

## Freshwater algal diversity of the South-Tajik Depression in a high-mountainous extreme environment, Tajikistan

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**Abstract:** The research on algal communities' response to altitude and altitude-related climatic conditions is sparse. So far, a full, accessible list of algae from the water bodies of the South-Tajik Depression has not been available. We compiled an algal species list of 1190 taxa that were revealed by us or listed in references in the South-Tajik Depression high-mountain rivers Kafirnigan, Vakhsh, Kyzylsu, Yakhsu, and Tairsu and in the lakes of its basin. The altitude gradient of the studied area is about 2500 m above sea level. An altitude-related algal diversity analysis was done with help of statistics and bioindication. The Willis curve for the distribution of species to genera had a trend line of  $R^2 = 0.92$ . A multivariate analysis was used for quantitative estimates of the ecological tolerance ranges of critical species and for detecting cardinal factors and trends at local water bodies to global levels of biodiversity evolution. Our analysis shows that species distribution was strongly affected by altitude and altitude-related climatic variables. Statistical methods revealed that temperatures stimulate algal species diversity, while precipitation and altitude suppress it. One of the floristic complexity criteria is the average species richness of the algal genera or the infraspecies to species ratio, which increased from 1.12 to 1.20 and reflects increases in structural complexity with altitude. Therefore, high altitude stresses algal communities and stimulates species polymorphism as a compensatory mechanism for algal species survival. Our approach is pertinent to the problem of floristic differentiation under climate change and climatic instability.

**Key words:** Freshwater algae, diversity, ecology, bioindication, altitude, canonical correspondence analysis, Tajikistan

### 1. Introduction

The adaptation level of a species and a community as a whole determines the relationship between freshwater algal biodiversity and environmental conditions. Bioindication is based on the principal of congruence between community composition and the complexity of environmental factors. However, it is still a problem to define the role of climatic factors in predicting the community's response to environmental change. In an analysis of freshwater algae diversity we encounter certain difficulties. First, it is difficult to determine the scope of communities involved, as well as to define the scope of research tasks and the relevance of operative approaches (Barinova, 2013). The effects of altitude on freshwater algae distribution is widely discussed in the recent literature (Aboal et al., 1989; Sabater and Roca, 1992; Şahin, 1998, 2000, 2001; Poulíčková et al., 2003; Cantonati et al., 2007; Kapetanović and Hafner, 2007; Barinova, 2011b; Barinova and Nevo, 2012; Barinova et al., 2013; Hisoriev, 2013) but still remains a problem.

Our experience in freshwater algal communities' comparisons and infraspecific levels of comparison gives us a method for a productive approach when there are visible climatic responses in the ecoregional, riverine basin floras.

South-Tajik Depression algae from low- to high-mountain habitats of the Vakhsh, Kafirnigan, and Kyzylsu river basins have been studied since 1967 (Shmeleva, 1967, 1976, 1980; Andrievskaya, 1976; Hisoriev and Palamar-Mordvintseva, 1979). We examined algal communities not only in rivers, but also in numerous natural and artificial reservoirs encountered in the river valleys of the Kyzylsu, Yakhsu, and Tairsu rivers and the Muminabad and Selbursk reservoirs (Boboev, 2002).

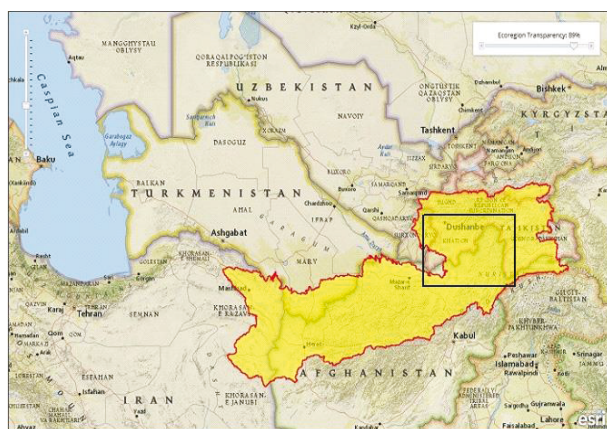
The aim of the current study was to reveal the response of algal communities in the South-Tajik Depression to altitude and altitude-related climatic conditions of its habitats. Thus, we try to implement diverse bioindicational and statistical methods, which represent some new approaches in freshwater algal diversity analysis.

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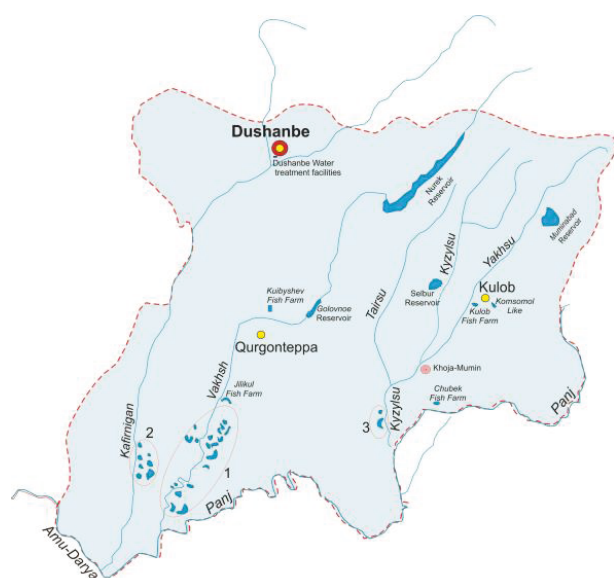
## 2. Materials and methods

### 2.1. Description of study site

The territory of the South-Tajik Depression crosses several high-water rivers: Kafirnigan, Vakhsh (middle and lower reaches), Kyzylsu, Yakhsu, and Tairsu, and many small rivers. All of these are right tributaries of the Panj River, which flow into the Amu-Darya River and then into the Aral Sea. They belong to the Upper Amu Darya 631 ecoregion (Figure 1), as per the Freshwater Ecoregions of the World (FEOW; <http://feow.org/>). In this territory there are artificial reservoirs, e.g., Muminabad, Selbursk, Golovnoe, Khodzhamumin, and Nurek (Safarov, 2003), as well as small lakes and fishponds (Figure 2).



