Diatom Species Richness in Algal Flora of Pamir, Tajikistan

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Abstract

The main objective of this study was to quantify the diatom floral richness and analyze the diversity structure in Pamir aquatic habitats. We revealed 455 species (552 with infraspecific taxa) of diatom algae compiled from reference studies in 1930-1983 that was done for the first time, and our data after many floristic surveys conducted in the field during 2000-2015. Floristic analysis of the total species richness revealed 65 rare and 22 species new for Pamir algal flora, and has allowed us to identify prevailed Classes, Orders, and Families in the diatoms. Only four genera are prevailing and contain about 30% of total richness. The *Pinnularia* species from them are representing extremely large numbers (39). They prefer fresh, clear, circumneutral-water habitats in natural aquatic objects with developed phytoperiphytonic communities, included many rare species and can be peculiarities of the Pamir diatom flora.

Keywords: Diatoms, Algal flora, Pamir, Tajikistan

Introduction

Freshwater algae are widely used in ecological assessment of water quality (Stevenson, 2014). It is very important to know about algal diversity in inland waters because most of algal species can be used as environmental indicators. Diversity of algae in Tajikistan has been studied sporadically during the last century. The uppermost, from 2,000 to 4,000 m above the sea level (a.s.l.), part of Tajikistan territory is Pamir where so large regional rivers as Panj and Gunt are started. This high mountain area is very rich in thermal and mineral waters, which in a way are unique habitats characterized by a constantly and high temperature from 10 ˚C to 86 ˚C and various chemical compositions saturated with carbon dioxide and nitrogen gases such as

hydrogen sulfide-siliceous, hydrocarbonate-sulphate-calcium-magnesium, chloride-sulfate-calcium-sodium, hydrocarbonate-sulfate-sodium and weakradon-chloride-sulfate (Bokhodjaev, Davlatmamadov, 1994; Churshina, 1982). In these waters, for many centuries, a special community of algae with a specific species composition and degree of species resistance to peculiarly extreme environmental conditions was formed and developed. Therefore, Pamir is one of high altitude area in Eurasia with close relations to Hindu Cush, Altay, and Himalayas. Its territory have diverse aquatic habitats from clear freshwater large rivers, streams, lakes, to mineral and thermal springs which are occupied by diverse algal communities.

Usually, diatom algae represent about one-half of species richness in the well-studied middle-latitudinal regional algal flora. Before our study, the referenced literature data on Pamir regional algal flora is known from sporadically collected material in period 1930-1983 (Petersen, 1930; Muzafarov, 1965; Ergashev, 1969; Balashova, Nikitina, 1978; Baturina, 1983). The regular work has been started in 2000 and continued up to 2006 by G.R. Jumaeva (Jumaeva, 2008). Our own study of diatoms in thermal and mineral springs is enriched the regional diversity by 134 diatom species (166 with infraspecific taxa) (Barinova, Niyatbekov, 2017). We assume that the diversity of this group of algae in Pamir is still far from complete.

Thus, the aim of our work was to compile full taxa list of diatom algae from different habitats of Pamir from own and referenced data, and analyse their species richness and systematic structure data.

Material and Methods

Sampling and laboratory studies

The material for this analysis is represented by our own data from 150 samples collected during few field trips in summer period of 2000-2015 from various thermal and mineral springs located at an altitude from 2,360 m to 3,800 m a.s.l. (Barinova, Niyatbekov, 2017). Algological samples were collected by scratching and scooping, placed in 15 ml plastic tubes, and partly fixed with 3% neutral formaldehyde solution, as well as partly not fixed and transported to the laboratory in the ice box.

The diatoms were prepared by the peroxide technique modified for glass slides and were placed in the Naphrax® resin from two repetitions of each sample.

The structure elements of the diatom shells were observed with Nikon stereomicroscope under magnifications 740x–1850x from two repetitions of each sample and were photographed with a DC in the Institute of Botany, Plant Physiology and Genetics, Dushanbe, Republic of Tajikistan, and the Institute of Evolution, University of Haifa, and species were defined with help of international handbooks.

Taxonomic data compilation

Total species list was compiled from our study as well as from referenced lists in publication about diatom diversity in Pamir aquatic habitats (Petersen, 1930; Muzafarov, 1965; Ergashev, 1969; Balashova, Nikitina, 1978; Churshina, 1982; Baturina, 1983; Bokhodjaev, Davlatmamadov, 1994; Jumaeva, 2008; Barinova, Niyatbekov, 2017). All collected taxonomic data was adopted to the modern system with help of algaebase.org. Taxonomic list was analyzed in the Microsoft Access 2013 Program.

Results and Discussion

The data compilation and analysis of the floristic surveys conducted in the field has allowed us to identify 455 species (552 with infraspecific taxa) of diatom algae (Table 1). Diatom species number in the floras of surrounding mountain areas is usually contain about half of the total species richness whereas in the lowland floras the Chlorophyta species are prevail (Zarei Darki, 2009). So, diatoms are contain 498 taxa from 1,190 in South-Tajik Depression (Barinova et al., 2015), 498 taxa from 1,063 in mountain Georgia (Barinova et al., 2011), 317 taxa from 644 in the Aragvi River basin (Barinova, Kukhaleishvili, 2014), 60 from 149 taxa in Hindu Cush (Barinova et al., 2013), 690 taxa from 1,621 in Israel (Barinova, 2011), 671 taxa from 1,559 in Iran (Zarei Darki, 2009), and 961 from 2,100 in Turkey (Aysel, 2005). It let us to assume that full list of freshwater diversity in Pamir can reach about 1,000 taxa and we will continuing our study in this direction.

Table 1. Diversity of diatom algae in the Pamir high mountain habitats. Sp – species, Ssp – subspecies.

No.	Taxa	Sp	Ssp
1	*Achnanthes brevipes* var. *intermedia* (Kützing) Cleve 1895	0	1
2	*Achnanthes brevipes* C.Agardh 1824 var. *brevipes*	1	1
3	*Achnanthes coarctata* (Brébisson ex W. Smith) Grunow in Cleve and Grunow 1880	1	1
4	*Achnanthes conspicua* var. *brevistriata* Hustedt 1930	0	1
5	*Achnanthes dispar* var. *angustissima* (Jasnitsky) Sheshukova in Proschkina-Lavrenko 1950	0	1
6	*Achnanthes exigua* Grunow in Cleve & Grunow 1880	1	1
7	*Achnanthes gibberula* Grunow in Cleve & Grunow 1880 var. *gibberula*	1	1
8	*Achnanthes gibberula* var. *interrupta* Poretzky & Anisimova 1933	0	1
9	*Achnanthes pamirensis* Hustedt 1922	1	1
10	*Achnanthidium exile* (Kützing) Heiberg 1863	1	1
11	*Achnanthidium gracillimum* (Meister) Lange-Bertalot 2004	1	1
12	*Achnanthidium lanceolatum* var. *ventricosum* (Hustedt) Poretsky 1924	0	1

