Bolshezemelskaya Tundra (2), and 14 Tiksi lakes from current research (3).



**Figure 7.** Bray–Curtis cluster analysis of diatom list similarity of the Arctic lakes over the Arctic circle in Eurasia. Cluster 1: Nine Yakutia lakes (Y): Aalaah, Kurelah, Sullah, Dyiere, Ynah, Nal Tungulu, L. and S. Tungulu, Abalah, Nidzhili [10]. Cluster 2: Bolshezemelskaya Tundra lakes (BZ) Vanutkiny, Kharbeyskiye, Korotaikha, Vorkuta, Usa, Kara [2]. Cluster 3: Tiksi (T), species from 14 lakes [18] (Appendix A Table A1).

We have expanded the list of diatom floras for the next step of comparison, which included Arctic Chukotka from Amguema basin lakes Ervynaygytgyn, Matachingagytygyn, Ekitiki [7,8], Bolshezemelskaya Tundra lakes Vanutkiny, Kharbeyskiye, Korotaikha, Vorkuta, Usa, Kara [2], Svalbard, ten Hornsund fiord lakes [5], and nine Yakutia lakes Aalaah, Kurelah, Sullah, Dyiere, Ynah, Nal Tungulu, Large and Small Tungulu, Abalah, and Nidzhili [10].

Comparison with the JASP program [58] represented results of similarity calculation, as shown in Figure 8. It can be seen that the species composition of each group of the lakes is strongly separated from each other. This high individuality of species composition can be the result of the influence of the geographical position of the lakes group and its climatic features.



**Figure 8.** JASP network plot of diatom species composition similarity for the small Arctic lakes,  $p < 0.5$ . Tiksi (T), species from the Tiksi region 14 lakes [18]. Arctic Chukotka, species from Anguema basin lakes: Ervynaygytgyn, Matachingagytgyn, Ekitiki [7,8]. Bolshezemelskaya Tundra lakes (BZ) Vanutkiny, Kharbeyskiye, Korotaikha, Vorkuta, Usa, Kara [2]. Svalbard (Sv), Hornsund fiord, eight lakes [5]. Yakutia (Y), nine lakes: Aalaah, Kurelah, Sullah, Dyiere, Ynah, Nal Tungulu, Large and Small Tungulu, Abalah, Nidzhili [10].

#### 4. Discussion

The subject of our study was the flora of diatoms found in the lakes of the “Tiksi region” in the vicinity of Tiksi settlement and the delta on the territory of the “delta region” of the Lena Delta Nature Reserve. The general list was compiled from our studies of the “delta region” [19] including 413 taxa, and 385 taxa of the “Tiksi region” [18], and amounted to 666 taxa of diatoms (including definitions to the genus level), 278 of which were enriched the regional flora. The floristic analysis was carried out after constructing the Willis curve, which was found to be quite smooth and close to the trend line, thereby indicating that the list of diatoms is sufficiently complete for an adequate flora of the analysis. The Willis curve was not so smooth to allow us to assume that the list of species has yet been exhausted, and the list will be increased with further research. The index of intraspecific variability  $Ssp./Sp.$  for the lakes of the “delta region” was 1.11, and for the lakes of the “Tiksi region” it was 1.14, which is typical for high-latitude and high-mountain communities.

We calculated the  $Sp./Area$  index as the number of diatom species per whole studied area, which was 0.05 for the “delta region” but 2.14 for the “Tiksi region”, thereby showing differences between biodiversity of both studied areas and confirming that the coastal zone can be the hotspot of the Arctic diatoms, as was revealed for Arctic chrysophytes [67]. Our reasoning boils down to the fact that in the lakes of Northern Europe, as well as in some subarctic and temperate lakes of northwestern Russia and the Baltic states, the species lists of diatoms were proportional to the area of the lakes [68]. In the lakes of the Tiksi region and some lakes of the delta region studied here, the area of lakes does not correlate with species richness. Even though all compared lakes are shallow and have been studied many times in the delta region, and samples were taken once in the Tiksi region, the diversity in the lakes of the Tiksi region was found to be significantly higher. We attempted to remove a possible reason for the high diversity in Tiksi lakes surveyed by SEM and carried out the same study of diatoms in some lakes of the delta, but here the species composition did not increase. Thus, we concluded that the burst of diversity of diatoms in lakes of the same type morphometrically but located in the coastal zone of the lakes of the Tiksi region is associated with the Arctic coastal ecotone. Thus, the geographic factor was found to be significant for the formation of diatom communities in the Arctic floras. In addition to this, the association with individual river runoff basins on the coast, elevated habitats,

and the influence of such climatic factors such as summer northeast winds on the species composition was previously revealed [18].

The Arctic deltas are responsible for nutrient transport to the sea, which varies by delta and season, and it is estimated that the Lena Delta retains about 15% of the input load, the largest in the Arctic Ocean [69]. At the same time, the deposition of nitrates by the tundra landscape in the spring and their subsequent accumulation in lakes and wetlands adjacent to river channels contributes to the enrichment of lake water with a nutrient base [69]. This makes the water of the Lena River a source of nutrients [17,70] on the one hand, but on the other hand, stimulates the diversity of algae, as has been shown in the lakes of the Tiksi coastal region [18]. Despite this, the current diatom flora shows clean, organically uncontaminated waters, although there is a diversity burst response to a one-time nutrient point impact in the Tiksi area.

Whole flora bioindicators analysis shows that the diatoms identified in the “delta region” and the coastal “Tiksi region” were mainly benthic autotrophs, preferring temperate, middle oxygenated, low-saline, low-alkalic clear class 2 water, and characterize two trophic types of waterbodies—oligotrophic and eutrophic.

The high individuality of diatom communities was revealed both for the entire Lena Delta and its adjacent areas, and in a comparative analysis with the lacustrine floras of Yakutia and the High Arctic of Eurasia. For the first time for the Arctic regions of Eurasia, a preliminary analysis of the threat of diatom species was carried out and 42 species of the IUCN categories were identified. These rare or threatened species prefer moderate temperatures, and slightly acidic or neutral environments free from organic pollution. Thus, the lake communities in clean, fresh, pH-neutral, and unpolluted waters in the coastal zone of the Arctic Ocean with the highest diversity are the most vulnerable.

As a result of comparing the properties of the natural environment of the “delta region” and the coastal zone of the “Tiksi region”, our hypothesis that one indicator of global climate change may be the introduction of diatom species from temperate latitudes to the Arctic was confirmed. The species richness in the Tiksi coastal lakes was higher than that in the delta lakes even though the lakes in the delta were sampled many times over several years, and 14 lakes in the “Tiksi region” were surveyed only once. This allows us to suggest that the high diversity inherent in the diatom lakes of the Tiksi coastal zone, which can even be enriched in further studies, can be considered as a property of coastal biota inherent in ecotones. Since it is in the coastal region of Tiksi that a surge in the number of species is observed, this region can be considered not only an ecotone, but also a hotspot of diatom diversity. Ecotones are border areas of different landscapes where there is a marked increase in the diversity of organisms [71]. Until now, the landscapes of the coast of the Arctic Ocean have not been considered as ecotones for diatom communities. However, for the diversity of algae, this term was used, for example, for communities of river habitats [72]. The diversity of diatoms in the coastal area of the “Tiksi region” may be due to several factors. As known, studies of diatoms in a scanning electron microscope give a higher percentage of certain species [73].

We have formed a hypothesis about the introduction of species from temperate latitudes into Arctic waters under the conditions of global climate change [20]. The revealed record level of species diversity of diatoms and related changes in the structure of diatom communities can be fingerprint evidence of the beginning of climate warming. On the other hand, there is an opinion that the similarity between the algal communities of the northern and temperate regions may be more apparent than real [74]. This is confirmed by the sharp predominance of species of the genera *Pinnularia* and *Eunotia*, not only in our studied lakes, but also in a comparative analysis with other Arctic floras. Moreover, the further north the flora, the more saturated with species are these two genera. This may be one of the decisive signs for assessing the impact of climate change on the aquatic communities of the Arctic. Our conclusions are in the frame of the Ruth Patrick theory [75] about the relationship between diatom biodiversity and the health of the environment that can be seen in increasing the species diversity in the tundra coastal area of Arctic. So, this

type of Arctic wetlands can have high importance because of their high water cleaning capacity by absorbing and assimilating a variety of pollutants.

Therefore, we revealed the important role of climatic and other environmental variables related with geographical position of the waterbody in forming the diatom community composition in the high latitude lakes. We suggest that the results of this study can be used to create a database on the biodiversity of diatoms as indicators of changes in untouched areas, as well as pioneers in monitoring climate change in the Arctic. Their relevance for assessing the consequences of local anthropogenic impact is high.

**Author Contributions:** Conceptualization, S.B. and V.G.; methodology, S.B. and V.G.; software, S.B.; validation, S.B., V.G. and S.G.; formal analysis, V.G. and S.G.; investigation, V.G.; resources, V.G.; data curation, S.G. and V.G.; writing—original draft preparation, S.B. and V.G.; writing—review and editing, S.B., V.G. and S.G.; visualization, S.B.; supervision, V.G.; project administration, V.G.; funding acquisition, V.G. All authors have read and agreed to the published version of the manuscript.

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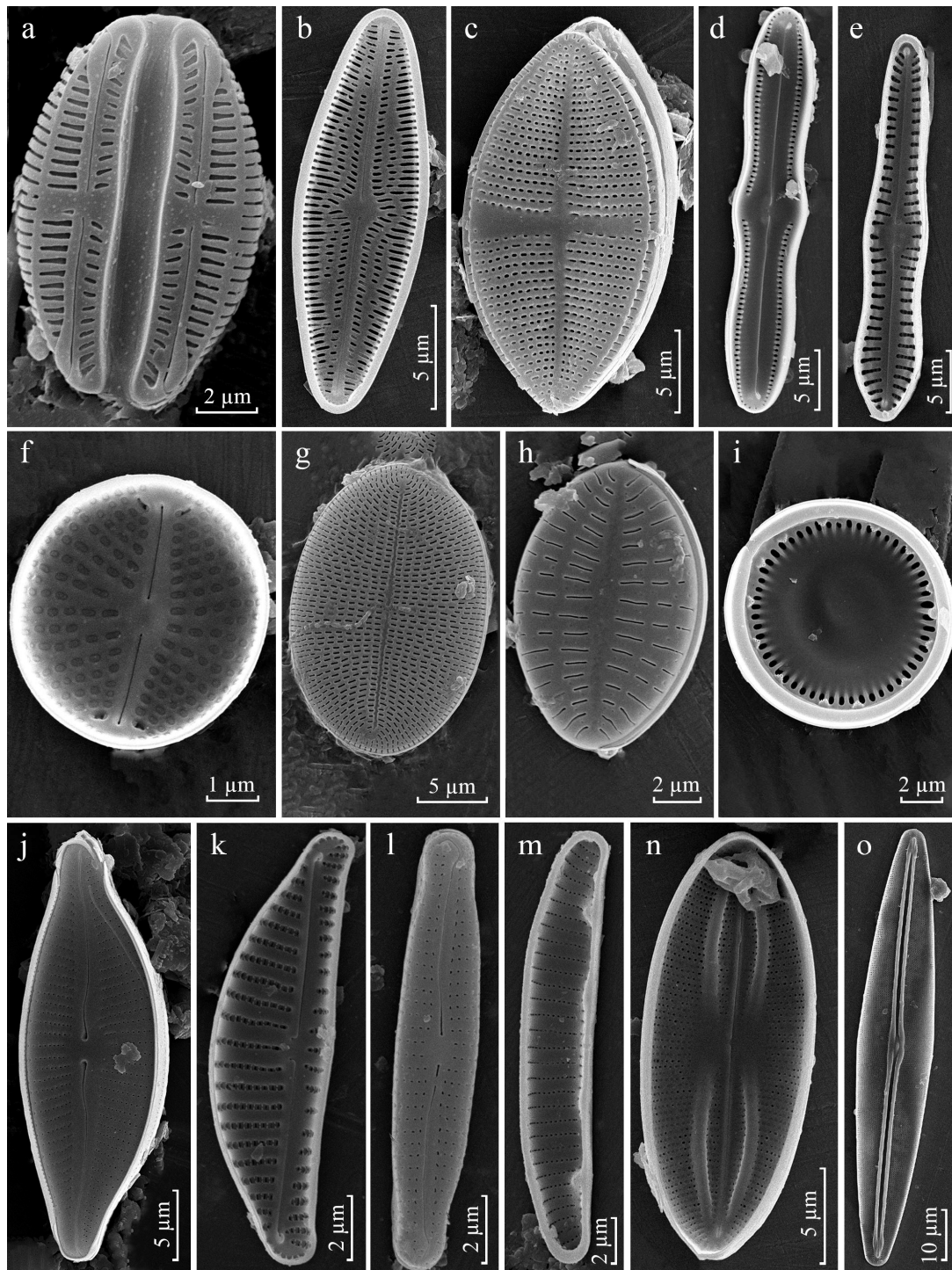
**Data Availability Statement:** Not applicable.