**Figure 1.** Location of the studied site in the map of Freshwater Ecoregions of the World (FEOW; <http://feow.org/>).



**Figure 2.** Schematic map of the studied area in the South-Tajik Depression: 1 – the Vakhsh River basin lakes; 2 – the Kafirnigan River basin lakes; 3 – the Kyzylsu River basin lakes.

### 2.2. Sampling and laboratory studies

Altogether, 766 samples of plankton, benthos, and periphyton were collected from rivers and lakes of the study area during the period of 2000–2011. They were fixed in 2%–4% neutral formaldehyde solution. Microscopy was performed with an MBI-3, Amplival, and Carl Zeiss Axioskop-40 with a high-resolution AxioCam MRC-5 digital camera and AxioVision 4.8 microscopes under 600–1000× magnification. Diatom shells were studied in permanent slides with Elyashev media. No less than 300 cells were calculated from each sample.

### 2.3. Taxonomic analysis and functional classification

For taxonomic identification the International Handbook series was used. The modern species names in our work come from AlgaeBase (Guiry and Guiry, 2014) with the common system nomenclature derived from Cavalier-Smith (2004).

### 2.4. Bioindication

Each group of species was separately assessed with respect to their significance as bioindicators according to synthetic tables on species ecology (Barinova et al., 2006; Ziglio et al., 2006). Those species that predictably responded to environmental variables could be used as bioindicators reflecting the response of the aquatic ecosystems to eutrophication, acidification (based upon pH levels), salinity, and self-purification (Sládeček, 1973; Barinova et al., 2006; Barinova, 2011). Class of water quality was defined using the EU 5-Classes system (Barinova et al., 2006) based on species indicators content. Saprobity indicators have a species-specific index in each species that is relevant to the Water Quality Class. The following index ranges determine the class: 0.0–0.5 = Class 1; 0.5–1.5 = Class 2; 1.5–2.5 = Class 3; 2.5–3.5 = Class 4; 3.5–4.5 = Class 5 (Sládeček, 1973, 1986).

### 2.5. Statistical analysis

Statistical processing of algological material included the comparison of the species composition in different water bodies and at different altitude levels using the Sørensen–Czekanowski (or Bray–Curtis) indices (the GRAPHS Program package; Novakovsky, 2004) with the construction of a similarity tree and a dendrite of species composition similarity. Statistical analysis of the relationships of species diversity in algal communities and their environmental variables were calculated using Statistica 7.0 and canonical correspondence analysis (CCA) with CANOCO for Windows 4.5 (Ter Braak and Šmilauer, 2002). The statistical significance of each variable was assessed using the Monte Carlo unrestricted permutation test involving 999 permutations (Ter Braak, 1990). The CCA biplot represents the overlap of species diversity in relation to a given combination of environmental variables. Arrows represent the environmental variables, with the maximal values for each variable located at the tip of the arrow

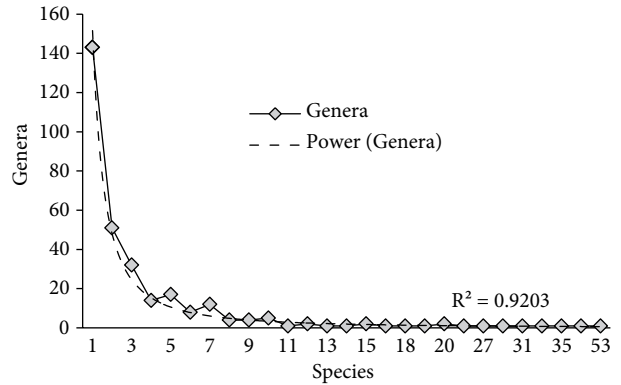
(Ter Braak, 1987). Pearson correlations between different taxonomical and climatic variables were calculated with the help of Free Statistics and Forecasting Software (<http://www.wessa.net/corr.wasp>).

**3. Results**

We compiled an algal species list (see Appendix, on the journal's website) from the studied area rivers and lakes containing 1190 taxa from 9 taxonomical divisions (Table; Appendix). Species richness was high; nevertheless, our first step was to check the representation of revealed diversity for adequate analysis. We adopted Willis' approach (1922) for assessing completeness of floristic data to freshwater algal floras. On the basis of our own experience (Barinova et al., 2006; Barinova, 2011) and the work of our colleagues (Bilous et al., 2013), the hyperbolic shape of the Willis curve is reasonably reliable evidence of taxonomic completeness in the case of thoroughly studied regional and local basinal floras. The validity of this approach has been tested in the comparably rich algal floras of Turkey (2100 species), the Aragvi River (964 species), Georgia (1164 species), and Israel (1621 species). As a result, we constructed a Willis curve for the revealed

algal diversity, which is the ratio of species to genera number (Figure 3). The trend line shows an almost exact correlation with the estimated distribution, which means that revealed diversity is statistically analyzable.