13	*Achnanthidium lineare* W.Smith 1855	1	1
14	*Achnanthidium minutissimum* (Kützing) Czarnecki 1994	1	1
15	*Achnanthidium minutum* Cleve 1891	1	1
16	*Achnanthidium thermale* Rabenhorst 1864	1	1
17	*Actinella punctata* F.W. Lewis 1864	1	1
18	*Adlafia bryophila* (J.B.Petersen) Lange-Bertalot in Gerd Moser, Lange-Bertalot & Metzeltin 1998	1	1
19	*Adlafia minuscula* (Grun.) Lange-Bertalot 1999 var. *minuscula*	1	1
20	*Adlafia minuscula* var. *muralis* (Grunow) Lange-Bertalot in Lange-Bertalot & Genkal 1999	0	1
21	*Amphiprora paludosa* var. *duplex* (Donkin) Van Heurck 1885	0	1
22	*Amphora commutata* Grunow in van Heurck 1880	1	1
23	*Amphora libyca* Ehrenberg 1841	1	1
24	*Amphora mongolica* Østrup 1908 var. *mongolica*	1	1
25	*Amphora mongolica* var. *cornuta* Skvortzov 1937	0	1
26	*Amphora ovalis* (Kützing) Kützing 1844 var. *ovalis*	1	1
27	*Amphora ovalis* var. *gracilis* (Ehrenberg) van Heurck 1885	0	1
28	*Amphora pediculus* (Kütz.) Grun. ex A. Schmidt	1	1
29	*Amphora proteus* Gregory 1857	1	1
30	*Amphora robusta* Gregory 1857	1	1
31	*Aneumastus apiculatus* (Østrup) Lange-Bertalot in Lange-Bertalot & Genkal 1999	1	1
32	*Aneumastus minor* Lange-Bertalot 1993	1	1
33	*Aneumastus rostratus* (Hustedt) Lange-Bertalot 2001	1	1
34	*Aneumastus tuscula* (Ehrenberg) D.G.Mann & A.J.Stickle in Round, R.M.Crawford & D.G.Mann 1990	1	1
35	*Anomoeoneis costata* (Kützing) Hustedt 1959	1	1
36	*Anomoeoneis serians* f. *thermalis* A.Cleve	0	1
37	*Anomoeoneis sphaerophora* Pfitzer 1871 var. *sphaerophora*	1	1
38	*Anomoeoneis sphaerophora* var. *guentheri* Otto Müller 1900	0	1
39	*Anomoeoneis sphaerophora* var. *sculpta* (Ehrenberg) Otto Müller 1900	0	1
40	*Aulacoseira alpigena* (Grunow) Krammer 1991	1	1
41	*Aulacoseira distans* (Ehrenberg) Simonsen 1979	1	1
42	*Aulacoseira granulata* (Ehrenberg) Simonsen 1979 var. *granulata*	1	1
43	*Aulacoseira granulata* var. *angustissima* (O. Müll.) Simons.	0	1
44	*Aulacoseira italica* (Ehrenberg) Simonsen 1979	1	1
45	*Aulacoseira nivaloides* (K.E.Camburn) J.English & M.Potapova 2009	1	1
46	*Aulacoseira valida* (Grunow) Krammer 1991	1	1

47	*Bacillaria paxillifera* (O.F.Müller) T.Marsson 1901	1	1
48	*Boreozonacola hustedtii* Lange-Bertalot, Kulikovskiy and Witkowski 2010	1	1
49	*Brachysira exilis* (Kützing) Round & D.G.Mann 1981	1	1
50	*Brachysira microcephala* (Grunow) Compère 1986	1	1
51	*Brachysira serians* (Brébisson) Round & D.G.Mann 1981	1	1
52	*Brebissonia lanceolata* (Agardh) Mahoney and Reimer 1986	1	1
53	*Caloneis amphisbaena* (Bory) Cleve 1894	1	1
54	*Caloneis bacillum* (Grunow) Cleve 1894	1	1
55	*Caloneis fasciata* (Lagerstedt) Cleve 1894	1	1
56	*Caloneis lewisii* Patrick 1945	1	1
57	*Caloneis limosa* (Kützing) R.M.Patrick in Patrick & Reimer 1966	1	1
58	*Caloneis molaris* (Grunow) Krammer in Krammer & Lange-Bertalot 1985	1	1
59	*Caloneis nubicola* (Grunow) Cleve 1894	1	1
60	*Caloneis schumaniana* (Grunow) Cleve var. *schumaniana*	1	1
61	*Caloneis schumanniana* var. *biconstricta* (Grunow) Reichelt 1903	0	1
62	*Caloneis silicula* (Ehrenberg) Cleve 1894 var. *silicula*	1	1
63	*Caloneis silicula* var. *jenissejensis* Grunow	0	1
64	*Caloneis silicula* var. *kjellmaniana* Cleve	0	1
65	*Caloneis tenuis* (Gregory) Krammer 1985	1	1
66	*Caloneis undulata* (Gregory) Krammer 1912	1	1
67	*Caloneis ventricosa* (Ehrenberg) F. Meister 1912 var. *ventricosa*	1	1
68	*Caloneis ventricosa* var. *truncatula* (Grunow) Meister 1912	0	1
69	*Campylodiscus clypeus* (Ehrenberg) Ehrenberg ex Kützing 1844	1	1
70	*Cavinula cocconeiformis* (Gregory ex Greville) Crawford & Mann 1990	1	1
71	*Cavinula scutelloides* (W. Smith) Lange-Bertalot in Lange-Bertalot & Metzeltin 1996	1	1
72	*Cocconeis disculus* (Schumann) Cleve in Cleve & Jentzsch 1882	1	1
73	*Cocconeis fluviatilis* J.H.Wallace 1960	1	1
74	*Cocconeis neodiminuta* Krammer 1990	1	1
75	*Cocconeis pediculus* Ehrenberg 1838	1	1
76	*Cocconeis placentula* Ehrenberg 1838 var. *placentula*	1	1
77	*Cocconeis placentula* var. *euglypta* (Ehrenberg) Grunow 1884	0	1
78	*Cocconeis placentula* var. *intermedia* (Héribaud-Joseph & M.Peragallo) Cleve 1895	0	1
79	*Cocconeis placentula* var. *lineata* (Ehrenberg) Van Heurck 1885	0	1
80	*Cocconeis placentula* var. *rouxii* (Héribaud-Joseph & Brun) Cleve 1895	0	1

81	*Cocconeis scutellum* Ehrenberg 1838	1	1
82	*Cosmioneis pusilla* (W.Smith) D.G.Mann & A.J.Stickle in Round, Crawford & Mann 1990	1	1
83	*Craticula ambigua* (Ehrenberg) D.G.Mann in Round, Crawford & D.G.Mann 1990	1	1
84	*Craticula cuspidata* (Kützing) Mann 1990	1	1
85	*Craticula halophila* (Grunow) D.G.Mann in Round, R.M.Crawford & D.G.Mann 1990	1	1
86	*Ctenophora pulchella* (Ralfs ex Kützing) D.M. Williams et Round 1986 var. *pulchella*	1	1
87	*Ctenophora pulchella* var. *lacerata* (Hustedt) Bukhtiyarova 1995	0	1
88	*Cyclotella choctawhatcheeana* Prasad in Prasad, Neinow & Livingston 1990:	1	1
89	*Cyclotella meneghiniana* Kützing 1844	1	1
90	*Cyclotella radiosa* (Grunow) Lemmermann 1900	1	1
91	*Cymatopleura elliptica* (Brébisson) W.Smith 1851	1	1
92	*Cymbella laevis* Nägeli in Rabenhorst 1863	1	1
93	*Cymbella affinis* Kützing 1844	1	1
94	*Cymbella amplificata* Krammer 2002	1	1
95	*Cymbella angustata* var. *diversistriata* Muzafarov 1958	0	1
96	*Cymbella aspera* (Ehrenberg) Cleve 1894 var. *aspera*	1	1
97	*Cymbella aspera* var. *intermedia* Skvortzov	0	1
98	*Cymbella cistula* (Ehrenberg) O.Kirchner 1878 var. *cistula*	0	1
99	*Cymbella cistula* var. *maculata* (Kützing) Van Heurck 1885	0	1
100	*Cymbella compacta* Østrup 1910	1	1
101	*Cymbella cosleyi* L.Bahls 2013	1	1
102	*Cymbella cymbiformis* C. Agardh 1830	1	1
103	*Cymbella excisiformis* Krammer 2002	1	1
104	*Cymbella falaisensis* (Grunow) Krammer & Lange-Bertalot 1985	1	1
105	*Cymbella gutwinskii* (Wislouch) Skvortzov & Meyer 1928	1	1
106	*Cymbella helvetica* Kützing 1844 var. *helvetica*	1	1
107	*Cymbella helvetica* var. *curta* Cleve	0	1
108	*Cymbella hustedtii* f. *lineolata* Muzafarov 1958	0	1
109	*Cymbella hustedtii* Krasske 1923	1	1
110	*Cymbella hybrida* var. *pamirica* J.B.Petersen	0	1
111	*Cymbella lanceolata* (C.Agardh) C.Agardh 1830 var. *lanceolata*	1	1
112	*Cymbella lanceolata* var. *cornuta* f. *minuta* Muzafarov 1958	0	1
113	*Cymbella lanceolata* var. *notata* Wisl.& Poretzky	0	1
114	*Cymbella neocistula* Krammer 2002	1	1
115	*Cymbella obtusiuscula* Kützing 1844	1	1