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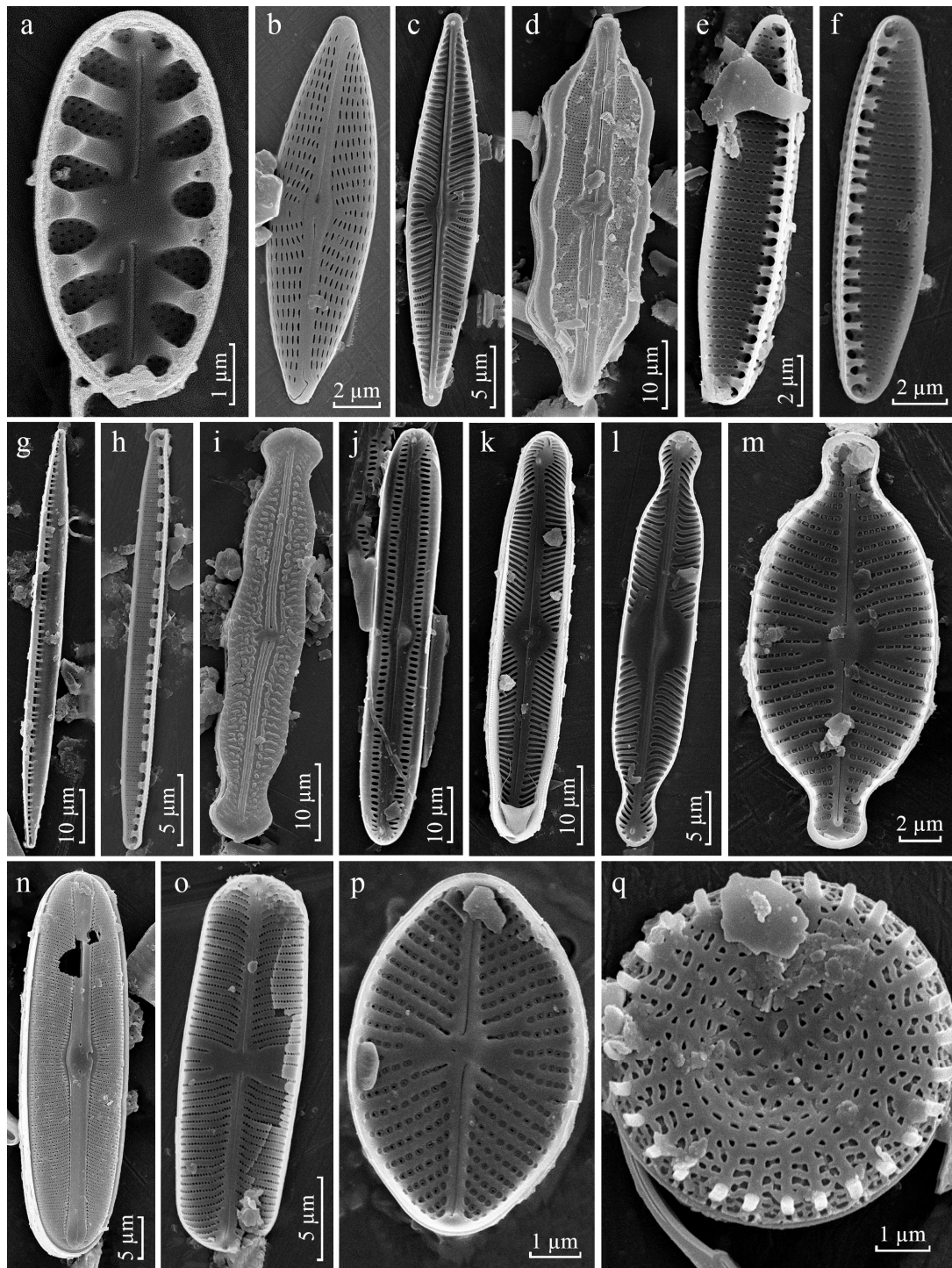
**Conflicts of Interest:** The authors declare no conflict of interest.



## Appendix A



**Figure A1.** Electron micrographs of diatoms of studied waterbodies: (a)—*Amphora indistincta*, (b)—*Brachysira brebissonii*, (c)—*Gololobovia obliqua*, (d)—*Caloneis holarctica*, (e)—*Gomphonema angusticephalum*, (f)—*Cavinula pseudoscutiformis*, (g)—*Cocconeis placentula* var. *euglypta*, (h)—*C. neodiminuta*, (i)—*Cyclotella distinguenda*, (j)—*Cymbopleura designata*, (k)—*Encyonema minutum*, (l)—*Encyonopsis perborealis*, (m)—*Eunotia incisa*, (n)—*Fallacia pygmaea*, (o)—*Frustulia krammeri*.



**Figure A2.** Electron micrographs of diatoms of studied waterbodies: (a)—*Hygropetra balfouriana*, (b)—*Navicula cryptocephala*, (c)—*N. radiosa*, (d)—*Neidium hitchcockii*, (e)—*Nitzschia alpina*, (f)—*N. inconspicua*, (g)—*N. media*, (h)—*N. perminuta*, (i)—*Pinnularia canadensis*, (j)—*P. notabilis*, (k)—*P. rhombarea*, (l)—*P. subanglica*, (m)—*Placoneis interglacialis*, (n)—*Sellaphora insolita*, (o)—*S. laevissima*, (p)—*Sellaphora oestrupii*, (q)—*Stephanodiscus hashiensis*.



Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Amphora pediculus</i> (Kützing) Grunow	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Amphora pseudosibirica</i> Levkov & Pavlov	0	NE	-	-	1	-	-	-	-	-	-	-	1	-	1	1	-
<i>Amphora</i> sp.	9	LC	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Amphorotia clevei</i> (Grunow) D.M.Williams & G.Reid	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Aneumastus apiculatus</i> (Østrup) Lange-Bertalot	8	DD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Aneumastus tusculus</i> (Ehrenberg) D.G.Mann & A.J.Stickle	0	NE	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Asterionella formosa</i> Hassall	9	LC	-	-	-	-	-	1	1	-	-	-	1	-	-	-	1
<i>Aulacoseira alpigena</i> (Grunow) Krammer	5	EN	1	-	1	1	-	1	1	1	-	1	1	1	1	1	1
<i>Aulacoseira ambigua</i> (Grunow) Simonsen	9	LC	-	-	-	1	-	1	-	-	1	-	-	-	1	-	1
<i>Aulacoseira distans</i> (Ehrenberg) Simonsen	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Aulacoseira granulata</i> (Ehrenberg) Simonsen f. <i>granulata</i>	9	LC	-	-	-	1	1	1	-	-	-	1	-	-	1	-	1
<i>Aulacoseira granulata</i> f. <i>curvata</i> (Hustedt) Simonsen	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Aulacoseira islandica</i> (O.Müller) Simonsen	9	LC	-	-	-	-	1	1	-	-	-	-	-	-	-	-	1
<i>Aulacoseira italica</i> (Ehrenberg) Simonsen var. <i>italica</i>	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Aulacoseira italica</i> var. <i>curvata</i> (Pantocsek) L.Yang & Q.X.Wang	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Aulacoseira italica</i> var. <i>tenuissima</i> (Grunow) Simonsen	8	DD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Aulacoseira lirata</i> (Ehrenberg) R.Ross	5	EN	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
<i>Aulacoseira perglabra</i> (Østrup) E.Y.Haworth	6	VU	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Aulacoseira pfaffiana</i> (Reinsch) Krammer	5	EN	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-

Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Aulacoseira pusilla</i> (F.Meister) A.Tuji & A.Houki	9	LC	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Aulacoseira scalaris</i> (Grunow) Houk, Klee & Passauer	0	NE	1	1	-	1	-	1	-	1	-	1	-	-	-	-	-
<i>Aulacoseira subarctica</i> (O.Müller) E.Y.Haworth	9	LC	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
<i>Aulacoseira valida</i> (Grunow) Krammer	5	EN	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
<i>Boreozonacola hustedtii</i> Lange-Bertalot, Kulikovskiy & Witkowski	3	CR	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-
<i>Brachysira brebissonii</i> R.Ross	4	EN	1	1	-	1	-	1	-	1	1	1	-	1	-	-	-
<i>Brachysira calcicola</i> Lange-Bertalot	3	CR	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Brachysira neoexilis</i> Lange-Bertalot	9	LC	1	-	-	-	-	-	-	1	1	1	-	1	-	-	-
<i>Brachysira procera</i> Lange-Bertalot & Gerd Moser	3	CR	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-
<i>Brachysira styriaca</i> (Grunow) R.Ross	3	CR	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Caloneis arctica</i> (Krasske) Lange-Bertalot & S.I.Genkal	0	NE	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-
<i>Caloneis bacillum</i> (Grunow) Cleve	8	DD	-	-	1	-	-	1	1	-	1	1	-	-	1	-	-
<i>Caloneis holarctica</i> Kulikovskiy, Lange-Bertalot & A.Witkowski	0	NE	1	1	1	-	-	1	1	1	-	-	1	1	-	-	-
<i>Caloneis silicula</i> (Ehrenberg) Cleve var. <i>Silicula</i>	9	LC	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
<i>Caloneis silicula</i> var. <i>elliptica</i> Mayer	0	NE	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Caloneis undosa</i> Krammer	4	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Caloneis ventricosa</i> F.Meister var. <i>truncatula</i> (Grunow) Meister	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Caloneis westii</i> (W.Smith) Hendey	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Campylodiscus hibernicus</i> Ehrenberg	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Cavinula cocconeiformis</i> (W.Gregory ex Greville) D.G.Mann & A.J.Stickle	5	EN	1	-	-	-	1	1	1	1	1	1	1	-	1	-	-
<i>Cavinula jaernefeltii</i> (Hustedt) D.G.Mann & A.J.Stickle	4	EN	1	-	1	-	-	1	-	-	1	-	1	-	1	1	-







Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Cymbella carassius</i> Skvortzov	3	CR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbella cleve-eulerae</i> Krammer	0	NE	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-
<i>Cymbella cymbiformis</i> C.Agardh	4	EN	-	-	-	-	1	-	-	1	-	-	-	-	-	-	1
<i>Cymbella hantzschiana</i> Krammer	8	DD	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Cymbella helvetica</i> Kützing	4	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbella krammeri</i> Bahls	0	NE	-	1	1	-	-	1	1	-	1	-	-	-	1	1	-
<i>Cymbella lanceolata</i> C.Agardh	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbella neocistula</i> Krammer	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbella neogena</i> (Grunow) Krammer	0	NE	-	1	-	-	-	1	1	-	-	-	-	-	1	-	-
<i>Cymbella proxima</i> Reimer	5	EN	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
<i>Cymbella stuxbergii</i> (Cleve) Cleve	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbella subcistula</i> Krammer	8	DD	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Cymbella tartuensis</i> Molder	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbella tumida</i> (Brébisson) Van Heurck	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbella</i> sp.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
<i>Cymbellafalsa diluviana</i> (Krasske) Lange-Bertalot & Metzeltin	3	CR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbopleura amphicephala</i> (Nägeli ex Kützing) Krammer	5	EN	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1
<i>Cymbopleura anglica</i> (Lagerstedt) Krammer	5	EN	-	-	1	-	-	1	1	1	-	1	1	-	1	-	-
<i>Cymbopleura angustata</i> var. <i>spitsbergensis</i> Krammer	0	NE	-	1	1	-	-	1	-	1	1	-	-	-	1	-	-
<i>Cymbopleura cuspidata</i> (Kützing) Krammer	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbopleura designata</i> (Krammer) Bahls	1	EX	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura elliptica</i> Krammer	5	EN	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-
<i>Cymbopleura hybrida</i> (Grunow ex Cleve) Krammer	5	EN	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-
<i>Cymbopleura incertiformis</i> Krammer	5	EN	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Cymbopleura naviculiformis</i> (Auerswald ex Heiberg) Krammer	9	LC	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1

Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Cymbopleura neoheteropleura</i> Krammer	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbopleura oblongata</i> var. <i>stenoraphe</i> Krammer	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Cymbopleura stauroneiformis</i> (Lagerstedt) Krammer	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cymbopleura subanglica</i> Krammer	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Cymbopleura subapiculata</i> Krammer	0	NE	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Cymbopleura subcuspidata</i> (Krammer) Krammer	5	EN	-	-	1	-	-	1	1	-	-	-	1	-	1	-	1
<i>Cymbopleura truncata</i> Krammer	0	NE	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura tymnii</i> (Krammer) Krammer	3	CR	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
<i>Cymbopleura</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Denticula elegans</i> Kützing	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Denticula tenuis</i> Kützing	9	LC	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Diatoma moniliformis</i> (Kützing) D.M.Williams	9	LC	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Diatoma moniliformis</i> subsp. <i>ovalis</i> (F.Fricke) Lange-Bertalot, Rumrich & G.Hofmann	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diatoma problematica</i> Lange-Bertalot	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diatoma tenuis</i> C.Agardh	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diatoma vulgare</i> Bory	9	LC	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
<i>Diatomella balfouriana</i> Greville	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Didymosphenia geminata</i> (Lyngbye) Mart.Schmidt	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Didymosphenia siberica</i> (Grunow) Mart.Schmidt	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diploneis boldtiana</i> Cleve	0	NE	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-

Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Diploneis didymus</i> (Ehrenberg)	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diploneis elliptica</i> (Kützing) Cleve	7	NT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diploneis interrupta</i> (Kützing) Cleve	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diploneis modica</i> Hustedt	8	DD	-	-	-	-	-	1	-	-	-	-	1	-	1	1	-
<i>Diploneis oblongella</i> (Nägeli ex Kützing) A.Cleve	8	DD	1	-	1	-	-	1	-	-	-	-	1	-	1	1	-
<i>Diploneis oculata</i> (Brébisson) Cleve	9	LC	-	-	1	-	-	1	-	-	1	1	1	-	1	-	1
<i>Diploneis ovalis</i> (Hilse) Cleve	3	CR	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
<i>Diploneis parma</i> Cleve	6	VU	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diploneis smithii</i> (Brébisson) Cleve var. <i>smithii</i>	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diploneis smithii</i> var. <i>pumila</i> (Grunow) Hustedt	8	DD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Diploneis subovalis</i> Cleve	0	NE	-	1	-	-	-	-	-	-	-	-	1	-	1	-	-
<i>Diploneis</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Discostella pseudostelligera</i> (Hustedt) Houk & Klee	9	LC	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1
<i>Discostella stelligera</i> (Cleve & Grunow) Houk & Klee	9	LC	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
<i>Encyonema auerswaldii</i> Rabenhorst	8	DD	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
<i>Encyonema elginense</i> (Krammer) D.G.Mann	0	NE	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
<i>Encyonema fogedii</i> Krammer	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Encyonema gaumannii</i> (F.Meister) Krammer	4	EN	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Encyonema groenlandica</i> (Foged) Kulikovskiy & Lange-Bertalot	0	NE	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
<i>Encyonema lacustre</i> (C.Agardh) Pantocsek	7	NT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Encyonema lange-bertalotii</i> Krammer	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Encyonema latens</i> (Krasske) D.G.Mann	1	EX	-	-	1	1	-	1	1	-	-	1	-	-	-	-	1
<i>Encyonema lunatum</i> (W.Smith) Van Heurck	8	DD	-	1	-	-	-	-	-	-	1	1	1	1	-	-	-
<i>Encyonema minutum</i> (Hilse) D.G.Mann var. <i>minutum</i>	9	LC	1	1	1	-	1	1	1	1	-	-	-	1	-	-	1







Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Eunotia curtagrunowii</i> Nörpel-Schempp & Lange-Bertalot	5	EN	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1
<i>Eunotia elegans</i> Østrup	2	CR	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia eurycephala</i> (Grunow) Nörpel-Schempp & Lange-Bertalot	6	VU	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia ewa</i> Lange-Bertalot & Witkowski	0	NE	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia exigua</i> (Brébisson ex Kützing) Rabenhorst	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Eunotia faba</i> Ehrenberg	2	CR	1	-	-	-	-	1	1	1	-	-	-	-	1	-	-
<i>Eunotia flexuosa</i> (Brébisson ex Kützing) Kützing	3	CR	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Eunotia formica</i> Ehrenberg	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Eunotia fureyae</i> Lange-Bertalot	0	NE	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
<i>Eunotia genuflexa</i> Nörpel-Schempp	8	DD	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
<i>Eunotia groenlandica</i> Nörpel-Schempp & Lange-Bertalot	5	EN	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
<i>Eunotia incisa</i> W.Smith ex W.Gregory	5	EN	-	-	-	1	-	-	1	1	-	1	-	-	-	-	-
<i>Eunotia islandica</i> Østrup	8	DD	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia julma</i> Lange-Bertalot	0	NE	1	-	-	-	-	-	-	-	-	1	1	-	-	-	-
<i>Eunotia major</i> (W.Smith) Rabenhorst	0	NE	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Eunotia meisteri</i> Hustedt	4	EN	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Eunotia minor</i> (Kützing) Grunow	7	NT	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia monnieri</i> Lange-Bertalot & Tagliaventi	5	EN	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
<i>Eunotia monodon</i> Ehrenberg	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Eunotia mucophila</i> (Lange-Bertalot, Nörpel-Schempp & Alles) Lange-Bertalot	5	EN	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-
<i>Eunotia naegelii</i> Migula	4	EN	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1



Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Fragilaria goulardii</i> var. <i>telezkoensis</i> (Poretzky) Kharitonov	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Fragilaria radians</i> (Kützing) D.M.Williams & Round	9	LC	-	-	1	-	-	1	-	-	-	1	1	-	1	-	1
<i>Fragilaria rumpens</i> (Kützing) G.W.F.Carlson	9	LC	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
<i>Fragilaria saxoplanctonica</i> Lange-Bertalot & S.Ulrich	9	LC	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Fragilaria striatula</i> Lyngbye	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Fragilaria vaucheriae</i> (Kützing) J.B.Petersen	9	LC	-	-	1	1	1	1	1	-	-	1	1	-	-	-	1
<i>Fragilaria</i> sp.	-	-	-	-	1	-	-	-	-	-	1	-	1	-	-	-	-
<i>Fragilariforma bicapitata</i> (A.Mayer) D.M.Williams & Round	5	EN	-	-	-	1	-	1	-	-	-	-	-	-	-	-	1
<i>Fragilariforma constricta</i> (Ehrenberg) D.M.Williams & Round	4	EN	-	-	1	-	-	-	-	-	1	1	1	-	1	-	-
<i>Fragilariforma mesolepta</i> (Rabenhorst) Kharitonov	9	LC	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Fragilariforma nitzschioides</i> (Grunow) Lange-Bertalot	4	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Fragilariforma virescens</i> (Ralfs) D.M.Williams & Round	9	LC	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
<i>Fragilariopsis oceanica</i> (Cleve) Hasle	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Frustulia crassinervia</i> (Brébisson ex W.Smith) Lange-Bertalot & Krammer	7	NT	1	-	-	1	-	1	1	1	1	-	-	1	-	-	-
<i>Frustulia erifuga</i> Lange-Bertalot & Krammer	4	EN	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
<i>Frustulia krammeri</i> Lange-Bertalot & Metzeltin	2	CR	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-
<i>Frustulia saxonica</i> Rabenhorst	7	NT	1	-	-	1	-	1	-	-	-	1	-	1	-	1	-
<i>Frustulia vulgaris</i> (Thwaites) De Toni	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Geissleria davydovae</i> Genkal et Yaruschina	0	NE	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-



















Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Neidium productum</i> (W.Smith) Cleve	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Neidium</i> sp.	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-
<i>Nitzschia acicularis</i> (Kützing) W.Smith	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
<i>Nitzschia acidoclinata</i> Lange-Bertalot	7	NT	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
<i>Nitzschia acuta</i> Hantzsch	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Nitzschia alpina</i> Hustedt	4	EN	-	1	1	-	-	-	-	-	-	1	-	-	-	-	-
<i>Nitzschia aquaea</i> Wislouch & V.S.Poretzky	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Nitzschia brevissima</i> Grunow	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Nitzschia capitellata</i> Hustedt var. <i>capitellata</i>	9	LC	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
<i>Nitzschia capitellata</i> var. <i>tenuirostris</i> (Grunow) Bukhtiyarova	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Nitzschia commutatooides</i> Lange-Bertalot	9	LC	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
<i>Nitzschia denticula</i> Grunow	7	NT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Nitzschia dissipata</i> (Kützing) Rabenhorst var. <i>dissipata</i>	9	LC	-	-	-	-	-	1	1	-	-	-	1	-	1	1	-
<i>Nitzschia flexoides</i> Geitler	8	DD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Nitzschia fonticola</i> (Grunow) Grunow	9	LC	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-
<i>Nitzschia frigida</i> Grunow	3	CR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Nitzschia frustulum</i> (Kützing) Grunow	9	LC	-	-	-	-	-	1	1	-	-	1	1	-	-	-	-
<i>Nitzschia graciliformis</i> Lange-Bertalot & Simonsen	9	LC	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
<i>Nitzschia gracilis</i> Hantzsch	9	LC	-	-	-	-	-	-	1	-	-	-	-	1	-	-	1



Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Odontidium mesodon</i> (Ehrenberg) Kützing	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Opephora mutabilis</i> Sabbe & Wyverman	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pantocsekiella costei</i> (J.C.Druart & F.Straub) K.T.Kiss & E.Ács	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Pantocsekiella kuetzingiana</i> (Thwaites) K.T.Kiss & E.Ács	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pantocsekiella ocellata</i> (Pantocsek) K.T.Kiss & Ács	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Paraplaconeis placentula</i> (Ehrenberg) Kulikovskiy & Lange-Bertalot	8	DD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pauliella taeniata</i> (Grunow) Round & Basson	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia acoricola</i> Hustedt	5	EN	-	-	-	-	1	-	-	-	1	-	1	-	-	-	-
<i>Pinnularia ammerensis</i> Kulikovskiy, Lange-Bertalot & Metzeltin	0	NE	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
<i>Pinnularia anglica</i> Krammer	5	EN	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia angustarea</i> Kulikovskiy, Lange-Bertalot, A.Witkovski & N.I.Dorofeyuk	0	NE	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
<i>Pinnularia biceps</i> W.Gregory	8	DD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia brebissonii</i> (Kützing) Rabenhorst var. <i>brebissonii</i>	9	LC	1	-	-	-	-	-	-	-	-	-	-	-	1	-	1



Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Pinnularia bottnica</i> Krammer	8	DD	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Pinnularia brandelii</i> Cleve	5	EN	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
<i>Pinnularia brevicostata</i> Cleve	8	DD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia bullacostae</i> Krammer & Lange-Bertalot	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia canadensis</i> Krammer	0	NE	-	-	-	-	-	-	1	-	-	1	1	-	-	-	-
<i>Pinnularia cardinaliculus</i> Cleve	6	VU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia cuneola</i> E.Reichardt	5	EN	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Pinnularia decrescens</i> (Grunow) Krammer	8	DD	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Pinnularia divergens</i> var. <i>sublinearis</i> Cleve	0	NE	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
<i>Pinnularia divergens</i> W.Smith	7	NT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia eifliana</i> (Krammer) Krammer	5	EN	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-
<i>Pinnularia gentilis</i> (Donkin) Cleve	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia grunowii</i> Krammer	9	LC	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-
<i>Pinnularia halophila</i> Krammer	6	VU	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Pinnularia intermedia</i> (Lagerstedt) Cleve	4	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia krammeri</i> Metzeltin	0	NE	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-

Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Pinnularia lagerstedtii</i> (Cleve) A.Cleve	5	EN	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia lailaensis</i> Foged	0	NE	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-
<i>Pinnularia lata</i> (Brébisson) W.Smith	4	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia macilenta</i> Ehrenberg	5	EN	-	-	-	1	-	1	-	1	-	-	-	1	-	-	-
<i>Pinnularia media</i> (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia mesogongyla</i> Ehrenberg	8	DD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia mesolepta</i> (Ehrenberg) W.Smith	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia microstauron</i> (Ehrenberg) Cleve var. <i>microstauron</i>	7	NT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia microstauron</i> var. <i>rostrata</i> Krammer	0	NE	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia neohalophila</i> Kulikovskiy, Genkal & Mikheeva	8	DD	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-
<i>Pinnularia neomajor</i> Krammer	5	EN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pinnularia nodosa</i> (Ehrenberg) W.Smith var. <i>nodosa</i>	5	EN	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1
<i>Pinnularia nodosa</i> var. <i>percapitata</i> Krammer	5	EN	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Pinnularia nodosa</i> var. <i>robusta</i> (Foged) Krammer	6	VU	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
<i>Pinnularia notabilis</i> Krammer	5	EN	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-
<i>Pinnularia oriunda</i> Krammer	5	EN	1	-	-	-	-	-	1	-	-	-	1	-	-	-	1
<i>Pinnularia oriundiformis</i> Krammer	5	EN	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-





Table A1. Cont.

Taxa	Red List Category	IUCN Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	ULR
<i>Planothidium lanceolatum</i> (Brébisson ex Kützing) Lange-Bertalot	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Planothidium straubianum</i> C.E.Wetzel, Van de Vijver & L.Ector	0	NE	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
<i>Planothidium</i> sp.	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	1	1
<i>Pleurosigma delicatulum</i> W.Smith	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Pleurosigma elongatum</i> W.Smith	9	LC	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Praestephanos triporus</i> (Genkal & G.V.Kuzmin) A.Tuji & J.-S.Ki	0	NE	-	-	-	-	-	1	1	-	-	1	-	-	-	-	-
<i>Prestauroneis crucicula</i> (W.Smith) Genkal & Yarushina	9	LC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Psammothidium petersenii</i> (Hastedt) Round et Bukhtiyarova	0	NE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Psammothidium bioretii</i> (H.Germain) Bukhtiyarova & Round	9	LC	-	-	1	-	-	-	-	1	1	-	1	-	1	-	-
<i>Psammothidium chlidanos</i> (M.H.Hohn & Helleman) Lange-Bertalot	4	EN	-	1	-	1	-	1	1	-	1	1	1	-	-	-	-
<i>Psammothidium daonense</i> (Lange-Bertalot) Lange-Bertalot	5	EN	-	1	-	-	-	-	1	-	-	-	-	-	1	-	-
<i>Psammothidium helveticum</i> (Hustedt) Bukhtiyarova & Round	9	LC	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Psammothidium kryophilum</i> (J.B.Petersen) E.Reichardt	3	CR	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Psammothidium levanderi</i> (Hustedt) Bukhtiyarova & Round	3	CR	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-
<i>Psammothidium marginulatum</i> (Grunow) Bukhtiyarova & Round	8	DD	-	-	1	-	-	-	-	-	1	-	1	-	-	-	-
<i>Psammothidium rechtense</i> (Leclercq) Lange-Bertalot	3	CR	-	-	1	-	-	1	1	1	1	-	1	-	-	-	-



















Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Amphora ovalis</i> (Kützing) Kützing	B	temp	st-str	i	alf	6.2–9.0	sx	1.5	b	ate	e
<i>Amphora pediculus</i> (Kützing) Grunow	B	temp	st	i	alf	6.9–8.9	es	1.7	b	ate	me
<i>Amphora pseudosibirica</i> Levkov & Pavlov	-	-	-	-	-	-	-	-	-	-	-
<i>Amphora</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Amphorotia clevei</i> (Grunow) D.M.Williams & G.Reid	B	-	-	hb	-	-	-	-	-	-	-
<i>Aneumastus apiculatus</i> (Østrup) Lange-Bertalot	P-B	-	str	i	ind	-	-	2.0	b	ats	me
<i>Aneumastus tusculus</i> (Ehrenberg) D.G.Mann & A.J.Stickle	P-B	-	st	i	alb	-	-	0.9	b	ate	o-e
<i>Asterionella formosa</i> Hassall	P	temp	st-str	i	alf	6.4–7.99	sx	1.35	b	ate	me
<i>Aulacoseira alpigena</i> (Grunow) Krammer	P-B	temp	st-str	i	alf	4.8–8.4	sp	0.8	x-b	ate	ot
<i>Aulacoseira ambigua</i> (Grunow) Simonsen	P	temp	st-str	i	alf	6.0–8.5	sp	1.7	b-o	ate	om
<i>Aulacoseira distans</i> (Ehrenberg) Simonsen	P-B	cool	str	i	acf	4.5–7.8	sp	0.4	o	ats	ot
<i>Aulacoseira granulata</i> (Ehrenberg) Simonsen f. <i>granulata</i>	P-B	temp	st-str	i	alf	5.8–9.4	es	2.0	b	ate	e
<i>Aulacoseira granulata</i> f. <i>curvata</i> (Hustedt) Simonsen	P-B	-	st-str	i	alf	-	-	2.0	b	ate	e
<i>Aulacoseira islandica</i> (O.Müller) Simonsen	P-B	cool	st-str	i	ind	8.0	es	2.0	b	ate	o-e
<i>Aulacoseira italica</i> (Ehrenberg) Simonsen var. <i>italica</i>	P-B	cool	st-str	i	ind	5.8–8.4	es	1.45	b	ate	me
<i>Aulacoseira italica</i> var. <i>curvata</i> (Pantocsek) L.Yang & Q.X.Wang	P	-	-	i	acf	-	es	-	-	-	-
<i>Aulacoseira italica</i> var. <i>tenuissima</i> (Grunow) Simonsen	P-B	cool	st-str	i	ind	7.0	es	1.3	b	ate	me