The next step was a bioindicational analysis of the identified species with respect to ecological groups. The standard deviation line singles out the most significant ecological indicator groups or combinations of such. As can



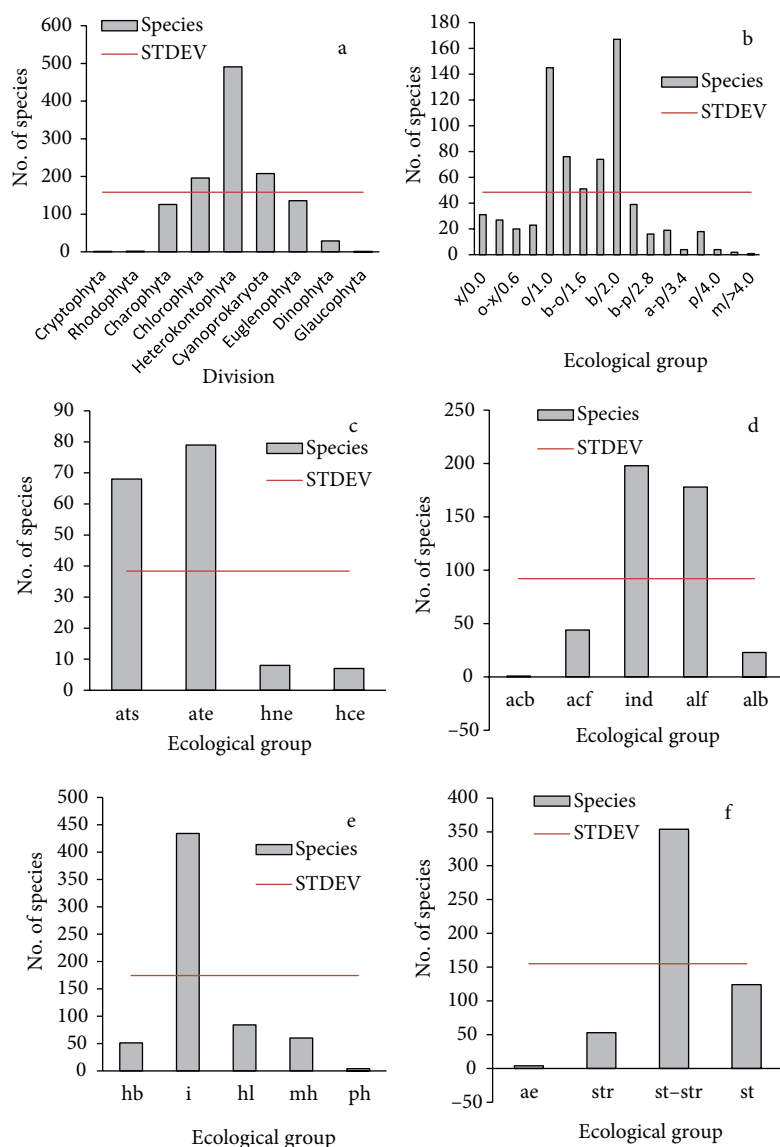
**Figure 3.** Willis curve for the algal species to genera distribution in the South-Tajik Depression alga flora.

**Table.** Climatic variables and distribution of freshwater algal species in taxonomic divisions over altitudes of the South-Tajik Depression.

Altitude, m a.s.l.	100–500	500–1000	1000–1500	1500–2000	2000–2500
Climatic zone	1	2	2	3	3
T mean, °C	17	15	15	11	12
T January, °C	2	1	1	-7	-7
T min, °C	-25	-29	-30	-34	-34
T July, °C	32	27	27	23	23
T max, °C	44	44	44	40	40
Precipitation, mm year <sup>-1</sup>	150	650	650	1200	1200
Heterokontophyta	177	391	89	27	5
Cyanoprokaryota	97	149	25	20	0
Chlorophyta	67	155	42	11	1
Euglenophyta	33	110	28	3	0
Charophyta	24	88	33	11	0
Dinophyta	15	14	6	0	0
Cryptophyta	1	0	0	0	0
Rhodophyta	0	2	0	0	0
Glaucophyta	0	1	0	0	0
No. of species	414	910	223	72	6

be seen in Figures 4 and 5, and in the electronic Appendix, the most represented algae were from the Heterokontophyta, Chlorophyta, and Cyanoprokaryota taxonomic divisions (Figure 4a). Two major groups of organic pollution indicators are represented: oligo- and betamesosaprobe (Figure 4b), which means that the studied habitats can

be divided into two different groups of low and medium pollution. The identified species mostly use photosynthetic ways for organic carbon production, whereby there was strong evidence of prevailing autotrophic ecological groups (Figure 4c). Indifferent and low-alkaliphilic species can be seen as indicators of low-alkaline water (Figure