116	*Cymbella palustris* var. *alpine* Muzafarov 1958	0	1
117	*Cymbella pamirensis* Z.G.Zhang & Rioual in Z.G.Zhang et al. 2017	1	1
118	*Cymbella parva* (W.Smith) Kirchner 1878	1	1
119	*Cymbella proschkinae* Muzafarov	1	1
120	*Cymbella stuxbergii* (Cleve) Cleve 1894	1	1
121	*Cymbella subsymmetrica* J.B.Petersen	1	1
122	*Cymbella subturgidula* Krammer 2002	1	1
123	*Cymbella tropica* Krammer 2002	1	1
124	*Cymbella tumida* (Brébisson) van Heurck 1880	1	1
125	*Cymbella tumidula* Grunow in Schmidt et al. 1875	1	1
126	*Cymbella turgidula* Grunow in A.Schmidt et al. 1875	1	1
127	*Cymbella ventricosa* Kützing 1844	1	1
128	*Cymbella tartuensis* Molder	1	1
129	*Cymbopleura amphicephala* (Naegeli) Krammer 2003	1	1
130	*Cymbopleura anglica* (Lagerstedt) Krammer 2003	1	1
131	*Cymbopleura angustata* (W. Smith) Krammer 2003	1	1
132	*Cymbopleura florentina* (Grunow) K.Krammer 2003	1	1
133	*Cymbopleura gutwinskii* (Wislouch) Krammer 2003	1	1
134	*Cymbopleura hybrida* (Grunow ex Cleve) Krammer 2003	1	1
135	*Cymbopleura inaequalis* (Ehrenberg) Krammer 2003	1	1
136	*Cymbopleura incerta* (Grunow) Krammer 2003	1	1
137	*Cymbopleura naviculiformis* (Auerswald ex Heiberg) Krammer 2003	1	1
138	*Cymbopleura reinhardtii* (Grunow) K.Krammer 2003	1	1
139	*Cymbopleura subaequalis* (Grunov) Krammer 2003	1	1
140	*Cymbopleura subcuspidata* (Krammer) Krammer 2003	1	1
141	*Delicata delicatula* (Kützing) Krammer 2003	1	1
142	*Denticula kuetzingii* Grunow 1862	1	1
143	*Denticula tenuis* Kützing 1844	1	1
144	*Denticula thermalis* Kützing 1844	1	1
145	*Diadesmis contenta* var. *biceps* (Grunow) P.B.Hamilton in Hamilton et al. 1992	0	1
146	*Diatoma elongata* (Lyngbye) C.Agardh 1824	1	1
147	*Diatoma moniliformis* (Kützing) D.M.Williams 2012	1	1
148	*Diatoma tenuis* Agardh 1812	1	1
149	*Diatoma vulgaris* Bory 1824 var. *vulgaris*	1	1
150	*Diatoma vulgaris* var. *brevis* Grunow 1862	0	1
151	*Diatoma vulgaris* var. *linearis* Grunow in Van Heurck 1881	0	1
152	*Diatoma vulgaris* var. *producta* Grunow 1862	0	1

153	*Didymosphenia geminata* (Lyngbye) Mart.Schmidt in A.Schmidt 1899	1	1
154	*Diploneis elliptica* (Kützing) Cleve 1894	1	1
155	*Diploneis oblongella* (Nägeli ex Kützing) Cleve-Euler 1922	1	1
156	*Diploneis oculata* (Brébisson) Clve 1894	1	1
157	*Diploneis ovalis* (Hilse) Cleve 1891	1	1
158	*Diploneis parma* Cleve 1891	1	1
159	*Diploneis subovalis* Cleve 1894	1	1
160	*Discostella stelligera* (Cleve and Grunow) Houk and Klee 2004	1	1
161	*Ellerbeckia arenaria* (Moore ex Ralfs) Crawford 1988	1	1
162	*Encyonema alpinum* (Grunow) D.G.Mann in Round, R.M.Crawford & D.G.Mann 1990	1	1
163	*Encyonema caespitosum* Kützing 1849	1	1
164	*Encyonema elginense* (Krammer) D.G.Mann in Round, Crawford & Mann 1990	1	1
165	*Encyonema gracile* Rabenhorst 1853	1	1
166	*Encyonema lacustre* (C.Agardh) Pantocsek 1934	1	1
167	*Encyonema leibleinii* (C.Agardh) W.J.Silva, R.Jahn, T.A.Veiga Ludwig & M.Menezes 2013	1	1
168	*Encyonema minutum* (Hilse in Rabenhorst) D.G. Mann 1990	1	1
169	*Encyonema pergracile* Krammer 1997	1	1
170	*Encyonema prostratum* (Berkeley) Kützing 1844	1	1
171	*Encyonema silesiacum* (Bleisch in Rabenhorst) D.G. Mann 1990	1	1
172	*Encyonopsis aequalis* (W. Smith) Krammer 1997	1	1
173	*Encyonopsis microcephala* (Grunow) Krammer 1997	1	1
174	*Entomoneis alata* (Ehrenberg) Ehrenberg 1845	1	1
175	*Entomoneis ornata* (Bailey) Reimer 1975	1	1
176	*Entomoneis paludosa* (W. Smith) Reimer 1975 var. *paludosa*	1	1
177	*Entomoneis paludosa* var. *duplex* (Donkin) Makarova & Achmetova 1987	1	1
178	*Epithemia adnata* (Kützing) Brébisson 1838 var. *adnata*	1	1
179	*Epithemia adnata* var. *porcellus* (Kützing) R.Ross 1950	0	1
180	*Epithemia adnata* var. *saxonica* (Kützing) R.M.Patrick in Patrick & Reimer 1975	0	1
181	*Epithemia argus* var. *longicornis* (Ehrenberg) Grunow 1862	0	1
182	*Epithemia argus* var. *angusta* Tarnavschi 1940	0	1
183	*Epithemia argus* (Ehrenberg) Kützing 1843 var. *argus*	1	1
184	*Epithemia argus* var. *alpestris* (W.Smith) Grunow 1862	0	1
185	*Epithemia operculata* (C.Agardh) Ruck & Nakov in Ruck et al. 2016	1	1
186	*Epithemia parallela* (Grunow) Ruck & Nakov in Ruck et al. 2016	1	1

187	*Epithemia sorex* Kützing 1844	1	1
188	*Epithemia turgida* var. *granulata* (Ehrenberg) Brun 1880	0	1
189	*Epithemia turgida* (Ehrenberg) Kützing 1844 var. *turgida*	1	1
190	*Epithemia turgida* var. *capitata* Fricke in Schmidt et al. 1904	0	1
191	*Epithemia turgida* var. *genuina* Grunow	0	1
192	*Eucocconeis flexella* (Kützing) Meister 1912	1	1
193	*Eucocconeis quadratarea* (Østrup) Lange-Bertalot & Genkal 1999	1	1
194	*Eunotia pectinalis* (Kützing) Rabenhorst 1864	1	1
195	*Eunotia arcus* Ehrenberg 1837	1	1
196	*Eunotia bidens* Ehrenberg 1843	1	1
197	*Eunotia bilunaris* (Ehrenberg) Scharschmidt 1881	1	1
198	*Eunotia diodon* Ehrenberg 1837	1	1
199	*Eunotia exigua* (Brébisson in Kützing) Rabenhorst 1864	1	1
200	*Eunotia faba* Ehrenberg 1837	1	1
201	*Eunotia lunaris* (Ehrenberg) Grunow 1877	1	1
202	*Eunotia pectinalis* var. *minor* (Kützing) Rabenhorst 1864	0	1
203	*Eunotia polydentula* (Brun) Hustedt 1932	1	1
204	*Eunotia praerupta* Ehrenberg 1843	1	1
205	*Eunotia valida* Hustedt 1930	1	1
206	*Fallacia insociabilis* (Krasske) D.G.Mann in F.E.Round, R.M.Crawford & D.G.Mann 1990	1	1
207	*Fallacia pygmaea* (Kützing) De Mann 1990	1	1
208	*Fragilaria acus* (Kützing) Lange-Bertalot in Krammer & Lange-Bertalot 2000	1	1
209	*Fragilaria alpestris* Krasske 1825	1	1
210	*Fragilaria amphicephaloides* Lange-Bertalot 2013	1	1
211	*Fragilaria bicapitata* A.Mayer 1917	1	1
212	*Fragilaria bidens* Heiberg 1863	1	1
213	*Fragilaria brevistriata* Grunow in Van Heurck 1885	1	1
214	*Fragilaria capucina* Desmazières 1830 var. *capucina*	1	1
215	*Fragilaria capucina* var. *lanceolata* Grunow in van Heurck 1881	0	1
216	*Fragilaria capucina* var. *vaucheriae* (Kützing) Lange-Bertalot 1980	0	1
217	*Fragilaria crotonensis* Kitton 1869	1	1
218	*Fragilaria gracilis* Østrup 1910	1	1
219	*Fragilaria inflata* (Heiden) Hustedt 1931 var. *inflata*	1	1
220	*Fragilaria inflata* var. *istvanffyi* (Pantoscek) Hustedt 1931	0	1
221	*Fragilaria leptostauron* (Ehrenberg) Hustedt 1931	1	1
222	*Fragilaria mesolepta* Rabenhorst 1861	1	1