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Aulacoseira lirata</i> (Ehrenberg) R.Ross	P-B	temp	-	hb	acf	4.6–7.3	-	0.5	x-o	ate	-
<i>Aulacoseira perglabra</i> (Østrup) E.Y.Haworth	P-B	temp	-	hb	acf	4.76	-	1.0	o	ate	ot
<i>Aulacoseira pfaffiana</i> (Reinsch) Krammer	P-B	cool	str	hb	acf	-	-	0.3	x	ats	ot
<i>Aulacoseira pusilla</i> (F.Meister) A.Tuji & A.Houki	-	-	-	-	-	-	-	-	-	-	-
<i>Aulacoseira scalaris</i> (Grunow) Houk, Klee & Passauer	-	-	-	-	-	-	-	-	-	-	-
<i>Aulacoseira subarctica</i> (O.Müller) E.Y.Haworth	P	temp	st-str	i	alf	6.72–8.14	-	1.7	b-o	ats	om
<i>Aulacoseira valida</i> (Grunow) Krammer	P-B	-	-	i	alf	-	es	1.3	o	ate	om
<i>Boreozonacola hustedtii</i> Lange-Bertalot, Kulikovskiy & Witkowski	-	-	-	-	-	-	-	-	-	-	-
<i>Brachysira brebissonii</i> R.Ross	P-B	temp	st-str	hb	acf	4.6–7.8	sx	0.4	o	ats	ot
<i>Brachysira calcicola</i> Lange-Bertalot	B	-	-	-	-	-	-	1.0	o	-	-
<i>Brachysira neoexilis</i> Lange-Bertalot	B	-	-	-	acf	7.8	-	0.5	x-o	-	om
<i>Brachysira procera</i> Lange-Bertalot & Gerd Moser	B	-	-	-	acf	6.3–6.5	-	-	-	-	-
<i>Brachysira styriaca</i> (Grunow) R.Ross	B	temp	-	i	ind	6.45–7.26	es	1.0	o	-	ot
<i>Caloneis arctica</i> (Krasske) Lange-Bertalot & S.I.Genkal	-	-	-	-	-	-	-	-	-	-	-
<i>Caloneis bacillum</i> (Grunow) Cleve	B	temp	st-str	i	alf	6.8–8.4	es	1.3	b	ats	me
<i>Caloneis holarctica</i> Kulikovskiy, Lange-Bertalot & A.Witkowski	-	-	-	-	-	-	-	-	-	-	-
<i>Caloneis silicula</i> (Ehrenberg) Cleve var. <i>Silicula</i>	B	warm	st	i	ind	6.3–9.0	sp	1.3	o	ats	om





Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Chaetoceros subtilis</i> Cleve	P-B	-	-	mh	alb	-	-	-	-	-	-
<i>Chaetoceros teres</i> Cleve	-	-	-	-	-	-	-	-	-	-	-
<i>Chaetoceros wighamii</i> Brightwell	P-B	-	-	mh	alb	-	-	-	-	-	-
<i>Chamaepinnularia begeri</i> (Krasske) Lange-Bertalot	B	temp	-	i	ind	6.35	-	1.0	o	ats	-
<i>Chamaepinnularia circumborealis</i> Lange-Bertalot	-	-	-	-	-	-	-	-	-	-	-
<i>Chamaepinnularia krookiformis</i> (Krammer) Lange-Bertalot & Krammer	B	-	-	hl	neu	-	-	1.0	o	-	-
<i>Chamaepinnularia soehrensii</i> (Krasske) Lange-Bertalot & Krammer	B	-	st-str	hb	acf	8.20	-	1.0	o	ats	ot
<i>Chamaepinnularia</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Cocconeis lineata</i> Ehrenberg	P-B	temp	st-str	i	alf	6.3–9.5	sx	1.2	b	ate	e
<i>Cocconeis neodiminuta</i> Krammer	P-B	temp	st-str	i	alf	7–9	sx	0.9	b	ats	me
<i>Cocconeis pediculus</i> Ehrenberg	B	temp	st-str	i	alf	6.9–8.6	sx	1.8	a-b	ate	me
<i>Cocconeis placentula</i> Ehrenberg var. <i>placentula</i>	P-B	temp	st-str	i	alf	5.5–9.0	es	1.35	o	ate	me
<i>Cocconeis placentula</i> var. <i>euglypta</i> (Ehrenberg) Cleve	P-B	temp	st-str	i	alf	5.5–9.0	sx	1.3	b	ate	om
<i>Cocconeis</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Coscinodiscus curvatulus</i> Grunow	P-B	-	-	eh	-	-	-	-	-	-	-
<i>Cosmioneis pusilla</i> (W.Smith) D.G.Mann & A.J.Stickle	P-B,aer	-	st-str	hl	ind	-	sp	1.8	o-a	ats	om
<i>Craticula ambigua</i> (Ehrenberg) D.G.Mann	B	temp	st	i	alf	5.5–8.0	es	2.3	b	-	me



Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Cymbella cleve-eulerae</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbella cymbiformis</i> C.Agardh	B	temp	st-str	i	alf	6.2–9.0	sx	2.0	b	ats	om
<i>Cymbella hantzschiana</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbella helvetica</i> Kützing	B	temp	st-str	i	ind	7.36–8.4	-	0.6	b	ats	me
<i>Cymbella krammeri</i> Bahls	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbella lanceolata</i> C.Agardh	B	temp	st-str	i	alf	6.5–8.6	es	2.5	b-a	ate	e
<i>Cymbella neocistula</i> Krammer	B	-	-	i	ind	-	-	-	-	hne	-
<i>Cymbella neogena</i> (Grunow) Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbella proxima</i> Reimer	B	-	-	i	alf	-	es	1.0	o	-	m
<i>Cymbella stuxbergii</i> (Cleve) Cleve	B	-	-	i	neu	-	-	1.0	o	-	ot
<i>Cymbella subcistula</i> Krammer	B	-	-	-	-	-	-	1.2	o	-	-
<i>Cymbella tartuensis</i> Molder	B	-	-	i	ind	-	-	-	-	-	-
<i>Cymbella tumida</i> (Brébisson) Van Heurck	B	temp	st-str	i	alf	6.8–9.5	sx	2.2	b	ats	me
<i>Cymbella</i> sp. <i>Cymbellafalsa diluviana</i> (Krasske) Lange-Bertalot & Metzeltin	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura amphicephala</i> (Nägeli ex Kützing) Krammer	B	-	st-str	i	ind	4.6–8.2	-	-	-	-	-
<i>Cymbopleura anglica</i> (Lagerstedt) Krammer	B	-	-	hb	ind	-	sx	1.2	o	ats	om
<i>Cymbopleura angustata</i> var. <i>spitsbergensis</i> Krammer	B	-	str	i	ind	4.9–8.20	-	1.0	o	-	ot
<i>Cymbopleura cuspidata</i> (Kützing) Krammer	P-B	temp	st-str	i	alf	5.7–7.5	-	-	-	-	-
<i>Cymbopleura designata</i> (Krammer) Bahls	B	temp	st-str	i	alf	6.3–9.0	-	1.8	o-a	ats	m

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Cymbopleura elliptica</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura hybrida</i> (Grunow ex Cleve) Krammer	P-B	-	-	i	ind	8.10	-	1.2	o	ats	-
<i>Cymbopleura incertiformis</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura naviculiformis</i> (Auerswald ex Heiberg) Krammer	B	temp	st-str	i	ind	7.8–6.94	-	-	-	-	-
<i>Cymbopleura neoheteropleura</i> Krammer	B	-	-	hb	acf	-	es	1.2	o	ate	om
<i>Cymbopleura oblongata</i> var. <i>stenoraphe</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura stauroneiformis</i> (Lagerstedt) Krammer	B	-	-	-	ind	-	-	1.0	o	ats	ot
<i>Cymbopleura subanglica</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura subapiculata</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura subcuspidata</i> (Krammer) Krammer	P-B	-	str	i	acf	-	sx	1.0	o	ats	om
<i>Cymbopleura truncata</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura tynnii</i> (Krammer) Krammer	B	-	-	-	-	-	-	-	-	-	-
<i>Cymbopleura</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Denticula elegans</i> Kützing	P-B,aer	-	-	i	alf	7.3–9.0	-	-	-	-	-
<i>Denticula tenuis</i> Kützing	B	-	st-str	i	alf	7.42–8.0	-	-	-	-	-
<i>Diatoma moniliformis</i> (Kützing) D.M.Williams	P-B	temp	st-str	i	alf	8.0–8.5	-	0.4	x-o	-	-
<i>Diatoma moniliformis</i> subsp. <i>ovalis</i> (F.Fricke) Lange-Bertalot, Rumrich & G.Hofmann	B	-	st-str	i	alf	-	sx	1.4	o-b	-	-
<i>Diatoma problematica</i> Lange-Bertalot	B	-	-	-	-	-	-	1.3	o	-	om
<i>Diatoma tenuis</i> C.Agardh	P-B	temp	st-str	hl	alf	6.9–8.39	-	2.4	b-a	-	om

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Diatoma vulgare</i> Bory	P-B	temp	st-str	i	alf	6.2–8.9	-	2.4	b-a	-	-
<i>Diatomella balfouriana</i> Greville	B	-	-	-	-	-	es	2.2	b	ate	me
<i>Didymosphenia geminata</i> (Lyngbye) Mart.Schmidt	B	-	st-str	i	ind	-	-	2.0	b	-	-
<i>Didymosphenia siberica</i> (Grunow) Mart.Schmidt	-	-	-	-	-	-	-	-	-	-	-
<i>Diploneis boldtiana</i> Cleve	B	-	st-str	i	ind	-	-	-	-	-	-
<i>Diploneis didymus</i> (Ehrenberg) Ehrenberg	B	-	-	mh	alf	-	-	-	-	-	-
<i>Diploneis elliptica</i> (Kützing) Cleve	B	temp	str	i	alf	8.2	es	-	-	-	-
<i>Diploneis interrupta</i> (Kützing) Cleve	B	-	-	mh	alf	-	-	-	-	-	-
<i>Diploneis modica</i> Hustedt	B	-	-	-	-	6.58	-	-	-	-	-
<i>Diploneis oblongella</i> (Nägeli ex Kützing) A.Cleve	B	-	st-str	i	ind	6.9–8.0	-	-	-	-	-
<i>Diploneis oculata</i> (Brébisson) Cleve	B	temp	st-str	i	alf	7.4–8.2	-	-	-	-	-
<i>Diploneis ovalis</i> (Hilse) Cleve	B	-	st-str	i	alf	6.5–9.0	-	0.9	x-b	ate	m
<i>Diploneis parva</i> Cleve	B	cool	-	i	alf	6.6–8.6	-	-	-	-	-
<i>Diploneis smithii</i> (Brébisson) Cleve var. <i>smithii</i>	B	-	-	mh	alf	-	-	-	-	-	-
<i>Diploneis smithii</i> var. <i>pumila</i> (Grunow) Hustedt	B	-	-	mh	alf	-	-	0.7	o-x	-	-
<i>Diploneis subovalis</i> Cleve	B	temp	st-str	hl	ind	-	-	-	-	-	-
<i>Diploneis</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Discostella pseudostelligera</i> (Hustedt) Houk & Klee	P	temp	st-str	i	ind	6.32–8.5	-	2.7	a-o	-	-



Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Encyonopsis cesatiformis</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Encyonopsis cesatii</i> (Rabenhorst) Krammer	B	temp	str	i	ind	5.7–8.0	-	1.5	o-b	-	-
<i>Encyonopsis perborealis</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Entomoneis alata</i> (Ehrenberg) Ehrenberg	P-B	-	st	mh	alf	-	-	2.5	b-a	-	-
<i>Entomoneis ornata</i> (Bailey) Reimer	B	-	st-str	i	alf	-	-	2.0	b	hne	-
<i>Entomoneis paludosa</i> (W.Smith) Reimer var. <i>paludosa</i>	B	-	-	hl	-	-	-	1.5	o-b	ats	om
<i>Entomoneis paludosa</i> var. <i>hyperborea</i> (Grunow) Czarnecki & D.C.Reinke	-	-	-	-	-	-	-	-	-	-	-
<i>Envekadea</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Epithemia adnata</i> (Kützing) Brébisson var. <i>adnata</i>	B	temp	st-str	i	alb	5.5–9.0	-	1.2	o	-	-
<i>Epithemia adnata</i> var. <i>saxonica</i> (Kützing) R.M.Patrick	B	temp	-	i	alf	4.8–9.0	-	1.2	o	-	-
<i>Epithemia argus</i> (Ehrenberg) Kützing	P-B	-	st-str	i	ind	-	sx	1.2	o	ats	me
<i>Epithemia parallela</i> (Grunow) Ruck & Nakov	B	-	str	i	alf	-	-	1.0	o	-	-
<i>Epithemia porcellus</i> Kützing	B	-	-	i	alf	-	-	-	-	-	-
<i>Epithemia sorex</i> Kützing	B	temp	st-str	i	alf	5.0–9.0	-	-	-	-	-
<i>Epithemia turgida</i> (Ehrenberg) Kützing	B	temp	st-str	i	alf	5.0–9.0	-	1.1	-	-	-
<i>Eucampia zodiacus</i> Ehrenberg	-	-	-	hl	-	-	-	-	-	-	-
<i>Eucocconeis alpestris</i> (Brun) Lange-Bertalot	B	temp	str	hb	ind	6.35–7.09	-	-	-	-	-
<i>Eucocconeis austriaca</i> (Hustedt) Lange-Bertalot	B	-	-	i	alf	-	-	0.2	x	ats	ot
<i>Eucocconeis depressa</i> (Cleve) Lange-Bertalot	B	-	-	hb	acf	-	-	1.0	o	-	ot



Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Eucocconeis diluviana</i> (Hustedt) Lange-Bertalot	-	-	-	-	-	-	-	-	-	-	-
<i>Eucocconeis flexella</i> (Kützing) F.Meister	B	temp	str	mh	ind	7.13–8.10	-	-	-	-	-
<i>Eucocconeis laevis</i> (Østrup) Lange-Bertalot	B	-	str	hb	neu	7.90	sx	0.2	x	ats	ot
<i>Eucocconeis leptostriata</i> Lange-Bertalot apud H.Lange-Bertalot & S.I.Genkal	B	-	-	i	neu	-	sx	-	-	ate	-
<i>Eucocconeis quadratarea</i> (Østrup) Lange-Bertalot	B	-	-	i	acf	-	-	1.0	o	-	-
<i>Eunotia ambivalens</i> Lange-Bertalot & Tagliaventi	B	-	-	i	acf	-	-	3.9	b-p	-	-
<i>Eunotia arcubus</i> var. <i>bidens</i> (Grunow) Lange-Bertalot	B	-	-	i	alf	-	sx	1.0	o	-	ot
<i>Eunotia arcus</i> Ehrenberg	B	temp	st-str	i	acf	5.8–6.95	sx	0.4	x-o	ats	ot
<i>Eunotia bidens</i> Ehrenberg	P-B,aer	cool	st-str	hb	acf	-	-	1.0	o	-	ot
<i>Eunotia bidentula</i> W.Smith	B	-	st-str	i	acf	4.66–7.0	-	0.4	x-o	ats	om
<i>Eunotia bigibba</i> Kützing	B	-	str	i	acf	4.6–5.0	-	0.4	x-o	-	ot
<i>Eunotia bigibboidea</i> Lange-Bertalot & Witkowski	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia bilunaris</i> (Ehrenberg) Schaarschmidt	B	temp	st-str	i	acf	5.0–7.8	-	-	-	-	-
<i>Eunotia borealpina</i> Lange-Bertalot & Nörpel-Schempp	B	-	-	hb	-	-	-	-	-	-	-
<i>Eunotia boreotenuis</i> Nörpel-Schempp & Lange-Bertalot	B	-	-	hb	-	-	-	1.0	o	-	ot
<i>Eunotia botuliformis</i> F.Wild, Nörpel & Lange-Bertalot	B	-	-	hb	acf	-	-	1.0	o	-	ot
<i>Eunotia cantonatii</i> Lange-Bertalot & Tagliaventi	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia chelonia</i> Nörpel-Schempp, Lange-Bertalot & Metzeltin	B	-	-	i	acf	-	-	-	-	-	-

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Eunotia curtagrunowii</i> Nörpel-Schempp & Lange-Bertalot	P-B	-	-	hb	acf	-	-	0.4	x-o	ats	ot
<i>Eunotia elegans</i> Østrup	P-B	-	st-str	hb	acf	6.3	-	0.2	x	ats	ot
<i>Eunotia eurycephala</i> (Grunow) Nörpel-Schempp & Lange-Bertalot	B	-	-	i	-	-	-	-	-	-	-
<i>Eunotia ewa</i> Lange-Bertalot & Witkowski	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia exigua</i> (Brébisson ex Kützing) Rabenhorst	P-B,aer	temp	st-str	hb	acb	3.4–8.0	-	1.0	o	-	ot
<i>Eunotia faba</i> Ehrenberg	B	temp	st-str	-	alf	5.38–7.0	-	-	o	ats	ot
<i>Eunotia flexuosa</i> (Brébisson ex Kützing) Kützing	B	temp	st-str	i	acf	4.5–7.8	-	0.4	x-o	-	-
<i>Eunotia formica</i> Ehrenberg	B	-	st-str	i	acf	-	-	0.8	x-b	ats	om
<i>Eunotia fureyae</i> Lange-Bertalot	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia genuflexa</i> Nörpel-Schempp	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia groenlandica</i> Nörpel-Schempp & Lange-Bertalot	B	-	st-str	hb	acf	3.80	-	0.6	o-x	-	-
<i>Eunotia incisa</i> W.Smith ex W.Gregory	P-B	temp	st-str	i	acf	4.5–7.0	-	-	o	ats	om
<i>Eunotia islandica</i> Østrup	B	-	-	i	acf	-	-	0.4	x-o	-	ot
<i>Eunotia julma</i> Lange-Bertalot	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia major</i> (W.Smith) Rabenhorst	B	-	st-str	hb	acf	6.7	-	1.0	o	-	-
<i>Eunotia meisteri</i> Hustedt	P-B	-	str	i	acf	4.5–7.2	-	0.4	x-o	ats	-
<i>Eunotia minor</i> (Kützing) Grunow	B	temp	st-str	hb	acf	4.5–8.2	-	-	-	-	-
<i>Eunotia monnieri</i> Lange-Bertalot & Tagliaventi	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia monodon</i> Ehrenberg	B	-	st-str	hb	acf	7.3	es	0.4	x-o	ats	ot

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Eunotia mucophila</i> (Lange-Bertalot, Nörpel-Schempp & Alles) Lange-Bertalot	P-B	temp	st-str	hb	acf	5.25–6.4	-	-	-	-	-
<i>Eunotia naegelia</i> Migula	P-B	temp	str	hb	acf	4.5–6.0	sx	0.5	x-o	ate	ot
<i>Eunotia neocompacta</i> var. <i>vixcompacta</i> Lange-Bertalot	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia parallela</i> Ehrenberg <i>Eunotia paralleladubia</i> Lange-Bertalot & S.Mayama	P-B	-	str	i	acf	-	-	1.0	o	-	-
<i>Eunotia parapreraupta</i> Lange-Bertalot & Metzeltin	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia praerupta</i> Ehrenberg	P-B	cool	st-str	hb	acf	6.68–8.0	-	0.3	x	-	-
<i>Eunotia pseudogroenlandica</i> Lange-Bertalot & Tagliaventi	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia pseudopapilio</i> Lange-Bertalot & M.Nörpel-Schempp	B	-	st-str	hb	acf	-	sx	0.4	x-o	ats	om
<i>Eunotia rhomboidea</i> Hustedt <i>Eunotia scandiorussica</i> Kulikovskiy, Lange-Bertalot, Genkal & Witkowski	B	temp	str	hb	acf	4.84–6.4	-	1.0	o	-	-
<i>Eunotia semicircularis</i> (Ehrenberg) Lange-Bertalot & Metzeltin	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia septentrionalis</i> Østrup	P-B	-	str	hb	acf	4.5–7.5	-	1.0	o	-	ot
<i>Eunotia subarcuatoidea</i> Alles, Nörpel & Lange-Bertalot	B	-	str	hb	acb	6.7	-	0.4	x-o	-	-
<i>Eunotia subherkiniensis</i> Lange-Bertalot	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia triodon</i> Ehrenberg <i>Eunotia ursamaioris</i> Lange-Bertalot & Nörpel-Schempp	B	temp	-	hb	acf	6.33	-	1.0	o	-	ot
<i>Eunotia valida</i> Hustedt	B	-	-	hb	-	-	-	1.0	o	-	ot
<i>Eunotia valida</i> Hustedt	P-B	-	-	hb	acf	-	-	1.0	o	-	ot

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Eunotia</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Fallacia crassicostata</i> Lange-Bertalot & Werum	-	-	-	-	-	-	-	-	-	-	-
<i>Fallacia pygmaea</i> (Kützing) Stickle & D.G.Mann	P-B	-	st-str	mh	alf	7.4–9.1	-	-	-	ats	-
<i>Fallacia</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Fragilaria amphicephaloides</i> Lange-Bertalot	B	-	-	i	alf	6.76	-	1.1	o	-	-
<i>Fragilaria aquaplus</i> Lange-Bertalot & S.Ulrich	-	-	-	-	-	-	-	-	-	-	-
<i>Fragilaria capucina</i> Desmazières	P-B	temp	st-str	i	ind	6.4–8.9	-	-	-	-	-
<i>Fragilaria crotonensis</i> Kitton	P-B	temp	st-str	i	alf	5.7–8.9	-	-	-	-	-
<i>Fragilaria goulardii</i> var. <i>telezkoensis</i> (Poretzky) Kharitonov	-	-	-	-	-	-	-	-	-	-	-
<i>Fragilaria radians</i> (Kützing) D.M.Williams & Round	P-B	warm	st-str	i	alf	7.0–7.5	-	-	-	-	-
<i>Fragilaria rumpens</i> (Kützing) G.W.F.Carlson	P-B	eterm	st-str	i	ind	6.5–8.8	-	2.0	b	ats	e
<i>Fragilaria saxoplanctonica</i> Lange-Bertalot & S.Ulrich	-	-	-	-	-	-	-	-	-	-	-
<i>Fragilaria striatula</i> Lyngbye	P-B	-	-	eh	-	-	-	-	-	-	-
<i>Fragilaria vaucheriae</i> (Kützing) J.B.Petersen	P-B,Ep	temp	st-str	i	alf	6.5–8.8	-	-	-	-	-
<i>Fragilaria</i> sp.	-	-	-	i	-	4.9–7.8	es	-	-	hne	-
<i>Fragilariforma bicapitata</i> (A.Mayer) D.M.Williams & Round	P-B	-	st-str	hb	ind	-	-	-	-	-	-



Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Gomphonella olivacea</i> (Hornemann) Rabenhorst	B	temp	st-str	i	alf	6.5–8.8	-	2.3	b	ate	om
<i>Gomphonema acuminatum</i> Ehrenberg	B	temp	st-str	i	ind	6.3–9.5	-	0.8	x-b	-	-
<i>Gomphonema angustatum</i> (Kützing) Rabenhorst	B	temp	st-str	i	ind	5.7–9.0	-	1.0	o	-	-
<i>Gomphonema angusticephalum</i> E.Reichardt & Lange-Bertalot	-	-	-	-	-	-	-	-	-	-	-
<i>Gomphonema angustum</i> C.Agardh	B	-	st-str	i	ind	8.17–8.2	-	-	-	-	-
<i>Gomphonema brebissonii</i> Kützing	B	-	st	i	ind	-	-	-	-	-	m
<i>Gomphonema capitatum</i> Ehrenberg	B	temp	st	i	alf	6.9–8.9	-	1.2	o	-	om
<i>Gomphonema coronatum</i> Ehrenberg	B	-	st	i	ind	7.33	-	-	-	-	-
<i>Gomphonema gracile</i> Ehrenberg	B	temp	st-str	i	alf	6.4–8.6	-	-	-	-	-
<i>Gomphonema hebridense</i> W.Gregory	B	-	-	-	acf	6.1	-	1.0	o	-	-
<i>Gomphonema helveticum</i> Brun	B	-	-	i	ind	-	-	-	-	-	-
<i>Gomphonema italicum</i> Kützing	-	-	-	-	-	-	-	-	-	-	-
<i>Gomphonema lagenula</i> Kützing	B	-	-	-	-	-	-	-	b	ate	e
<i>Gomphonema lagerheimii</i> A.Cleve	B	-	str	hb	acf	-	-	-	-	-	m
<i>Gomphonema laticollum</i> E.Reichardt	-	-	-	-	-	-	-	1.0	o	ats	ot
<i>Gomphonema longiceps</i> f. <i>suecicum</i> (Grunow) Hustedt	-	-	-	-	-	-	-	-	-	-	-
<i>Gomphonema microcapitatum</i> Kulikovskiy, Kociolek & Solak	-	-	-	-	-	-	-	-	-	-	-
<i>Gomphonema micropus</i> Kützing	B	temp	st-str	i	ind	6.6–8.3	-	1.1	-	-	-

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Gomphonema mihoi</i> Levkov	-	-	-	-	-	-	-	-	-	-	-
<i>Gomphonema minutum</i> f. <i>pachypus</i> Lange-Bertalot & E.Reichardt	-	-	-	-	-	-	-	-	-	-	-
<i>Gomphonema montanum</i> (Schumann) Grunow	B	-	str	i	ind	-	-	-	-	ate	-
<i>Gomphonema olivaceoides</i> Hustedt	B	-	str	hb	ind	-	-	1.0	o	-	-
<i>Gomphonema parvulum</i> (Kützing) Kützing	B	temp	st-str	i	ind	4.5–8.6	-	0.7	o-x	ats	ot
<i>Gomphonema productum</i> (Grunow) Lange-Bertalot & E.Reichardt	B	-	str	i	ind	-	-	1.0	o	-	-
<i>Gomphonema</i> <i>pseudacuminatum</i> Kulikovskiy, Kociolek & Solak	-	-	-	-	-	-	-	-	-	-	-
<i>Gomphonema pumilum</i> (Grunow) E.Reichardt & Lange-Bertalot	B	temp	-	i	alf	6.6–8.4	-	-	-	-	-
<i>Gomphonema subclavatum</i> (Grunow) Grunow	B	-	str	i	ind	-	-	1.0	o	-	ot
<i>Gomphonema tergestinum</i> (Grunow) Fricke	B	-	str	i	ind	-	-	1.0	o	-	-
<i>Gomphonema truncatum</i> Ehrenberg	B	temp	st-str	i	ind	7.19	-	2.0	b	-	-
<i>Gomphonema ventricosum</i> W.Gregory	B	cool	str	i	ind	-	-	1.0	o	-	-
<i>Gomphonema</i> sp. <i>Gomphosphenia vallei</i> Beauger, C.E.Wetzel, Allain & Ector	B	-	-	i	-	5.7–7.8	sx	-	-	-	-
<i>Gomphosphenia</i> sp. <i>Gyrosigma acuminatum</i> (Kützing) Rabenhorst var. <i>acuminatum</i>	-	-	-	-	-	-	-	-	-	-	-
<i>Gyrosigma acuminatum</i> var. <i>gallicum</i> (Grunow) Cleve	B	temp	st-str	i	alf	6.3–9.5	-	-	-	-	-
<i>Gyrosigma attenuatum</i> (Kützing) Rabenhorst	B	-	st-str	hl	alf	-	-	-	-	-	-
<i>Gyrosigma balticum</i> (Ehrenberg) Rabenhorst	P-B	temp	st-str	i	alf	6.9–8.5	-	-	-	-	-
<i>Gyrosigma peisonis</i> (Grunow) Hustedt	B	temp	st	mh	alb	-	-	-	-	-	-
	B	-	st-str	mh	alf	-	sp	2.0	b	ate	e