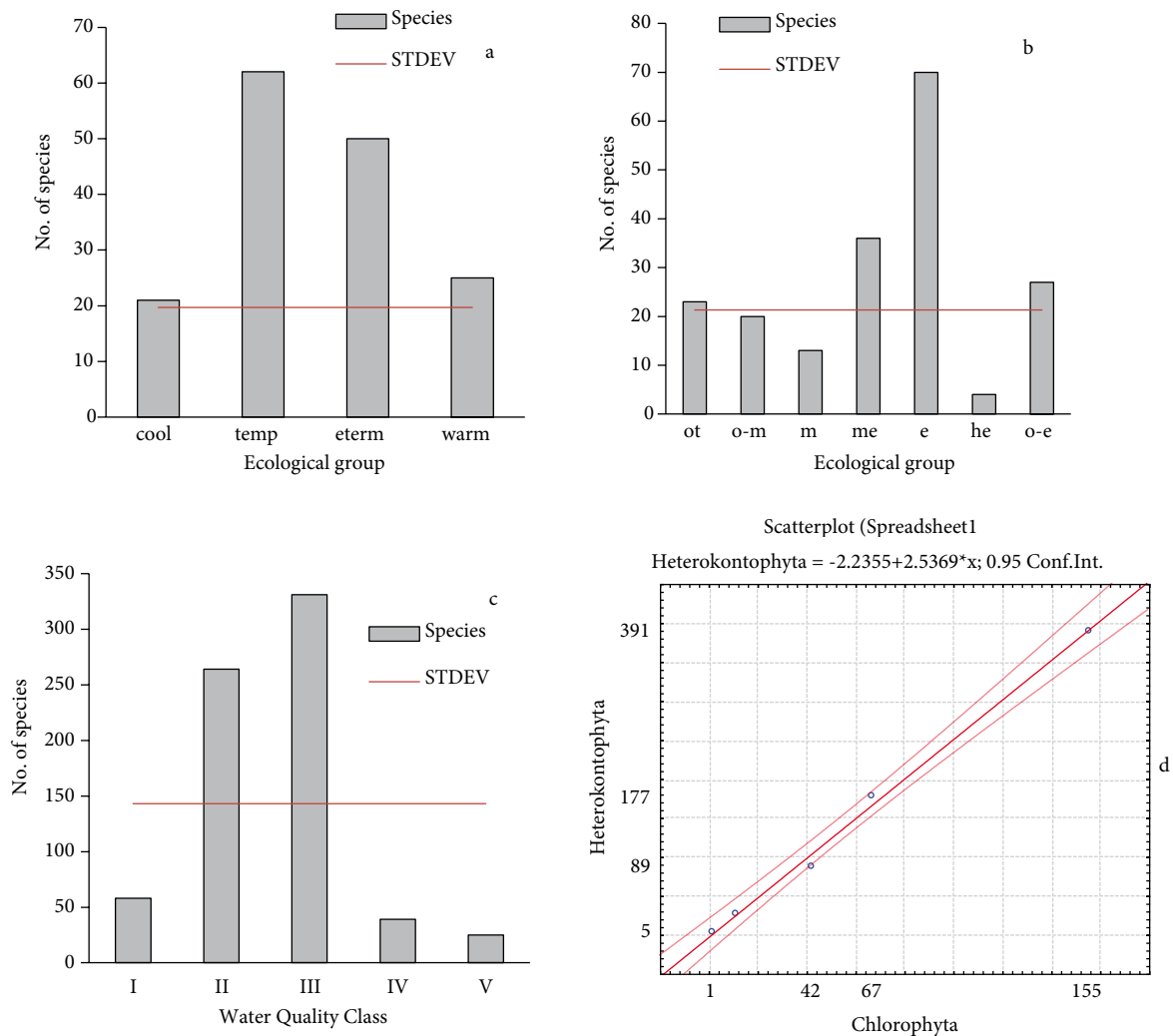
**Figure 4.** Taxonomy and bioindication of major environmental variables by the algal species of the South-Tajik Depression water bodies: (a) Species distribution over taxonomic divisions; (b) Self-purification zone preferences with index of saprobity (x/0.0 – xenosaprobe; o-x/0.6 – oligoxenosaprobe; o/1.0 – oligosaprobe; b-o/1.6 – betaoligosaprobe; b/2.0 – betamesosaprobe; b-p/2.8 – betapolsaprobe; a-p/3.4 – alphapolsaprobe; p/4.0 – polysaprobe; m/>4.0 – m-eusaprobe); (c) Nitrogen uptake metabolism (Het) (Van Dam et al., 1994): ats – nitrogen-autotrophic taxa, tolerating very small concentrations of organically bound nitrogen; ate – nitrogen-autotrophic taxa, tolerating elevated concentrations of organically bound nitrogen; hne – facultatively nitrogen-heterotrophic taxa, needing periodically elevated concentrations of organically bound nitrogen; hce – obligately nitrogen-heterotrophic taxa, needing continuously elevated concentrations of organically bound nitrogen; (d) Acidity (pH) degree according to Hustedt (1957) (alb – alkalibiontes; alf – alkaliphiles, ind – indifferent; acf – acidophiles; acb – acidobiontes, neu – neutrophiles as a part of indifferent taxa); (e) Halobity degree according to Hustedt (1938–1939) (hb – oligohalobes-halophobes, i – oligohalobes-indifferent, mh – mesohalobes, hl – halophiles; ph – polyhalobes); (f) Oxygenation and streaming (st – standing water, str – streaming water, st-str – low streaming water, ae – aerophiles). STDEV: Standard deviation line.

4d) with low salinity (Figure 4e). Communities mostly occupy low-streaming waters (Figure 4f) in a full range of temperatures from cool to warm (Figure 5a). The identified species diversity indicated a full range of trophic ecosystem conditions from oligotrophy to hypertrophy (Figure 5b), with an eutrophic state of Class II and III of water quality (Barinova et al., 2006) prevailing (Figure 5c). Only four species were found as indicators of anoxic conditions in the lowermost habitats (see electronic Appendix).