223	*Fragilaria radians* (Kützing) Lange-Bertalot 1991	1	1
224	*Fragilaria recapitellata* H. Lange-Bertalot & D. Nergui 2009	1	1
225	*Fragilaria rumpens* (Kützing) G.W.F.Carlson 1913	1	1
226	*Fragilaria tenera* (W.Smith) Lange-Bertalot 1980	1	1
227	*Fragilaria vaucheriae* (Kützing) J.B.Petersen 1938	1	1
228	*Fragilariforma bicapitata* (A.Mayer) D.M.Williams & Round 1988	1	1
229	*Fragilariforma virescens* (Ralfs) D.M.Williams & Round 1988	1	1
230	*Fragilariopsis cylindrus* (Grunow) Helmcke & Krieger 1954	1	1
231	*Frustulia rhomboides* (Ehrenberg) De Toni 1891	1	1
232	*Genkalia digituloides* (Lange-Bertalot) Lange-Bertalot & Kulikovskiy in Kulikovskiy et al. 2012	1	1
233	*Gliwiczia calcar* (Cleve) M.Kulikovskiy, Lange-Bertalot & A.Witkowski 2013	1	1
234	*Gomphoneis herculeana* (Ehrenberg) Cleve 1894	1	1
235	*Gomphonema acuminatum* Ehrenberg 1832	1	1
236	*Gomphonema constrictum* var. *capitatum* (Ehrenberg) Grunow 1880	0	1
237	*Gomphonema coronatum* Ehrenberg 1840	1	1
238	*Gomphonema gracile* Ehrenberg 1838	1	1
239	*Gomphonema parvulum* (Kützing) Kützing 1849 var. *parvulum*	1	1
240	*Gomphonema parvulum* var. *subellipticum* Cleve 1894	0	1
241	*Gomphonema salinarum* (Pantosek) Cleve 1894	1	1
242	*Gomphonema subclavatum* var. *montanum* (J.Schumann) Cleve	0	1
243	*Gomphonema ventricosum* Gregory 1856	1	1
244	*Gomphonema acuminatum* var. *brebissonii* (Kützing) Grunow in van Heurck 1880	0	1
245	*Gomphonema angustatum* (Kützing) Rabenhorst 1864	1	1
246	*Gomphonema calcareum* Cleve 1868	1	1
247	*Gomphonema constrictum* Ehrenberg in Kützing 1844 var. *constrictum*	1	1
248	*Gomphonema constrictum* var. *curta* (Grunow) Van Heurck 1896	0	1
249	*Gomphonema exilissimum* (Grunow) Lange-Bertalot & E.Reichardt in Lange-Bertalot & Metzeltin 1996	1	1
250	*Gomphonema grunowii* R.M.Patrick & Reimer 1975	1	1
251	*Gomphonema hedinii* Hustedt 1922	1	1
252	*Gomphonema intricatum* Kützing 1844	1	1
253	*Gomphonema kobayasii* Kociolek & J.C.Kingston 1999	1	1
254	*Gomphonema lagenula* Kützing 1844	1	1
255	*Gomphonema longiceps* Ehrenberg 1854	1	1
256	*Gomphonema micropus* Kützing 1844	1	1
257	*Gomphonema montanum* (J.Schumann) Grunow in Schneider 1878	1	1

258	*Gomphonema olivaceum* var. *minutissimum* Hustedt 1930	0	1
259	*Gomphonema olivaceum* (Hornemann) Brébisson 1838 var. *olivaceum*	1	1
260	*Gomphonema productum* (Grunow) Lange-Bertalot & Reichardt in Lange-Bertalot 1993	1	1
261	*Gomphonema subclavatum* (Grunow) Grunow 1884	1	1
262	*Gomphonema subsalinum* Wislouch & Poretzky in Poretzky 1924	1	1
263	*Gomphonema tenellum* Kützing 1844	1	1
264	*Gomphonema truncatum* Ehrenberg 1832	1	1
265	*Gomphonema vibrio* var. *pumilum* (Grunow) R.Ross in B.Hartley, R.Ross & D.M.Williams 1986.	0	1
266	*Gomphosinica hedinii* (Hustedt) Kociolek, You, Wang & Liu 2015	1	1
267	*Gyrosigma acuminatum* (Kützing) Rabenhorst 1853	1	1
268	*Gyrosigma attenuatum* (Kützing) Rabenhorst 1894	1	1
269	*Gyrosigma obtusatum* (Sullivant & Wormley) C.S.Boyer 1922	1	1
270	*Gyrosigma peisone* (Grunow) Hustedt in Pascher 1930	1	1
271	*Gyrosigma scalproides* (Rabenhorst) Cleve 1894	1	1
272	*Halamphora acutiuscula* (Kützing) Levkov 2009	1	1
273	*Halamphora coffeaeformis* (Agardh) Levkov 2009	1	1
274	*Halamphora latecostata* Stepanek and Kociolek 2013	1	1
275	*Halamphora normanii* (Rabenhorst) Levkov 2009	1	1
276	*Halamphora perpusilla* (Grunow) Q.-M.You & J.P.Kociolek in You et al. 2015	1	1
277	*Halamphora schroederi* (Hustedt) Levkov 2009	1	1
278	*Halamphora subcapitata* (Kisselew) Levkov 2009	1	1
279	*Halamphora veneta* (Kützing) Levkov 2009	1	1
280	*Hannaea arcus* (Ehrenberg) Patrick 1961 emend. Genkal et Kharitonov var. *arcus*	1	1
281	*Hannaea arcus* var. *amphioxys* (Rabenhorst) R.M.Patrick 1966	0	1
282	*Hannaea linearis* (Holmboe) Álvarez-Blanco & S.Blanco 2013	1	1
283	*Hantzschia amphioxys* (Ehr.) Grunow 1880 var. *amphioxys*	1	1
284	*Hantzschia amphioxys* var. *rupestris* Grunow 1880	0	1
285	*Hantzschia amphioxys* var. *vivax* (Hantzsch) Grunow in Cleve & Grunow 1880	0	1
286	*Hantzschia compacta* (Hustedt) Lange-Bertalot in Lange-Bertalot & Genkal 1999	1	1
287	*Hippodonta capitata* (Ehrenberg) Lange-Bertalot, Metzeltin & Witkowski	1	1
288	*Hippodonta hungarica* (Grunow) Lange-Bertalot, Metzeltin and Witkowski 1996	1	1
289	*Humidophila contenta* (Grunow) Lowe, Kociolek, J.R.Johansen, Van de Vijver, Lange-Bertalot & Kopalová 2014	1	1