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Gyrosigma strigilis</i> (W.Smith) J.W.Griffin & Henfrey	B	-	-	mh	alb	-	es	-	-	hne	-
<i>Gyrosigma</i> sp.	B	-	-	-	-	-	-	-	-	-	-
<i>Halamphora hassiaca</i> (Krammer & S.Strecker)	-	-	-	-	-	-	-	-	-	-	-
Lange-Bertalot											
<i>Halamphora veneta</i> (Kützing) Levkov	B	temp	st-str	hl	alf	7.4–8.4	-	-	-	-	-
<i>Handmannia antiqua</i> (W.Smith) Kociolek et Khursevich	P-B	temp	-	hb	acf	7.25–7.27	-	1.2	o	-	-
<i>Handmannia comta</i> (Ehrenberg) Kociolek et Khursevich emend. Genkal	P	temp	st	i	alf	6.0–7.8	-	-	-	-	-
<i>Hannaea arcus</i> (Ehrenberg) R.M.Patrick	B	temp	str	i	alf	5.7–7.5	-	-	-	-	-
<i>Hannaea inaequidentata</i> (Lagerstedt) Genkal & Kharitonov	P-B	-	-	hb	neu	-	-	-	-	-	-
<i>Hantzschia amphioxys</i> (Ehrenberg) Grunow f. <i>amphioxys</i>	B,aer	temp	st-str	i	ind	6.3–9.5	-	3.0	a	-	me
<i>Hantzschia amphioxys</i> f. <i>capitata</i> O.Müller	B	-	st-str	I	ind	-	es	1.9	a	ate	o-e
<i>Hantzschia virgata</i> var. <i>capitellata</i> Hustedt	B	-	-	hl	-	-	-	2.0	b	-	m
<i>Hantzschia</i> sp.	B	-	-	-	-	-	-	-	-	-	-
<i>Hemiaulus hauckii</i> Grunow ex Van Heurck	-	-	-	-	-	-	-	-	-	-	-
<i>Hippodonta capitata</i> (Ehrenberg) Lange-Bertalot, Metzeltin & Witkowski	B	temp	st-str	hl	alf	6.6–9.5	-	-	a-b	-	me
<i>Hippodonta hungarica</i> (Grunow) Lange-Bertalot, Metzeltin & Witkowski	B	-	st-str	hl	alf	6.9–8.6	-	-	-	-	-
<i>Humidophila brekkaensis</i> (J.B.Petersen) R.L.Lowe, Kociolek, J.R.Johansen, Van de Vijver, Lange-Bertalot & Krammer et Kopalova	B	-	aer	mh	alf	-	-	-	-	-	-
<i>Humidophila gallica</i> (W.Smith) Lowe, Kociolek, Q.You, Q.Wang & Stepanek	B	-	st-str	i	ind	7.60	es	0.7	o-x	ate	om





Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Lindavia costata</i> (Loginova, Lupikina & Khursevich) Nakov, Guillory, Julius, Theriot & Alverson	-	-	-	-	-	-	-	-	-	-	-
<i>Mayamaea agrestis</i> (Hustedt) Lange-Bertalot	B	-	-	i	ind	7.2	es	2.6	a-o	hce	he
<i>Mayamaea disjuncta</i> (Hustedt) J.Y. Li & Y.Z.Qi	B	-	str	i	ind	7.5	sp	3.0	a	ate	he
<i>Mayamaea permitis</i> (Hustedt) K.Bruder & Medlin	B	temp	st	i	alf	6.5–8.9	-	0.7	o-x	-	-
<i>Melosira lineata</i> var. <i>subangularis</i> (Grunow) Aboal	P-B	cool	-	mh	alf	6.3–9.1	-	2.0	b	-	-
<i>Melosira moniliformis</i> (Link) C.Agardh	P-B	eterm	str	mh	alf	-	-	2.0	b	-	-
<i>Melosira normanii</i> Arnott ex Van Heurck	-	-	-	-	-	-	-	-	-	-	-
<i>Melosira undulata</i> (Ehrenberg) Kützing	P-B	-	-	i	ind	-	-	2.8	a-o	-	-
<i>Melosira varians</i> C.Agardh	P-B	temp	st-str	hl	ind	5–9	-	2.4	b-a	-	-
<i>Meridion circulare</i> (Greville) C.Agardh	P-B	temp	st-str	i	ind	6.6–8.3	-	-	-	-	-
<i>Navicula angusta</i> Grunow	B	-	st-str	i	ind	7.6–8.2	-	1.0	o	-	-
<i>Navicula antonii</i> Lange-Bertalot	B	temp	-	oh	alf	7.5–8.5	es	-	-	-	-
<i>Navicula bottnica</i> Grunow	B	-	-	mh	alf	-	sx	2.1	b	ate	e
<i>Navicula capitatoradiata</i> H.Germain ex Gasse	P-B	temp	st-str	mh	alf	7.6–8.1	-	-	-	-	-
<i>Navicula chiarae</i> Lange-Bertalot & Genkal	-	-	-	-	-	8.30	-	-	-	hce	-
<i>Navicula cincta</i> (Ehrenberg) Ralfs	B	temp	st-str	hl	alf	6.9–8.4	-	-	-	-	-

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Navicula cryptocephala</i> Kützing var. <i>cryptocephala</i>	P-B	temp	st-str	i	ind	6.5–8.4	-	2.4	b-a	-	-
<i>Navicula cryptocephala</i> var. <i>lata</i> Poretzky & Anisimova	B	-	-	i	-	-	-	-	-	-	-
<i>Navicula cryptotenella</i> Lange-Bertalot	P-B	temp	st-str	i	ind	6.5–8.7	-	-	-	-	-
<i>Navicula cryptotenelloides</i> Lange-Bertalot	B	-	-	oh	alf	7.9–8.19	-	1.0	o	-	-
<i>Navicula digitoconvergens</i> Lange-Bertalot	-	-	-	-	-	-	-	-	-	-	-
<i>Navicula digitoradiata</i> (W.Gregory) Ralfs	B	-	-	i	alf	-	-	-	-	-	-
<i>Navicula gottlandica</i> Grunow	P-B	-	-	hl	alf	-	es	2.5	b-a	ate	e
<i>Navicula granii</i> (Jørgensen) Gran	-	-	-	-	-	-	-	-	-	-	-
<i>Navicula hasta</i> Pantocsek	B	-	-	-	ind	-	-	-	-	-	-
<i>Navicula kariana</i> Grunow	-	warm	-	i	-	-	-	-	-	-	-
<i>Navicula lanceolata</i> var. <i>tenuirostris</i> Skvortzov	B	-	-	i	alf	-	-	1.0	o	-	-
<i>Navicula laterostrata</i> Hustedt	P-B	-	str	i	alf	7.1–7.9	-	1.1	o	-	-
<i>Navicula margalithii</i> Lange-Bertalot	B	-	-	hl	alf	-	-	-	-	-	-
<i>Navicula mediocostata</i> E.Reichardt	B	-	-	oh	alf	-	es	3.0	a	ate	e
<i>Navicula menisculus</i> Schumann	P-B	-	st-str	hl	alf	6.7–7.6	-	-	o	ats	e
<i>Navicula notha</i> J.H.Wallace	B	-	str	i	acf	6.3–7.5	-	-	-	-	-
<i>Navicula phyllepta</i> Kützing	B	-	-	hl	-	-	-	-	-	-	-
<i>Navicula phylleptosoma</i> Lange-Bertalot	B	-	-	mh	alf	7.7	-	-	-	-	-
<i>Navicula pusilla</i> var. <i>jacutica</i> Kisseleva	B	-	-	hl	ind	-	-	-	-	-	-
<i>Navicula radiosa</i> Kützing	B	temp	st-str	i	ind	5–9	sx	-	-	-	-



Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Naviculadicta</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Navigeia paludosa</i> (Hustedt) Bukhtiyarova	B	-	str	i	ind	8.11	sx	-	-	-	-
<i>Navigeia thingvallae</i> (Østrup) Bukhtiyarova	B	-	-	-	-	-	-	-	-	-	-
<i>Neidiopsis wulffii</i> (J.B.Petersen) Lange-Bertalot	-	-	-	-	-	7.80	-	-	-	ats	ot
<i>Neidium affine</i> (Ehrenberg) Pfitzer	B	temp	st-str	i	ind	4.5–7.8	-	-	-	-	-
<i>Neidium ampliatum</i> (Ehrenberg) Krammer	B	temp	st	i	ind	5.2–8.6	-	-	-	-	-
<i>Neidium bisulcatum</i> (Lagerstedt) Cleve	B	-	st-str	i	ind	4.9–7.0	-	1.0	o	-	-
<i>Neidium dubium</i> (Ehrenberg) Cleve	B	-	str	i	alf	-	-	-	-	-	-
<i>Neidium hercynicum</i> Ant.Mayer	B	-	-	i	acf	-	-	-	-	-	-
<i>Neidium hitchcockii</i> (Ehrenberg) Cleve	P-B	-	st	I	ind	-	es	0.6	o-x	ats	ot
<i>Neidium iridis</i> (Ehrenberg) Cleve var. <i>iridis</i>	B	temp	st-str	hb	ind	5.1–8.9	-	-	-	-	-
<i>Neidium iridis</i> var. <i>diminutum</i> (Pantocsek) Wislouch & Kolbe	B	-	-	i	ind	-	-	1.0	o	-	-
<i>Neidium productum</i> (W.Smith) Cleve	P-B	temp	st-str	i	ind	-	-	-	-	-	-
<i>Neidium</i> sp.	B	-	-	-	-	4.6–6.9	-	-	-	-	-
<i>Nitzschia acicularis</i> (Kützing) W.Smith	P-B	temp	st	i	alf	6.8–8.1	es	1.4	o-b	ats	om
<i>Nitzschia acidoclinata</i> Lange-Bertalot	B	temp	str	hb	ind	6.5–8.0	-	3.6	a-b	ate	e
<i>Nitzschia acuta</i> Hantzsch	P-B	-	st-str	i	alf	-	-	-	-	-	-
<i>Nitzschia alpina</i> Hustedt	P-B	temp	str	i	acf	7.39	-	1.0	o	-	-

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Nitzschia aquaea</i> Wislouch & V.S.Poretzky		-	-	hb	-	-	es	2.1	b	ate	e
<i>Nitzschia brevissima</i> Grunow	B	-	st-str	hl	alf	6.5–8.0	-	-	-	-	-
<i>Nitzschia capitellata</i> Hustedt var. <i>capitellata</i>	B	temp	-	i	ind	6.9–8.6	-	3.6	a-b	-	o-e
<i>Nitzschia capitellata</i> var. <i>tenuirostris</i> (Grunow) Bukhtiyarova	P-B	-	-	i	alf	7.0–8.2	-	1.0	o	-	-
<i>Nitzschia commutatooides</i> Lange-Bertalot	-	-	-	hl	-	-	-	-	-	-	-
<i>Nitzschia denticula</i> Grunow	B	-	-	mh	alf	8.0	-	-	-	-	-
<i>Nitzschia dissipata</i> (Kützing) Rabenhorst var. <i>dissipata</i>	B	temp	st-str	i	alf	6.5–8.5	sx	1.4	o-b	-	-
<i>Nitzschia flexoides</i> Geitler	B	-	-	-	-	-	-	1.5	o-b	-	-
<i>Nitzschia fonticola</i> (Grunow) Grunow	P-B	temp	st-str	i	alf	6.0–8.9	-	3.6	a-b	hne	-
<i>Nitzschia frigida</i> Grunow	-	-	-	-	-	-	-	-	-	-	-
<i>Nitzschia frustulum</i> (Kützing) Grunow	P-B	temp	st-str	hl	alf	6.7–8.8	es	2.7	a-o	-	-
<i>Nitzschia graciliformis</i> Lange-Bertalot & Simonsen	B	-	-	i	alf	-	es	1.0	o	-	-
<i>Nitzschia gracilis</i> Hantzsch	P-B	temp	st-str	i	ind	5.51–8.25	-	-	-	-	-
<i>Nitzschia hamburgiensis</i> Lange-Bertalot	B	-	st-str	i	alf	-	-	-	-	-	-
<i>Nitzschia inconspicua</i> Grunow	B	temp	st-str	hl	alf	6.7–8.9	-	-	-	-	-
<i>Nitzschia intermedia</i> Hantzsch ex Cleve & Grunow	P-B	temp	-	i	ind	6.6–8.1	-	-	-	-	-
<i>Nitzschia linearis</i> W.Smith	B	temp	-	i	alf	7.1–8.1	es	1.7	b-o	ate	me