Altitude-related environmental variables are represented in the Table and show fluctuation ranges with correlations with climatic zones. The Pearson correlation of temperature and humidity with altitude is negative and very high (from -0.860 to -0.961), with a significance value

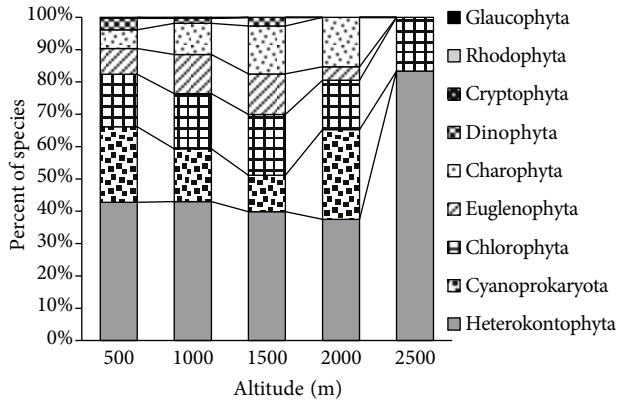
of 0.01–0.009. Precipitation has a high (0.947) positive correlation with altitude with a level of significance of 0.007. This means that major climatic conditions are regulated by the altitude of the habitat.

We tried to discover which taxonomic groups are correlated with altitude-related variables. The Pearson correlation of the major divisions is significant and negative (Heterokontophyta, -0.715; Chlorophyta, -0.708; Cyanopokaryota, -0.815), whereas other taxonomical groups have no significant correlation with altitude. Species richness as a whole also has negative correlation (-0.721) at the 0.08 level of significance. At the same time, the most correlated taxonomical groups are Heterokontophyta and Chlorophyta (Figure 5d).



**Figure 5.** Bioindication of major environmental variables by the algal species of the South-Tajik Depression water bodies: (a) Temperature preferences (cool – cool-water, temp – temperate, eterm – eurythermic, warm – warm-water); (b) Trophic state (Tro) (Van Dam et al., 1994): ot – oligotraphentic; o-m – oligomesotraphentic; m – mesotraphentic; me – mesoeutraphentic; e – eutraphentic; he – hypereutraphentic; o-e – oligo- to eutraphentic (hypereutraphentic); (c) Water Quality Class in the FWD color ranges; (d) Correlation plot of Heterokontophyta and Chlorophyta species over altitude. STDEV: Standard deviation line.

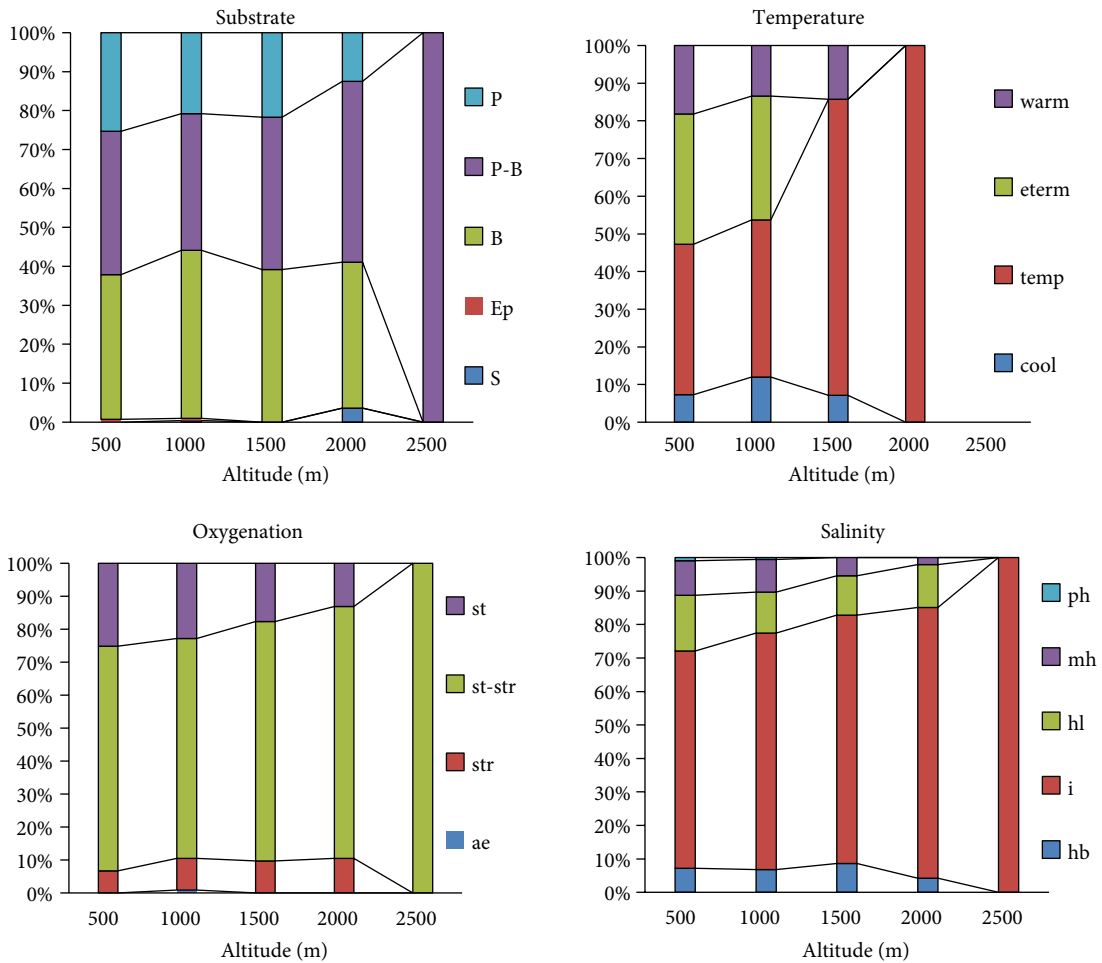
Our analysis shows that community structure fluctuates with altitude, as can be seen in Figure 6 and the electronic Appendix. While at altitudes between 300 and 2000 m