290	*Humidophila perpusilla* (Grunow) Lowe, Kociolek, Johansen, Van de Vijver, Lange-Bertalot & Kopalová 2014	1	1
291	*Iconella helvetica* (Brun) Ruck & Nakov in Ruck et al. 2016	1	1
292	*Iconella linearis* (W.Smith) Ruck & Nakov in Ruck et al. 2016	1	1
293	*Iconella tenera* (W.Gregory) Ruck & Nakov in Ruck et al. 2016	1	1
294	*Kobayasiella micropunctata* (Germain) Lange-Bertalot 1999	1	1
295	*Kobayasiella subtilissima* (Cleve) Lange-Bertalot 1999	1	1
296	*Kurtkrammeria aequalis* (W.Smith) L.Bahls 2015	1	1
297	*Lacustriella lacustris* (W.Gregory) Lange-Bertalot & M.S.Kulikovskiy in Kulikovskiy et al. 2012	1	1
298	Lindavia antiqua (W. Smith) Nakov et al. 2015	1	1
299	*Lindavia bodanica* (Eulenstein ex Grunow) T.Nakov et al. 2015	1	1
300	*Lindavia comta* (Kützing) T. Nakov et al. 2015	1	1
301	*Lindavia intermedia* (Manguin ex Kociolek and Reviers) T. Nakov et al. 2015	1	1
302	*Lindavia kuetzingiana* (Thwaites) T.Nakov et al. 2015 var. *kuetzingiana*	1	1
303	*Lindavia kuetzingiana* var. *radiosa* (Fricke) T.Nakov et al. 2015	1	1
304	*Lindavia lacunarum* (Hustedt) T. Nakov et al. 2015	1	1
305	*Lindavia schumannii* (Grunow) T.Nakov et al. 2015	1	1
306	*Luticola cohnii* (Hilse) D.G.Mann in Round, R.M.Crawford & D.G.Mann 1990	1	1
307	*Luticola mutica* (Kützing) D.G.Mann in Round et al. 1990	1	1
308	*Luticola muticopsis* (Van Heurck) D.G.Mann in Round, R.M.Crawford & D.G.Mann 1990	1	1
309	*Luticola nivalis* (Ehrenberg) D.G.Mann in Round, R.M.Crawford & D.G.Mann 1990	1	1
310	*Mastogloia albertii* A.Pavlov, E.Jovanovska, C.E.Wetzel, L.Ector & Z.Levkov 2016	1	1
311	*Mastogloia baltica* Grunow in van Heurck 1880	1	1
312	*Mastogloia braunii* Grunow 1863	1	1
313	*Mastogloia elliptica* (C.Agardh) Cleve in Schmidt et al. 1893	1	1
314	*Mastogloia lacustris* (Grunow) Grunow in Van Heurck 1880	1	1
315	*Mastogloia pseudosmithii* S.S.Lee, E.E.Gaiser, B.Van de Vijver, M.B.Edlund & Spaulding 2014	1	1
316	*Mastogloia pumila* (Grunow) Cleve 1895	1	1
317	*Mastogloia smithii* Thwaites 1856	1	1
318	*Meridion circulare* (Greville) Agardh 1831	1	1
319	*Meridion constrictum* Ralfs 1843	1	1
320	*Meridion lineare* Williams 1985	1	1
321	*Navicula brasiliensis* Grunow 1863	1	1
322	*Navicula bryophila* Østrup	1	1

323	*Navicula capitatoradiata* H.Germain 1981	1	1
324	*Navicula cari* Ehrenberg 1836	1	1
325	*Navicula cincta* (Ehrenberg) Ralfs 1861	1	1
326	*Navicula cryptocephala* Kützing 1844 var. *cryptocephala*	1	1
327	*Navicula cryptocephala* var. *lata* Poretz. et Anissimova 1933	0	1
328	*Navicula dicephala* Ehrenberg 1838 var. *dicephala*	1	1
329	*Navicula dicephala* var. *triundulata* Kisselev 1937	0	1
330	*Navicula digitoradiata* (Gregory) Ralfs in Prichard 1861	1	1
331	*Navicula exilis* Kützing 1844	1	1
332	*Navicula fritschii* J.W.G.Lund 1946	1	1
333	*Navicula gothlandica* Grunow in Van Heurck 1880	1	1
334	*Navicula gregaria* Donkin 1861	1	1
335	*Navicula halophila* f. *subcapitata* (Østrup) Krasske 1929	0	1
336	*Navicula hofmanniae* Lange-Bertalot 1993	1	1
337	*Navicula lacustris* var. *parallela* Wisl. & Kolbe 1916	0	1
338	*Navicula lacustris* var. *paulseniana* (J.B.Petersen) Zabelina 1951	0	1
339	*Navicula lanceolata* (Agardh) Ehrenberg 1838	1	1
340	*Navicula libonensis* Schoeman 1970	1	1
341	*Navicula lucidula* Grunow in Van Heurck 1880	1	1
342	*Navicula menisculus* Schumann 1867	1	1
343	*Navicula microstauron* f. *diminuta* Grunow	0	1
344	*Navicula minima* Grunow in van Heurck 1880	1	1
345	*Navicula oblonga* (Kützing) Kützing 1844	1	1
346	*Navicula peregrina* (Ehrenberg) Kützing 1843	1	1
347	*Navicula pygmaea* (Kützing) Pantocsek 1901	1	1
348	*Navicula radiosa* Kützing 1844	1	1
349	*Navicula recens* (Lange-Bertalot) Lange-Bertalot in Krammer & Lange-Bertalot 1985	1	1
350	*Navicula reinhardtii* Grun.	1	1
351	*Navicula rhynchocephala* Ehrenberg 1844	1	1
352	*Navicula rostellata* Kützing 1844	1	1
353	*Navicula rotaeana* (Rabenhorst) Grunow in van Heurck 1880	1	1
354	*Navicula salinarum* f. *minima* Kolbe 1927	0	1
355	*Navicula scutum* Schumann 1862	1	1
356	*Navicula semen* Ehrenberg 1843	1	1
357	*Navicula tenella* Brébisson ex Kützing 1849	1	1
358	*Navicula tripunctata* (O.F.Müller) Bory in Bory de Saint-Vincent 1822	1	1

359	*Navicula tuscula* f. *intermedia* Kisselev 1932	0	1
360	*Navicula veneta* Kützing 1844	1	1
361	*Navicula viridula* (Kützing) Ehrenberg 1836	1	1
362	*Navicula vulpina* Kützing 1844	1	1
363	*Navicymbula pusilla* (Grunow in A. Schmidt) Krammer 2003	1	1
364	*Neidiomorpha binodis* (Ehrenberg) M.Cantonati, Lange-Bertalot & N.Angeli 2010	1	1
365	*Neidium affine* (Ehrenberg) Pfizer 1871 f. *affine*	1	1
366	*Neidium affine* f. *undulatum* (Grunow) Hustedt 1930	0	1
367	*Neidium affine* var. *amphirhynchus* (Ehrenberg) Cleve 1894	0	1
368	*Neidium iridis* (Ehrenberg) Cleve 1894	1	1
369	*Neidium kozlowii* Mereschkovsky 1906	1	1
370	*Neidium productum* (W.Smith) Cleve 1894	1	1
371	*Neidium punctulatum* Hustedt	1	1
372	*Neidium undulatum* Bahls 2013	1	1
373	*Nitzschia ostenfeldii* Hustedt	1	1
374	*Nitzschia commutata* Grunow in Cleve & Grunow 1880	1	1
375	*Nitzschia amphibia* Grunow 1862 var. *amphibia*	1	1
376	*Nitzschia amphibia* var. *thermalis* Grunow 1862	0	1
377	*Nitzschia angularis* W.Smith 1853	1	1
378	*Nitzschia angustata* var. *acuta* Grunow in Cleve & Grunow 1880	0	1
379	*Nitzschia brevissima* Grunow in Van Heurck 1880	1	1
380	*Nitzschia communis* Rabenhorst 1860	1	1
381	*Nitzschia denticula* Grunow in Cleve & Grunow 1880	1	1
382	*Nitzschia dissipata* (Kützing) Rabenhorst 1860	1	1
383	*Nitzschia distans* W.Gregory 1857	1	1
384	*Nitzschia dubia* W.Smith 1853	1	1
385	*Nitzschia fasciculata* (Grunow) Grunow in Van Heurck 1881	1	1
386	*Nitzschia fonticola* (Grunow) Grunow in Van Heurck 1881	1	1
387	*Nitzschia frustulum* (Kützing) Grunow in Cleve & Grunow 1880 var. *frustulum*	1	1
388	*Nitzschia frustulum* var. *subsalina* Hustedt 1930	0	1
389	*Nitzschia frustulum* var. *perpusilla* (Rabenhorst) Van Heurck 1885	0	1
390	*Nitzschia gracilis* Hantzsch1860	1	1
391	*Nitzschia gradifera* Hustedt 1922	1	1
392	*Nitzschia hantzschiana* Rabenhorst 1860	1	1
393	*Nitzschia heidenii* (Meister) Hustedt 1924 var. *heidenii*	1	1
394	*Nitzschia heidenii* var. *pamirensis* J.B.Petersen 1930	0	1