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Nitzschia longissima</i> (Brébisson) Ralfs	-	-	-	mh	alf	-	-	-	-	-	-
<i>Nitzschia media</i> Hantzsch	-	-	-	-	-	-	-	-	-	-	-
<i>Nitzschia palea</i> (Kützing) W.Smith	P-B	temp	st-str	i	ind	4.5–8.8	-	2.0	b	-	-
<i>Nitzschia paleacea</i> (Grunow) Grunow	P-B	temp	st-str	i	alf	6.8–8.9	es	2.0	b	ate	o-e
<i>Nitzschia perminuta</i> Grunow	P-B	temp	str	hl	alf	5.79–8.0	-	-	-	-	-
<i>Nitzschia recta</i> Hantzsch ex Rabenhorst	B	temp	st-str	i	alf	6–9	-	1.0	o	-	-
<i>Nitzschia rosenstockii</i> Lange-Bertalot	B	-	-	hl	-	-	-	-	-	-	-
<i>Nitzschia sigma</i> (Kützing) W.Smith	B	temp	st-str	mh	alf	6.9–8.2	-	-	-	-	-
<i>Nitzschia sublinearis</i> Hustedt	P-B	-	-	i	alf	-	-	-	-	-	-
<i>Nitzschia umbonata</i> (Ehrenberg) Lange-Bertalot	P-B	-	st-str	i	ind	7.2–8.2	sp	2.0	b	hne	me
<i>Nitzschia vermicularis</i> (Kützing) Hantzsch	P-B	temp	st-str	i	alf	7.23	-	-	-	-	-
<i>Nitzschia</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Nupela impexiformis</i> (Lange-Bertalot) Lange-Bertalot	B	-	-	-	ind	6.8–7.3	sx	0.5	x-o	ats	ot
<i>Nupela neogracillima</i> Kulikovskiy & Lange-Bertalot	P-B	-	-	i	ind	-	-	-	-	-	ot
<i>Nupela silvaahercynia</i> (Lange-Bertalot) Lange-Bertalot	B	-	-	i	-	-	-	-	-	-	-
<i>Nupela tenuicephala</i> (Hustedt) Lange-Bertalot	B	-	-	-	acf	-	es	-	-	-	-
<i>Odontidium anceps</i> (Ehrenberg) Ralfs	P-B	cool	st-str	hb	ind	7.8–8.2	-	-	-	-	-
<i>Odontidium hyemale</i> (Roth) Kützing	P-B	cool	st-str	hb	ind	6.5–7.5	-	-	-	-	-





Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Pinnularia cardinaliculus</i> Cleve	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia cuneola</i> E.Reichardt	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia decrescens</i> (Grunow) Krammer	B	-	str	hb	ind	-	-	-	-	-	-
<i>Pinnularia divergens</i> var. <i>sublinearis</i> Cleve	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia divergens</i> W.Smith	B	-	st	hb	ind	-	-	-	-	-	-
<i>Pinnularia eifeliana</i> (Krammer) Krammer	B	-	-	-	-	-	-	1.0	o	-	-
<i>Pinnularia gentilis</i> (Donkin) Cleve	B	-	st-str	i	ind	-	-	-	-	-	-
<i>Pinnularia grunowii</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia halophila</i> Krammer	B	-	-	hl	-	-	-	0.2	x	ats	om
<i>Pinnularia intermedia</i> (Lagerstedt) Cleve	P-B	cool	st-str	i	ind	-	-	1.0	o	-	-
<i>Pinnularia krammeri</i> Metzeltin	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia lagerstedtii</i> (Cleve) A.Cleve	B	-	aer	hb	ind	-	-	-	-	-	-
<i>Pinnularia lailaensis</i> Foged	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia lata</i> (Brébisson) W.Smith	P-B	-	str	i	acf	-	-	0.3	x	-	-
<i>Pinnularia macilenta</i> Ehrenberg	B	-	-	-	-	-	-	0.9	x-b	-	-
<i>Pinnularia media</i> (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin	B	-	-	-	-	-	-	0.6	o-x	ate	me
<i>Pinnularia mesogongyla</i> Ehrenberg	B	-	st	i	ind	-	sx	0.2	o	ats	ot

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Pinnularia mesolepta</i> (Ehrenberg) W.Smith	P-B	temp	st-str	i	ind	6.9–7.1	-	-	-	-	ot
<i>Pinnularia microstauron</i> (Ehrenberg) Cleve var. <i>microstauron</i>	P-B	temp	st-str	i	ind	4.5–8.7	-	0.3	x	ats	ot
<i>Pinnularia microstauron</i> var. <i>rostrata</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia neohalophila</i> Kulikovskiy, Genkal & Mikheeva	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia neomajor</i> Krammer	B	-	-	i	ind	-	-	-	-	-	-
<i>Pinnularia nodosa</i> (Ehrenberg) W.Smith var. <i>nodosa</i>	B	temp	str	i	ind	6.79	-	0.4	x-o	-	-
<i>Pinnularia nodosa</i> var. <i>percapitata</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia nodosa</i> var. <i>robusta</i> (Foged) Krammer	B	-	-	-	-	-	-	0.4	x-o	ats	ot
<i>Pinnularia notabilis</i> Krammer	B	-	-	-	-	-	-	0.6	o-x	-	-
<i>Pinnularia oriunda</i> Krammer	B	-	-	i	neu	-	-	1.0	o	ats	ot
<i>Pinnularia oriundiformis</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia parvulissima</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia permicrostauron</i> Krammer & Metzeltin	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia pluvianiformis</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia quadratarea</i> (A.W.F.Schmidt) Cleve	B	-	-	ph	-	-	-	0.3	x	-	-
<i>Pinnularia rhombarea</i> Krammer	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia rupestris</i> Hantzsch	B	temp	str	i	acf	5.39	-	-	-	-	-
<i>Pinnularia septentrionalis</i> Krammer	B	-	-	i	ind	-	-	1.0	o	-	om
<i>Pinnularia similiformis</i> Krammer	B	-	-	-	acf	-	-	1.0	o	-	ot



Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Planothidium delicatulum</i> (Kützing) Round & Bukhtiyarova	P-B	-	st-str	mh	alb	6.6–8.5	-	1.0	o	ats	ot
<i>Planothidium haynaldii</i> (Schaarschmidt) Lange-Bertalot	B	-	st-str	i	alf	-	-	1.0	o	hne	om
<i>Planothidium lanceolatum</i> (Brébisson ex Kützing) Lange-Bertalot	P-B	temp	st-str	i	alf	6.4–9.0	sx	1.0	o	ats	om
<i>Planothidium straubianum</i> C.E.Wetzels, Van de Vijver & L.Ector	B	-	str	i	alf	8.0	-	-	a	ats	e
<i>Planothidium</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Pleurosigma delicatulum</i> W.Smith	B	-	-	mh	-	-	-	-	-	-	-
<i>Pleurosigma elongatum</i> W.Smith	P-B	-	-	mh	alf	-	-	-	-	-	-
<i>Praestephanos triporus</i> (Genkal & G.V.Kuzmin) A.Tuji & J.-S.Ki	P	-	-	i	alf	-	-	-	-	-	-
<i>Prestauroneis crucicula</i> (W.Smith) Genkal & Yarushina	B	-	-	mh	ind	-	-	0.2	x	-	-
<i>Psammothidium petersenii</i> (Hustedt) Round et Bukhtiyarova	-	-	-	-	-	-	-	-	-	-	-
<i>Psammothidium bioretii</i> (H.Germain) Bukhtiyarova & Round	B	-	str	i	ind	6.08–7.9	-	0.7	o-x	ats	ot
<i>Psammothidium chlidanos</i> (M.H.Hohn & Hellerman) Lange-Bertalot	B	-	-	hb	acf	7.1–7.9	-	1.0	o	-	ot
<i>Psammothidium daonense</i> (Lange-Bertalot) Lange-Bertalot	B	temp	str	hb	ind	6.6–8.2	-	-	o	ats	ot
<i>Psammothidium helveticum</i> (Hustedt) Bukhtiyarova & Round	B	temp	st-str	hb	alf	6.0–7.4	es	2.4	b-a	ate	m
<i>Psammothidium kryophilum</i> (J.B.Petersen) E.Reichardt	P-B	-	str	i	ind	8.10	sx	0.5	x-o	ats	ot
<i>Psammothidium levanderi</i> (Hustedt) Bukhtiyarova & Round	B	temp	str	i	ind	6.6–8.4	sx	2.0	b	ats	om
<i>Psammothidium marginulatum</i> (Grunow) Bukhtiyarova & Round	B	temp	st-str	hb	acf	4.6–7.9	sx	0.2	x	ats	ot

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Psammothidium rechtense</i> (Leclercq) Lange-Bertalot	B	-	str	hb	alf	-	-	1.0	o	ats	ot
<i>Psammothidium rossii</i> (Hustedt) Bukhtiyarova & Round	B	-	str	hb	ind	-	-	1.0	o	ats	ot
<i>Psammothidium scoticum</i> (R.J.Flower & V.J.Jones) Bukhtiyarova & Round	B	temp	-	-	-	6.42	-	-	-	-	-
<i>Psammothidium subatomoides</i> (Hustedt) Bukhtiyarova & Round	P-B	temp	str	hb	acf	6.4–8.01	sx	2.0	b	ats	me
<i>Psammothidium subsalsum</i> (J.B.Petersen) Kulikowski, Witkowski & Pliński	B	-	-	-	-	-	-	-	-	-	-
<i>Psammothidium ventrale</i> (Krasske) Bukhtiyarova & Round	B	-	str	hb	acf	7.45	-	2.0	b	ats	om
<i>Psammothidium</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Pseudostaurosira brevistriata</i> (Grunow) D.M.Williams & Round	P-B	temp	st-str	i	alf	5.2–8.4	-	2.0	b	ate	-
<i>Pseudostaurosira parasitica</i> (W.Smith) E.Morales	P-B	temp	st-str	i	alf	6.41–8.22	-	1.0	o	ate	ot
<i>Pulchellophycus obsitus</i> (Hustedt) Edlund & M.J.Wynne	-	-	-	-	-	-	-	-	-	-	-
<i>Pulchellophycus</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Reimeria sinuata</i> (W.Gregory) Kociolek & Stoermer	P-B,aer	temp	st-str	i	ind	6.6–8.9	-	-	-	-	-
<i>Rexlowea parasemen</i> (Lange-Bertalot) Kulikovskiy, Kociolek & Genkal	B	-	-	i	ind	-	es	-	-	-	-
<i>Rhizosolenia hebetata</i> f. <i>semispina</i> (Hensen) Gran	P	cool	-	eh	-	-	-	-	-	-	-
<i>Rhizosolenia hebetata</i> J.W.Bailey	P	cool	-	eh	-	-	-	-	-	-	-
<i>Rhoicosphenia abbreviata</i> (C.Agardh) Lange-Bertalot	B	temp	st-str	i	alf	6.5–8.6	es	1.9	o-a	ate	me
<i>Rhopalodia gibba</i> (Ehrenberg) O.Müller var. <i>gibba</i>	P-B	temp	st-str	i	alf	6.2–9.0	es	1.4	x-o	ate	om
<i>Rhopalodia gibba</i> var. <i>ventricosa</i> (Kützing) H.Peragallo & M.Peragallo	B	temp	-	i	alf	6.2–9.0	es	1.4	o-b	hne	-

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Roperia praetesselata</i> H.J.Schrader	-	-	-	-	-	-	-	-	-	-	-
<i>Rossthidium kreigeri</i> (Krasske) Bahls	B	-	-	hb	-	-	sx	1.0	o	-	ot
<i>Sellaphora absoluta</i> (Hustedt) Wetzel, Ector, Van de Vijver, Compère & D.G.Mann	B	-	str	i	ind	-	es	1.0	o	ats	m
<i>Sellaphora bacillum</i> (Ehrenberg) D.G.Mann	B	-	st-str	i	alf	7–9	sx	1.5	o-b	ats	me
<i>Sellaphora difficillima</i> (Hustedt) C.E.Wetzel, L.Ector & D.G.Mann	B	temp	str	hb	acf	7.8	-	1.0	o	ate	om
<i>Sellaphora insolita</i> (É.Manguin ex Kociolek & B.de Reviers) P.B.Hamilton & D.Antoniades	-	-	-	-	-	-	-	-	-	-	-
<i>Sellaphora laevissima</i> (Kützing) D.G.Mann	B	-	st-str	i	ind	5.7–8.1	-	2.0	b	ats	om
<i>Sellaphora parapupula</i> Lange-Bertalot	B	-	st	i	ind	6.5–7.6	-	1.0	o	ate	m
<i>Sellaphora pupula</i> (Kützing) Mereschkovskiy	B	eterm	st-str	hl	ind	5.2–9.0	sx	1.9	o-a	ate	me
<i>Sellaphora rectangularis</i> (W.Gregory) Lange-Bertalot & Metzeltin	B	temp	st-str	hl	ind	6.5–9.0	sx	1.9	o-a	ate	me
<i>Sellaphora vitabunda</i> (Hustedt) D.G.Mann	B	-	-	i	alf	8.06	es	1.0	o	ats	om
<i>Sellaphora</i> sp.	B	-	-	-	-	-	-	-	-	-	-
<i>Simonsenia delognei</i> (Grunow) Lange-Bertalot	B	temp	str	oh	alf	7.5–8.1	-	3.0	a	hne	e
<i>Skabitschewskia oestrupii</i> (A.Cleve) Kuliskovskiy & Lange-Bertalot	B	-	str	i	ind	7.6	-	1.0	o	ats	om
<i>Skabitschewskia peragalloi</i> (Brun & Héribaud) Kuliskovskiy & Lange-Bertalot	B	-	str	i	ind	8.20	sx	0.4	x-o	ats	om
<i>Skeletonema subsalsum</i> (A.Cleve) Bethge	P	-	-	i	ind	-	-	2.3	b	-	me
<i>Stauroneis amphicephala</i> Kützing	P-B	temp	st-str	i	ind	4.8–8.2	sx	1.3	o	ats	om
<i>Stauroneis anceps</i> Ehrenberg f. <i>anceps</i>	P-B	temp	st-str	i	ind	4.8–8.2	sx	1.3	o	ats	om