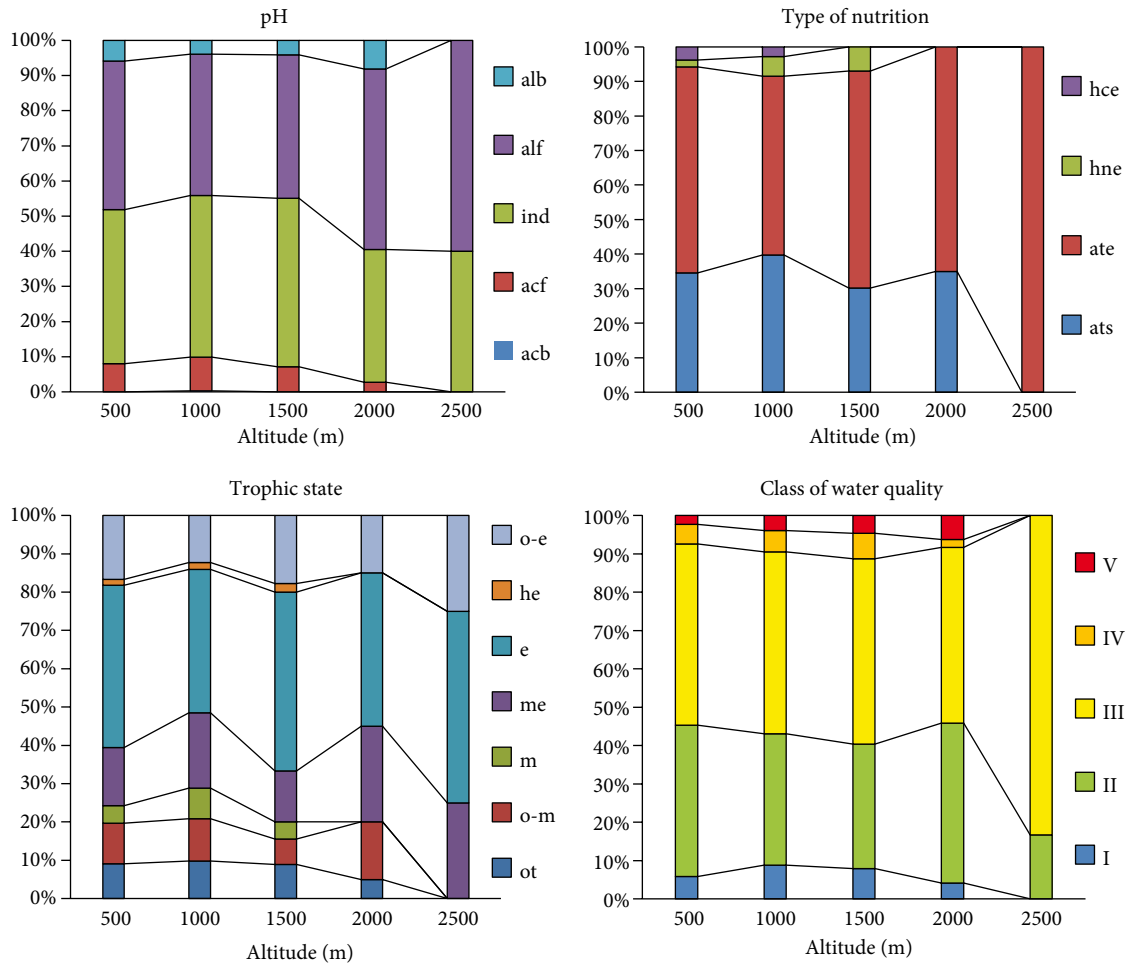
**Figure 6.** Distribution of species in taxonomic divisions over altitudes of the South-Tajik Depression water bodies.

a.s.l. there is an increased presence of Cyanoprokaryota and Chlorophyta species, the upper habitats are mostly enriched by diatoms (Figure 6). Bioindication of communities of different altitudes shows that the role of planktobenthic (Figure 7a), temperate (Figure 7b) species inhabiting middle oxygenated (Figure 7c), fresh (Figure 7d), and alkaline (Figure 8a) waters increased with altitude. Algal species indicated increases with altitude of the photosynthetic type of nutrition (Figure 8b) and the eutrophic to mesotrophic state of the ecosystem (Figure 8c) with Class III water quality (Figure 8d).

The major habitats of the study area represented riverine communities. Therefore, we compared species richness in five rivers to reveal the influence of hydrological factors. Comparative floristic analysis shows (Figure 9) that species with a similarity level of 40% were divided into three clusters relevant to the major river basins of Vakhsh, Kafirnigan, and Kyzylsu with their tributaries.



**Figure 7.** Distribution of species indicators over altitudes in the South-Tajik Depression water bodies: substrate preferences (P – planktonic, P-B – planktobenthic, B – benthic, Ep – epiphyte, S – soil); temperature preferences (cool – cool-water, temp – temperate, eterm – eurythermic, warm – warm-water); oxygenation and streaming (st – standing water, str – streaming water, st-str – low streaming water, ae – aerophiles); salinity ecological groups (hb – oligohalobes-halophobes, i – oligohalobes-indifferent, mh – mesohalobes, hl – halophiles; ph – polyhalobes).