395	*Nitzschia holsatica* Hustedt 1930	1	1
396	*Nitzschia hungarica* var. *pantocsekii* Wisl.& Poretzky	0	1
397	*Nitzschia kittlii* Grunow 1882	1	1
398	*Nitzschia kuetzingiana* Hilse 1863	1	1
399	*Nitzschia linearis* var. *tenuis* (W.Smith) Grunow in Cleve & Grunow 1880	0	1
400	*Nitzschia linearis* W.Smith 1853 var. *linearis*	1	1
401	*Nitzschia microcephala* Grunow in Cleve & Möller 1878	1	1
402	*Nitzschia obtusa* W.Smith 1853	1	1
403	*Nitzschia palea* (Kützing) W. Smith 1856	1	1
404	*Nitzschia paleaceae* Grunow in Van Heurck 1881	1	1
405	*Nitzschia parvula* W.Smith 1853	1	1
406	*Nitzschia regula* Hustedt var. *regula*	1	1
407	*Nitzschia regula* var. *robusta* Hustedt 1924	0	1
408	*Nitzschia sigma* (Kützing) W. Smith 1853 var. *sigma*	1	1
409	*Nitzschia sigma* var. *curvula* (Ehrenberg) Brun.	0	1
410	*Nitzschia sigmoidea* (Nitzsch) W.Smith 1853	1	1
411	*Nitzschia solgensis* Cleve-Euler 1952	1	1
412	*Nitzschia sublinearis* Hustedt 1930	1	1
413	*Nitzschia subtilis* (Kützing) Grunow in Cleve & Grunow 1880	1	1
414	*Nitzschia supralitorea* Lange-Bertalot	1	1
415	*Nitzschia thermalis* (Ehrenberg) Auerswald in Rabenhorst 1861 var. *thermalis*	1	1
416	*Nitzschia thermalis* var. *minor* Hilse 1862	0	1
417	*Nitzschia tryblionella* Hantzsch in Rabenhorst 1860	1	1
418	*Nitzschia vermicularis* (Kützing) Hantzsch in Rabenhorst 1860	1	1
419	*Odontidium mesodon* (Kützing) Kützing 1849	1	1
420	*Paraplaconeis compositestriata* (Jasnitsky) Kulikovskiy, Metzeltin & Lange-Bertalot in Kulikovskiy et al. 2012	1	1
421	*Paraplaconeis placentula* (Ehrenberg) M.S.Kulikovskiy & Lange-Bertalot in Kulikowskiy et al. 2012	1	1
422	*Paraplaconeis subplacentula* (Hustedt) Kulikovskiy & Lange-Bertalot in Kulikovskiy et al. 2012	1	1
423	*Parlibellus crucicula* (W.Smith) Witkowski, Lange-Bertalot & Metzeltin 2000	1	1
424	*Parlibellus protracta* (Grunow) Witkowski, Lange-Bertalot & Metzeltin 2000	1	1
425	*Pinnularia abaujensis* var. *linearis* (Hustedt) R.M.Patrick 1966	0	1
426	*Pinnularia acrosphaeria* W. Smith 1853	1	1
427	*Pinnularia appendiculata* (C.Agardh) Schaarschmidt 1881	1	1
428	*Pinnularia biceps* W.Gregory 1856	1	1

429	*Pinnularia borealis* Ehrenberg 1843	1	1
430	*Pinnularia brauniana* (Grunow) Studnicka 1888	1	1
431	*Pinnularia brebissonii* (Kützing) Rabenhorst 1864	1	1
432	*Pinnularia brevicostata* Cleve 1891	1	1
433	*Pinnularia canadodivergens* Kulikovsky, Lange-Bertalot et Metzeltin 2010	1	1
434	*Pinnularia divergens* W.Smith 1853	1	1
435	*Pinnularia divergentissima* (Grunow) Cleve 1895	1	1
436	*Pinnularia elegans* (W.Smith) K.Krammer 1992	1	1
437	*Pinnularia fonticola* Hustedt 1922	1	1
438	*Pinnularia gibbiformis* K.Krammer 1992	1	1
439	*Pinnularia globiceps* W.Gregory 1856	1	1
440	*Pinnularia gracillima* W.Gregory 1856	1	1
441	*Pinnularia grunowii* Krammer 2000	1	1
442	*Pinnularia hartleyana* Greville 1865	1	1
443	*Pinnularia interrupta* W.Smith 1853	1	1
444	*Pinnularia lata* (Brébisson) W.Smith 1853 var. *lata*	1	1
445	*Pinnularia lata* var. *minor* (Grunow) Cleve	0	1
446	*Pinnularia major* (Kützing) Rabenhorst 1853	1	1
447	*Pinnularia mesolepta* (Ehrenberg) W.Smith 1853	1	1
448	*Pinnularia microstauron* (Ehrenberg) Cleve 1891	1	1
449	*Pinnularia rangoonensis* Grunow ex Cleve 1895	1	1
450	*Pinnularia rhombarea* var. *biundulata* (Otto Müller) Krammer 2000	0	1
451	*Pinnularia rhombica* Hustedt in Schmidt et al. 1934	1	1
452	*Pinnularia schoenfelderi* Krammer 1992	1	1
453	*Pinnularia septentrionalis* K.Krammer 2000	1	1
454	*Pinnularia socialis* var. *debesii* (Hustedt) Krammer 2000	0	1
455	*Pinnularia stomatophora* Hustedt 1935	1	1
456	*Pinnularia subborealis* Hustedt 1922	1	1
457	*Pinnularia subtibetana* A.M.Muzafarov	1	1
458	*Pinnularia tabellaria* Ehrenberg 1843 var. *tabellaria*	1	1
459	*Pinnularia tabellaria* var. *stauroneiformis* (van Heurck) Boyer 1927	0	1
460	*Pinnularia undulata* W.Gregory 1854	1	1
461	*Pinnularia viridiformis* Krammer 1992	1	1
462	*Pinnularia viridis* (Nitzsch) Ehrenberg 1843 var. *viridis*	1	1
463	*Pinnularia viridis* var. *diminuta* Mayer 1913	0	1
464	*Placoneis amphibola* (Cleve) E.J.Cox 2003	1	1
465	*Placoneis exigua* (Gregory) Mereschkovsky	1	1

466	*Placoneis gastrum* (Ehrenberg) Mereschkowsky 1903	1	1
467	*Planothidium dispar* (Cleve) Witkowski, Lange-Bertalot & Metzeltin 2000	1	1
468	*Planothidium lanceolatum* (Brébisson ex Kützing) Lange-Bertalot 1999	1	1
469	*Planothidium rostratoholoarcticum* Lange-Bertalot & Bąk in B?k & Lange-Bertalot 2015	1	1
470	*Planothidium rostratum* (Østrup) Lange-Bertalot 1999	1	1
471	*Platessa salinarum* (Grunow) Lange-Bertalot	1	1
472	*Prestauroneis integra* (W. Smith) Bruder 2008	1	1
473	*Prestauroneis protracta* (Grunow) I.W.Bishop, Minerovic, Q.Liu & Kociolek in I.W.Bishop, Minerovic & Kociolek 2017	1	1
474	*Pseudostaurosira brevistriata* (Grunow) Williams and Round 1987	1	1
475	*Pseudostaurosira elliptica* (Schumann) Edlund, Morales & Spaulding 2006	1	1
476	*Pseudostaurosira parasitica* (W.Smith) Morales 2003	1	1
477	*Pseudostaurosira robusta* (Fusey) Williams and Round 1988	1	1
478	*Pseudostaurosira subsalina* (Hustedt) E.A. Morales 2005	1	1
479	*Pseudostaurosira pseudoconstruens* (Marciniak) Williams and Round 1987	1	1
480	*Punctastriata lancettula* (Schumann) P.B.Hamilton & P.A.Siver 2008	1	1
481	*Reimeria sinuata* (Greg.) Kociolek et Stoermer	1	1
482	*Rexlowea navicularis* Kociolek and Thomas 2010	1	1
483	*Rhoicosphenia abbreviata* (Agardh) Lange-Bertalot 1980	1	1
484	*Rhopalodia gibba* (Ehrenberg) Otto Müller 1895 var. *gibba*	1	1
485	*Rhopalodia gibba* var. *mongolica* (Østrup) Proschkina-Lavrenko 1950	0	1
486	*Rhopalodia gibba* var. *ventricosa* (Kützing) Mayer 1913	0	1
487	*Rhopalodia gibberula* (Ehrenberg) O. Müller 1895 var. *gibberula*	1	1
488	*Rhopalodia gibberula* var. *producta* (Grunow) Otto Müller 1900	0	1
489	*Rhopalodia musculus* (Kützing) O. Müller 1900 var. *musculus*	1	1
490	*Rhopalodia musculus* var. *mirabilis* Fricke	0	1
491	*Rossithidium anastasiae* (Kaczmarska) Potapova 2012	1	1
492	*Sellaphora bacillum* (Ehrenberg) D.G. Mann 1989	1	1
493	*Sellaphora pupula* (Kützing) Mereschkowsky 1902	1	1
494	*Sellaphora rectangularis* (W.Gregory) Lange-Bertalot & Metzeltin 1996	1	1
495	*Sellaphora tridentula* (Krasske) C.E.Wetzel in Wetzel et al. 2015	1	1
496	*Stauroneis borrichii* (J.B.Petersen) J.W.G.Lund 1946	1	1
497	*Stauroneis acuta* W. Smith 1853	1	1
498	*Stauroneis anceps* Ehrenberg 1843 var. *anceps*	1	1