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Stauroneis anceps f. linearis</i> Rabenhorst	B	-	st-str	i	alf	-	-	-	-	-	-
<i>Stauroneis gracilior</i> E.Reichardt	B	-	-	-	-	-	-	-	-	-	-
<i>Stauroneis gracilis</i> Ehrenberg	B	-	-	I	ind	5.3	-	-	o	-	-
<i>Stauroneis guslyakovii</i> Genkal & Yarushina	-	-	-	-	-	-	-	-	-	-	-
<i>Stauroneis phoenicenteron</i> (Nitzsch) Ehrenberg	P-B	temp	st-str	i	ind	6.01–8.5	-	-	-	-	-
<i>Stauroneis reichardtii</i> Lange-Bertalot, Cavacini, Tagliaventi & Alfinito	P-B	temp	st-str	i	ind	4.8–8.2	sx	1.3	o	ats	om
<i>Stauroneis schulzii</i> Jousé	B	-	-	i	alf	-	-	-	-	ats	-
<i>Stauroneis siberica</i> (Grunow) Lange-Bertalot & Krammer	B	-	-	i	alf	-	-	-	-	-	-
<i>Stauroneis smithii</i> Grunow var. karelica Wislouch & Kolbe	B	cool	-	i	-	-	-	1.0	o	-	ot
<i>Stauroneis smithii</i> Grunow var. smithii	P-B	-	st-str	i	alf	-	-	1.0	o	-	om
<i>Stauroneis</i> sp.	B	-	-	-	-	-	-	1.5	o-b	ate	o-e
<i>Staurosira construens</i> Ehrenberg	P-B	temp	st-str	i	alf	5.5–9.0	-	1.0	o	-	-
<i>Staurosira sviridae</i> Kulikovskiy, Genkal & Mikheeva	-	-	-	-	-	-	-	-	-	-	-
<i>Staurosirella lanceolata</i> (Hustedt) E.A.Morales, C.Wetzel & L.Ector	-	-	-	-	-	-	-	-	-	-	-
<i>Staurosirella lapponica</i> (Grunow) D.M.Williams & Round	P-B	temp	st-str	i	ind	7.24–8.2	-	1.1	o	ate	ot
<i>Staurosirella pinnata</i> (Ehrenberg) D.M.Williams & Round	P-B	temp	st-str	hl	alf	6.2–9.3	es	1.1	o	ats	om
<i>Stenopterobia heribaudii</i> (Playfair) Playfair	P-B	-	st	-	-	-	-	0.4	x-o	-	-

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Stephanocyclus meneghinianus</i> (Kützing)	P-B	temp	st-str	hl	alf	5.5–9.0	sp	2.8	a	hne	e
Kulikovskiy, Genkal & Kociolek = <i>Cyclotella meneghiniana</i> Kützing											
<i>Stephanodiscus binderanus</i> (Kützing) Krieger	P	-	-	hl	ind	-	es	1.5	o-b	ate	me
<i>Stephanodiscus hantzschii</i> Grunow	P	temp	-	i	-	8.0–8.5	-	-	-	-	-
<i>Stephanodiscus hashiensis</i> H.Tanaka	-	-	-	-	-	-	-	-	-	-	-
<i>Stephanodiscus minutulus</i> (Kützing) Cleve & Möller	P	temp	st-str	i	alb	6.5–9.0	es	3.6	a-o	hne	he
<i>Stephanodiscus neoastraea</i> Håkansson & Hickel emend. Casper, Scheffler et Augsten	P	temp	st-str	i	alb	5.5–9.0	es	-	-	-	-
<i>Surirella angusta</i> Kützing	P-B	temp	st-str	i	alf	6.9–8.9	-	-	-	-	-
<i>Surirella brebissonii</i> Krammer & Lange-Bertalot	B	temp	st-str	hl	alf	7.2–8.4	-	0.5	x-o	-	-
<i>Surirella capronii</i> var. <i>hankensis</i> Skvortzov	-	-	-	-	-	-	-	-	-	-	-
<i>Surirella conifera</i> Skvortzov	-	-	-	-	-	-	-	-	-	-	-
<i>Surirella crumena</i> Brébisson ex Kützing	B	-	st-str	hl	alf	-	-	-	-	-	-
<i>Surirella didyma</i> Kützing	B	-	-	i	alf	-	-	-	-	-	-
<i>Surirella elegans</i> Ehrenberg	P-B	-	str	i	alf	-	-	1.0	o	-	om
<i>Surirella hibernica</i> (W.Smith) D.Kapustin & O.Kryvosheia	P-B	-	st-str	i	alf	-	-	-	-	-	-
<i>Surirella librile</i> (Ehrenberg) Ehrenberg	P-B	temp	st-str	i	alf	8.0	-	-	-	hne	-
<i>Surirella minuta</i> Brébisson ex Kützing	B	temp	st-str	i	alf	6.9–8.6	-	-	-	-	-



Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Surirella ovalis</i> Brébisson	P-B	-	st-str	mh	alf	-	es	1.7	b-o	-	-
<i>Surirella roba</i> Leclercq	B	-	str	i	acf	-	-	-	-	-	-
<i>Surirella</i> sp.	B	-	-	mh	-	-	es	1.85	o-a	hne	-
<i>Synedra actinastroides</i> (Lemmermann) Lemmermann	-	-	-	-	-	-	-	-	-	-	-
<i>Tabellaria fenestrata</i> (Lyngbye) Kützing	P-B	-	st-str	i	ind	6.2	-	1.9	o-a	-	-
<i>Tabellaria flocculosa</i> (Roth) Kützing	P-B	eterm	st-str	i	acf	4.5–8.0	-	3.0	a	-	-
<i>Tabularia parva</i> (Kützing) D.M.Williams & Round	-	-	-	mh	alf	-	-	-	-	-	-
<i>Tabularia tabulata</i> (C.Agardh) Snoeijis	B	-	-	mh	alf	-	-	-	-	-	-
<i>Tetracyclus glans</i> (Ehrenberg) F.W.Mills	P-B	temp	-	i	acf	6.95	-	1.0	x-o	-	ot
<i>Tetracyclus rupestris</i> (Kützing) Grunow	P-B	cool	aer	i	acf	-	-	0.8	x-b	-	ot
<i>Thalassionema nitzschioides</i> (Grunow) Mereschkowsky	P	-	-	eh	-	-	-	-	-	-	-
<i>Thalassiosira baltica</i> (Grunow) Ostenfeld	P-B	cool	-	mh	-	-	-	-	-	-	-
<i>Thalassiosira bramaputrae</i> (Ehrenberg) Håkansson & Locker	P-B	-	st-str	hl	alf	-	sp	1.4	o-b	ate	m
<i>Thalassiosira decipiens</i> (Grunow ex Van Heurck) Jørgensen	P-B	cool	-	eh	-	-	-	-	-	-	-
<i>Thalassiosira gravida</i> Cleve	P	cool	-	eh	alf	-	es	2.0	b	-	-
<i>Thalassiosira hyalina</i> (Grunow) Gran	-	warm	-	eh	-	-	-	-	-	-	-

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Thalassiosira leptopus</i> (Grunow) Hasle & G.Fryxell	P-B	cool	-	eh	alf	-	-	2.0	b	-	-
<i>Thalassiosira nordenskiöldii</i> Cleve	P	eterm	-	eh	-	-	-	-	-	-	-
<i>Thalassiosira pseudonana</i> Hasle & Heimdal	P	temp	st-str	hl	alf	7.4–8.0	-	2.4	b-a	hne	he
<i>Thalassiosira</i> sp.	B	-	-	-	-	-	-	-	-	-	-
<i>Tryblionella angustata</i> W.Smith var. <i>angustata</i>	P-B	temp	st	i	alf	6.86–7.7	sx	1.5	o-b	ats	e
<i>Tryblionella angustata</i> var. <i>acuta</i> (Grunow) Bukhtiyarova	P-B	-	-	i	alf	-	-	2.0	b	-	m
<i>Tryblionella calida</i> (Grunow) D.G.Mann	P-B	-	-	hl	-	7.8–8.2	-	2.6	a-o	-	e
<i>Tryblionella debilis</i> Arnott ex O'Meara	P-B	temp	st-str,aer	i	alf	6.9–8.3	es	2.6	a-o	ate	e
<i>Tryblionella hantzschiana</i> Grunow	B	-	st-str	hl	alf	-	-	2.6	a-o	ate	e
<i>Tryblionella gracilis</i> var. <i>ambigua</i> (Grunow) Bukhtiyarova	B	-	-	hl	-	-	-	2.0	b	-	-
<i>Tryblionella hungarica</i> (Grunow) Frenguelli	P-B	-	st-str	mh	alf	7.0–7.8	sp	2.9	a	ate	e
<i>Tryblionella littoralis</i> (Grunow) D.G.Mann	B	-	st-str	eh	alf	-	es	2.6	a-o	ats	e
<i>Ulnaria acus</i> (Kützing) Aboal	P-B	warm	st-str	i	alf	6.8–8.0	es	1.85	o-a	ate	me
<i>Ulnaria amphirhynchus</i> (Ehrenberg) Compère & Bukhtiyarova	P-B	-	-	i	alf	-	es	2.0	b	hne	om
<i>Ulnaria biceps</i> (Kützing) Compère	P-B	temp	-	i	alf	5–9	-	1.9	o-a	-	om
<i>Ulnaria capitata</i> (Ehrenberg) Compère	P-B	-	st-str	i	alf	-	es	2.0	b	ats	e
<i>Ulnaria contracta</i> (Østrup) E.A.Morales & M.L.Vis	B	-	-	i	alf	6.3–9	es	2.4	b-a	hne	-

Table A2. Cont.

Taxa	Hab	Temp	Oxy	Sal	pH	pH Range	D	Index S	Sap	Aut-Het	Tro
<i>Ulnaria danica</i> (Kützing) Compère & Bukhtiyarova	P-B	temp	-	i	alf	6.5–9.0	es	1.7	b-o	hne	om
<i>Ulnaria delicatissima</i> var. <i>angustissima</i> (Grunow) Aboal & P.C.Silva	P-B	-	-	i	alf	8.0	es	1.7	b-o	-	om
<i>Ulnaria ulna</i> (Nitzsch) Compère	P-B	temp	st-str	i	alf	5.0–9.5	es	2.4	b-a	ate	e
<i>Ulnaria</i> sp.	-	-	-	-	-	-	-	-	-	-	-
<i>Urosolenia eriensis</i> (H.L.Smith) Round & R.M.Crawford	P-B	-	str	hl	acf	7.93	-	0.5	x-o	ats	om
<i>Urosolenia longiseta</i> (O.Zacharias) Edlund & Stoermer	P	-	str	i	acf	-	-	0.9	x-b	ats	me

Note: “-”, not found. Abbreviations: Habitat (Hab) (P—planktonic, P-B—plankto-benthic, B—benthic); temperature (T) preferences (cool—cool-water, temp—temperate, eterm—eurhythmic, warm—warm-water); oxygenation and streaming (Oxy) (st—standing water, str—streaming water, st-str—low streaming water, aer—aerophiles); pH preferences groups (pH) according to Hustedt (1957) [63] (alb—alkalibiontes; alf—alkaliphiles, ind—indifferent; acf—acidophiles; acb—acidobiontes, neu—neutrophiles); salinity ecological groups (Sal) according to Hustedt (1938–1939) [62] (hb—oligohalobes-halophobes, i—oligohalobes-indifferent, hl—halophiles; mh—mesohalobes, oh—oligohalobes of wide spectrum with optimum as indifferent, eh—euhalobes, ph—polyhalobes); Index S, species-specific index saprobity according to Sládeček, 1986 [65]; self-purification zone with index of saprobity (Sap) (x/0.0—xenosaprobe; x-o/0.4—xeno-oligosaprobe; x-b/0.8—xeno-betamesosaprobe; o/1.0—oligosaprobe; b-o/1.6—beta-oligosaprobe; o-a/1.8—oligo-alphamesosaprobe; b/2.0—betamesosaprobe; a/3.0—alphamesosaprobe; o-x/0.6—oligo-xenosaprobe; o-b/1.4—oligo-betamesosaprobe; b-p/2.8—beta-polysaprobe; b-a/2.4—beta-alphamesosaprobe; a-p/3.4—alpha-polysaprobe; a-o/2.6—alpha-oligosaprobe; a-b/3.6—alpha-betamesosaprobe; organic pollution indicators according to Watanabe et al. (1986) [64] (D): sx—saproxenes; es—eurysaprobies; sp—saprophiles; nitrogen uptake metabolism (Aut-Het) (Van Dam et al., 1994) [66]: 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) (Van Dam et al., 1994) [66]: (ot—oligotraphentic; om—oligomesotraphentic; m—mesotraphentic; me—mesoeutraphentic; e—eutraphentic; he—hypereutraphentic; o-e—oligo- to eutraphentic (hypereutraphentic)).

**Table A3.** Distribution of species indicators over ecological groups in the waterbodies of the Lena Delta Nature Reserve and adjacent areas. Abbreviation of ecological groups as in Appendix A Table A2.

Ecological Group	No of Indicators
Habitat	
B	330
P-B	161
P	24
Temperature	
cool	26
temp	184
eterm	6
warm	6
Oxygen	
aer	3
str	73
st-str	211
st	26
Salinity	
hb	76
i	298
hl	50
mh	35
eh	16
ph	1
Water pH	
acb	4
acf	83
ind	162
alf	190
alb	10
Saprobity Watanabe	
sx	47
es	75

Table A3. Cont.

Ecological Group	No of Indicators
sp	13
Nutrition type	
ats	102
ate	70
hne	21
hce	2
Trophic state	
ot	79
om	52
m	13
me	36
e	45
o-e	6
he	4
Class of Water Quality	
Class 1	46
Class 2	165
Class 3	79
Class 4	17
Class 5	7

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