**Figure 8.** Distribution of species indicators over altitudes in the South-Tajik Depression water bodies: pH preferences range (alb – alkalibiontes; alf – alkaliphiles, ind – indifferent; acf – acidophiles; acb – acidobiontes, neu – neutrophiles as a part of indifferent taxa); nitrogen uptake metabolism preferences (ats – nitrogen-autotrophic taxa, tolerating very small concentrations of organically bound nitrogen; ate – nitrogen-autotrophic taxa, tolerating elevated concentrations of organically bound nitrogen; hne – facultatively nitrogen-heterotrophic taxa, needing periodically elevated concentrations of organically bound nitrogen; hce – obligately nitrogen-heterotrophic taxa, needing continuously elevated concentrations of organically bound nitrogen); trophic state indicators (ot – oligotrophic; o-m – oligomesotrophic; m – mesotrophic; me – mesoeutrophic; e – eutrophic; he – hypereutrophic; o-e – oligo- to eutrophic (hypereutrophic)); Water Quality Class in the EU FWD color ranges.

This evidence helps us to conclude that communities in each river basin have their own algal species diversity.

A comparison of algal diversity, grouped according to habitat altitudes (see electronic Appendix), is shown in the dendrogram (Figure 10) by three clusters with a similarity level of 40%. The first cluster included species from the lowest habitat altitudes of 300–500 m a.s.l. The second cluster represents habitats at altitudes of up to 1000 m and included the richest communities (Table). The third cluster unites communities living at altitudes above 1000 m. A dendrite of similarity that was based on percentage of species overlapping in each pair of altitude species group (Figure 11) shows decreasing species similarity from the lowest (32%) to highest

(15%) habitats. Species similarity can be related not only with species richness, which rather fluctuated, but mostly with the influence of specific altitude-related environments.

Floristic comparison of species richness in the lentic water bodies of the studied area helped us to divide communities into two different cores (Figure 12). Core one included lakes and reservoirs, whereas Core two included fishpond communities only. Apparently, the influence on species richness in lentic water bodies depends more on trophic levels than on the type of habitat in which the species live.

In this case we calculated the relationship between species richness on a divisional level with climatic

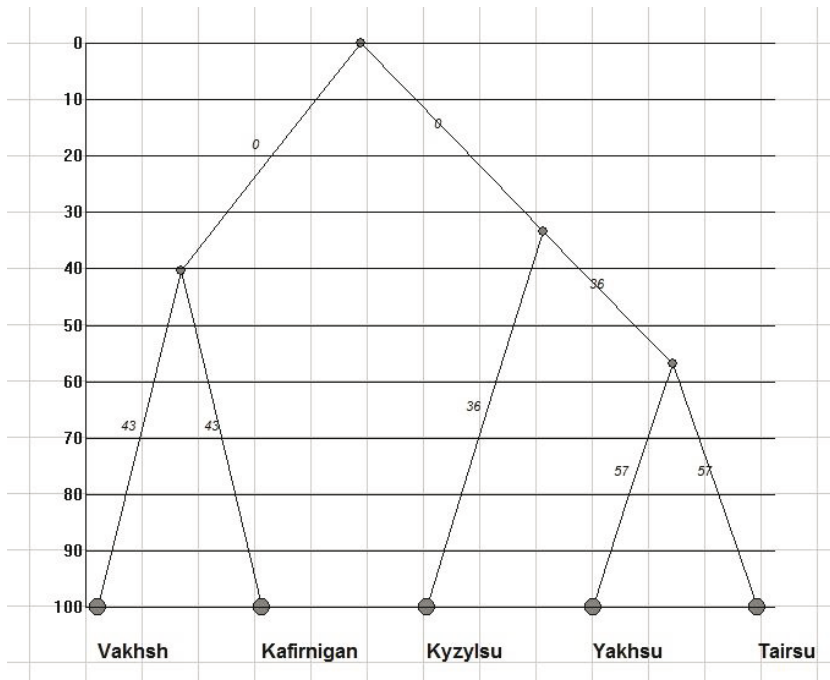


Figure 9. Dendrogram of similarity (Euclidean distance) of species diversity in the rivers of the South-Tajik Depression.

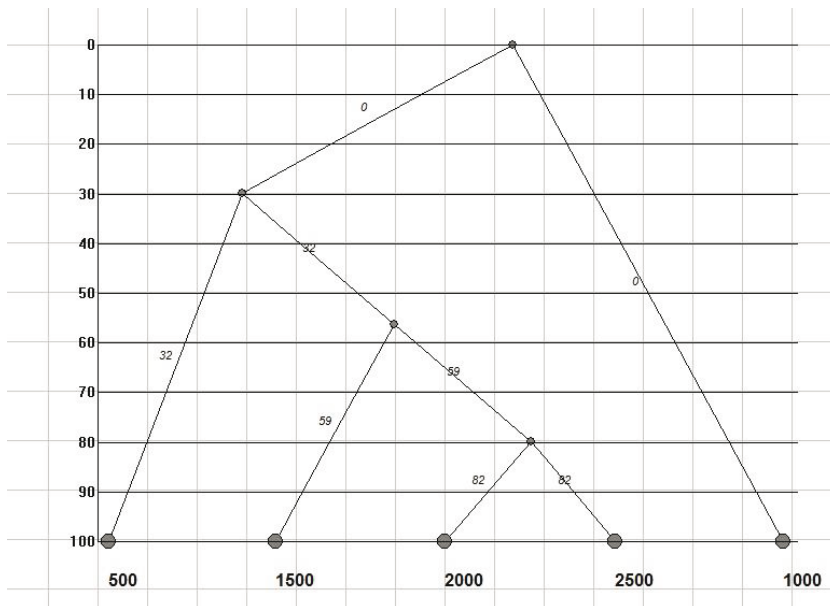


Figure 10. Dendrogram of species diversity similarity (Euclidean distance) over altitudes of habitats in the South-Tajik Depression.