499	*Stauroneis anceps* var. *argentina* (Cleve) Cleve	0	1
500	*Stauroneis borrichi* var. *subcapitata* (Peterson) Hustedt 195	0	1
501	*Stauroneis gracilis* Ehrenberg 1843	1	1
502	*Stauroneis lauenburgiana* Hustedt 1950	1	1
503	*Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843	1	1
504	*Stauroneis smithii* Grunow 1860	1	1
505	*Staurosira binodis* (Ehrenberg) Lange-Bertalot 2011	1	1
506	*Staurosira construens* Ehrenberg 1843 var. *construens*	1	1
507	*Staurosira construens* var. *exigua* (W.Smith) T.Nagumo 2002	0	1
508	*Staurosira venter* (Ehrenberg) Cleve & J.D.Möller 1879	1	1
509	*Staurosirella harrisonii* (W.Smith) E. Morales & C.E.Wetzel in Morales et al. 2015	1	1
510	*Staurosirella leptostauron* (Ehrenberg) Williams and Round 1987	1	1
511	*Staurosirella pinnata* (Ehrenberg) Williams and Round 1987	1	1
512	*Stephanodiscus astraea* (Ehrenberg) Grunow in Cleve & Grunow 1880 var. *astraea*	1	1
513	*Stephanodiscus astraea* var. *intermedia* Fricke	1	1
514	*Surirella angusta* Kützing 1844	1	1
515	*Surirella angustata* Hustedt 1930 var. *angustata*	1	1
516	*Surirella angustata* var. *constricta* Hustedt	0	1
517	*Surirella brebissonii* Krammer and Lange-Bertalot 1987	1	1
518	*Surirella librile* (Ehrenberg) Ehrenberg 1845	1	1
519	*Surirella minuta* Brébisson in Kützing 1849	1	1
520	*Surirella ovalis* Brébisson 1838	1	1
521	*Surirella ovata* var. *crumena* (Brébisson) Hustedt 1930	0	1
522	*Surirella spiralis* Kützing 1844	1	1
523	*Surirella splendida* (Ehrenberg) Kützing 1844	1	1
524	*Synedra acus* var. *radians* (Kützing) Hustedt 1930	0	1
525	*Synedra famelica* Kützing 1844	1	1
526	*Synedra goulardii* Brébisson ex Cleve and Grunow 1880	1	1
527	*Synedra minuscula* Grunow in Van Heurck 1881	1	1
528	*Synedra montana* Krasske ex Hustedt 1932	1	1
529	*Synedra nana* F.Meister 1912	1	1
530	*Synedra parasitica* (W.Smith) Hustedt 1930	1	1
531	*Synedra pulchella* var. *macrocephala* Grunow 1880	0	1
532	*Synedra spectabilis* Ehrenberg 1841	1	1
533	*Tabellaria fenestrata* (Lyngbye) Kützing 1844	1	1
534	*Tabellaria flocculosa* (Roth) Kützing 1844	1	1

535	*Tabularia fasciculata* (C.Agardh) D.M.Williams & Round 1986	1	1
536	*Tetracyclus rupestris* (Kützing) Grunow in Van Heurck 1881	1	1
537	*Tryblionella angustata* W.Smith 1853	1	1
538	*Tryblionella apiculata* W.Gregory 1857	1	1
539	*Tryblionella hantzschiana* Grunow	1	1
540	*Tryblionella hungarica* (Grunow) Frenguelli 1942	1	1
541	*Tryblionella levidensis* W.Smith 1856	1	1
542	*Tryblionella victoriae* Grunow 1862	1	1
543	*Ulnaria acus* Aboal 2003	1	1
544	*Ulnaria amphirhynchus* (Ehrenberg) Compère & Bukhtiyarova 2006	1	1
545	*Ulnaria biceps* (Kützing) Compére 2001	1	1
546	*Ulnaria capitata* (Ehrenberg) Compère 2001	1	1
547	*Ulnaria contracta* (Østrup) E.A.Morales & M.L.Vis 2007	1	1
548	*Ulnaria danica* (Kützing) Compère & Bukhtiyarova in Bukhtiyarova & Compère 2006	1	1
549	*Ulnaria delicatissima* var. *angustissima* (Grun.) Aboal et Silva	0	1
550	*Ulnaria oxyrhynchus* (Kützing) Aboal in Aboal, Alvarez Cobelas, Cambra & Ector 2003	1	1
551	*Ulnaria ulna* (Nitzsch) Compére 2001 var. *ulna*	1	1
552	*Ulnaria ulna* var. *aequalis* (Kützing) Aboal in Aboal, Alvarez Cobelas, Cambra & Ector 2003	0	1
	Total:	455	552

The study of the taxonomic structure of the flora is an important part of the floristic analysis, which makes it possible to identify the most diversified taxa of the floristic spectrum, showing the direction of the algal flora development of the region as a whole.

The diatoms found are subdivided into three classes: Bacillariophyceae, Coscinodiscophyceae, Mediophyceae, and two species has unclear position (Table 2). Most richest is Class Bacillariophyceae, included 94.97% of species. Order Naviculales prevail with 30.44% of total richness with Families Naviculaceae (12.01%) and Pinnulariaceae (7.12%) in leading position. One of the important characteristics of the flora is the composition of the leading algae genera. So, in Pamir diatom flora only four genera contain 30% of the list. It is *Nitzschia* (45 taxa), *Navicula* (41 taxa), *Pinnularia* (39 taxa), and *Cymbella* (36 taxa). Whereas three genera of them is usually are in the head part of the diatom flora list, it looks like surprisingly so large number of *Pinnularia* members can be describe as pecularities of Pamir diatom flora. Ecologically this are the species preferred fresh, clear, circumneutral water habitats in natural aquatic objects with developed phytoperiphytonic communities and included many rare species.

Table 2. Systematical structure of diatom algal diversity in the Pamir high mountain habitats. Note: *incertae sedis* unclear taxonomical position.

Taxa	Genera	Species	Subspecies	Percent
Division Bacillariophyta	**93**	**455**	**552**	**100.00**
Class 1. Bacillariophyceae	**86**	**437**	**539**	**94.67**
Order 1. Bacillariales	6	51	65	11.54
Family 1. Bacillariaceae	**6**	**51**	**65**	**11.54**
Order 2. Cocconeidales	5	19	24	4.26
Family 2. Achnanthidiaceae	**4**	**13**	**14**	**2.48**
Family 3. Cocconeidaceae	**1**	**6**	**10**	**1.78**
Order 3. Cymbellales	17	93	114	19.3
Family 4. Anomoeoneidaceae	**2**	**4**	**8**	**1.43**
Family 5. Cymbellaceae	**6**	**45**	**55**	**9.61**
Family 6. Gomphonemataceae	**8**	**43**	**50**	**8.09**
Family 7. Rhoicospheniaceae	**1**	**1**	**1**	**0.17**
Order 4. Eunotiales	2	13	14	2.48
Family 8. Eunotiaceae	**2**	**13**	**14**	**2.48**
Order *5.* Fragilariales	8	41	47	8.35
Family 9. Fragilariaceae	**5**	**29**	**34**	**6.03**
Family 10. Staurosiraceae	**3**	**12**	**13**	**2.32**
Order 6. Licmophorales	4	12	16	2.84
Family 11. Ulnariaceae	**4**	**12**	**16**	**2.84**
Order 7. Mastogloiales	4	18	22	3.91
Family 12. Achnanthaceae	**2**	**6**	**10**	**1.78**
Family 13. Mastogloiaceae	**2**	**12**	**12**	**2.13**
Order 8. Naviculales	28	147	172	30.44
Family 14. Amphipleuraceae	**3**	**9**	**10**	**1.77**
Family 15. Berkeleyaceae	**1**	**2**	**2**	**0.35**
Family 16. Brachysiraceae	**1**	**3**	**3**	**0.53**
Family 17. Cavinulaceae	**1**	**2**	**2**	**0.35**
Family 18. Cosmioneidaceae	**1**	**1**	**1**	**0.17**
Family 19. Diadesmidaceae	**3**	**6**	**7**	**1.24**
Family 20. Diploneidaceae	**1**	**6**	**6**	**1.06**
Family 21. Naviculaceae	**6**	**55**	**68**	**12.01**
Family 22. Naviculales *incertae sedis*	**3**	**4**	**4**	**0.71**
Family 23. Neidiaceae	**2**	**7**	**9**	**1.59**

Family 24. Pinnulariaceae	**1**	**34**	**40**	**7.12**
Family 25. Sellaphoraceae	**2**	**6**	**6**	**1.06**
Family 26. Stauroneidaceae	**3**	**12**	**14**	**2.48**
Order 9. Rhopalodiales	2	9	21	3.73
Family 27. Rhopalodiaceae	**2**	**9**	**21**	**3.73**
Order 10. Surirellales	5	16	19	3.37
Family 28. Entomoneidaceae	**1**	**3**	**4**	**0.71**
Family 29. Surirellaceae	**4**	**13**	**15**	**2.66**
Order 11. Tabellariales	4	10	13	2.32
Family 30. Tabellareaceae	**4**	**10**	**13**	**2.32**
Order 12. Thalassiophysales	1	8	12	2.13
Family 31. Catenulaceae	**1**	**8**	**12**	**2.13**
Class 2. Coscinodiscophyceae	**2**	**15**	**16**	**2.84**
Order 13. Aulacoseirales	1	6	7	1.24
Family 32. Aulacosiraceae	**1**	**6**	**7**	**1.24**
Order 14. Coscinodiscales	1	8	8	1.43
Family 33. Coscinodiscaceae	**1**	**8**	**8**	**1.43**
Order 15. Melosirales	1	1	1	0.17
Family 34. Paraliaceae	**1**	**1**	**1**	**0.17**
Class 3. Mediophyceae	**3**	**6**	**6**	**1.06**
Order 16. Stephanodiscales	3	6	6	1.06
Family 35. Stephanodiscaceae	**3**	**6**	**6**	**1.06**
Class 4. Bacillariophyta *classis incertae sedis*	**2**	**2**	**2**	**0.35**
Order 17. Bacillariophyta ordo incertae sedis	2	2	2	0.35
Family 36. Bacillariophyta *familia incertae sedis*	**2**	**2**	**2**	**0.35**

Conclusion

The unique, low studied localities of diatom algae – Pamir mountain aquatic habitats included 455 species (552 with infraspecific taxa) of diatoms that we here presented in the first time as a result of references data of 1930-2000 compilation with the species list from our study in 2000-2015. Systematical structure analysis revealed Class Bacillariophyceae, Order Naviculales, and Genus *Nitzschia* as most richest. The *Pinnularia* genus with extremely large species richness, 39, show peculiarities of the Pamir diatom

flora because prefer fresh, clear, circumneutral waters in natural aquatic objects with developed phytoperiphytonic communities, included many rare species. Comparison of revealed diatom species richness in Pamir with the surrounding mountain algal floras let us to assume that total algal flora of Pamir can reach about 1,000 taxa.

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References:

1. Balashova, N.B., Nikitina, V.N. (1978). *To the algal flora of some thermal springs of Pamir*. Proceedings of VI conference of lower plants of Middle Asia and Kazakhstan. Donish, Dushanbe, p. 22.
2. Aysel, V. (2005). *Check-list of the freshwater algae of Turkey*. Journal of the Black Sea/Mediterranean Environment, 11, 1–124.
3. Barinova, S, Naiz Ali, Barkatullah, Sarim, F.M. (2013). *Ecological Adaptation to Altitude of Algal Communities in the Swat Valley (Hindu Cush Mountains, Pakistan)*. Expert Opinion on Environmental Biology, 2(2), 1-15, DOI: 10.2478/s13545-014-0150-y
4. Barinova, S. (2011). *Algal Diversity Dynamics, Ecological Assessment, and Monitoring in the River Ecosystems of the Eastern Mediterranean*. Hauppauge, NY, USA: Nova Science Publishers, 363 p.
5. Barinova, S., Boboev, M., Hisoriev, H. (2015a). *Freshwater algal diversity of the South-Tajik Depression in a high mountainous extreme environment*. Turkish Journal of Botany, 39, 535-546, and Supplement 1-22, doi:10.3906/bot-1406-45.
6. Barinova, S., Gabyshev, V., Boboev, M., Kukhaleishvili, L., Bilous, O. (2015b). *Algal Indication of Climatic Gradients, American Journal of Environmental Protection*. Special Issue: Applied Ecology: Problems, Innovations, 4(3-1), 72-77, doi: 10.11648/j.ajep.s.2015040301.22.
7. Barinova, S., Kukhaleishvili, L. (2014). *Diversity and ecology of algae and cyanobacteria in the Aragvi River, Georgia*. The Journal of Biodiversity, Photon, 113, 305-338.
8. Barinova, S., Niyatbekov, T.P. (2017). *Algal Diversity of the Pamir High Mountain Mineral Springs in Environmental Variables Gradient*. International Journal of Environmental Sciences & Natural Resources, 7(2): 555706. DOI: 10.19080/IJESNR.2017.07.555706.
9. Barinova, S.S., Kukhaleishvili, L., Nevo, E., Janelidze, Z. (2011). *Diversity and ecology of algae in the Algeti National Park as a part of the Georgian system of protected areas*. Turkish Journal of Botany, 35, 729-774. DOI 10.3906/bot-1009-83.

10. Baturina, L.R. (1983). *Algae of thermal springs of Tajikistan*. PhD Thesis, Dushanbe, 284 p.
11. Bokhodjaev, I.Ya., Davlatmamadov, Sh.M. (1994). *Medical mineral springs of Pamir*. Dushanbe.
12. Churshina, N.M. (1982). *Mineral, thermal and cold water*. In: Tajikistan (nature and natural resources). Dushanbe, pp. 125–131.
13. Ergashev, A.E. (1969). *Materials to the algal floras of natural and artificial, thermal and hot springs of Middle Asia. Lower Plants of Middle Asia.* Tashkent, Fan, 3–37.
14. Jumaeva, G.R. (2008*). Algal flora of major thermal and mineral springs of Pamir*. PhD Thesis, Dushanbe, 151 p.
15. Muzafarov, A.M. (1965). *Algal flora of the Central Asian waterbodies*. Tashkent, Uzbekistan Academy of Science Publisher.
16. Petersen, J.B. (1930). *Algae from O. Olufsen's second Danish Pamir Expedition 1898–1899.* Dansk Bot. Ark., 6(6), 1–60.
17. Stevenson, J. (2014). *Ecological assessments with algae: a review and synthesis*. Journal of Phycology, 50, 437–461, doi:10.1111/jpy.12
18. Zarei Darki, B. (2009). *Taxonomic structure of the algal flora of Iran*. Bangladesh Journal of Plant Taxonomy, 16(2), 185-194, DOI: 10.3329/bjpt.v16i2.3933.