variables relating to altitude. The CCA biplot shows that variables are clustered in two opposite groups (Figure 13). Temperature variables form the upper right cluster of parameters that stimulate algal species diversity, whereas the second lower cluster includes altitude of habitats and precipitation, which suppress species diversity in the study

area. We did not see any special reaction of the identified divisional diversity taxa to different groups of variables; only Cryptophyta species appear relatively affected by temperature, but this division is only represented by one species (see electronic Appendix) in the lowermost habitat.



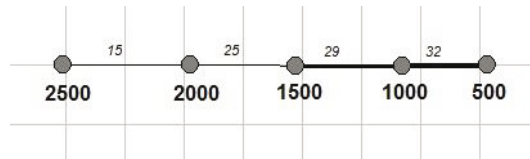


Figure 11. Dendrite of species diversity overlapping over altitudes of habitats in the South-Tajik Depression.

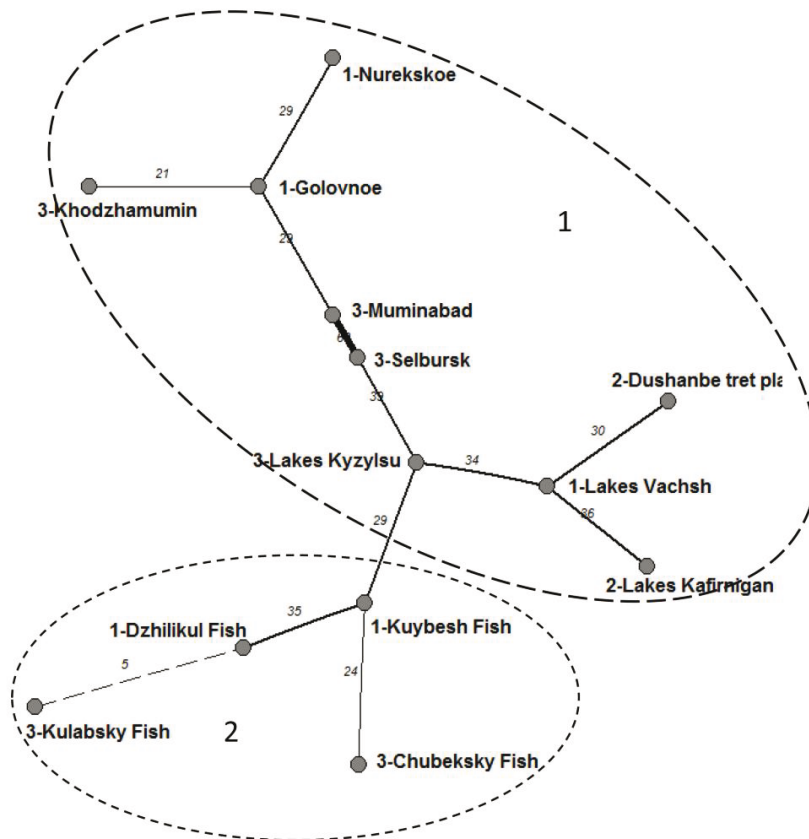
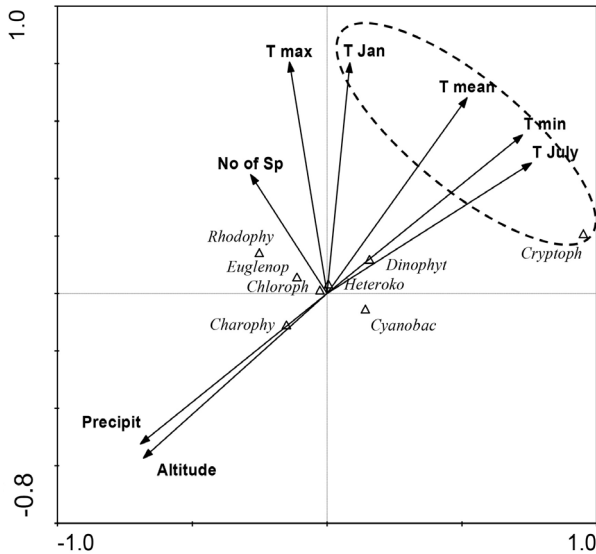


Figure 12. Dendrite of species diversity overlapping in the lakes, reservoirs, and fishponds in the South-Tajik Depression.

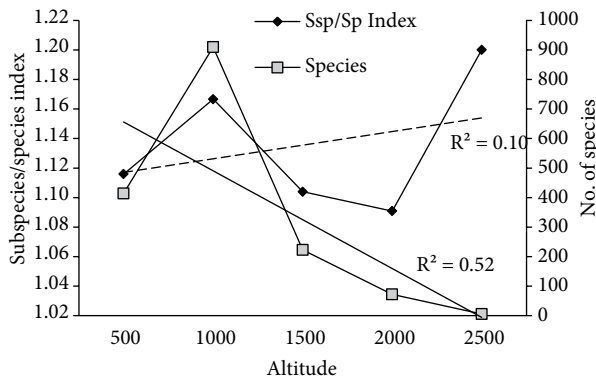
We calculated the infraspecies polymorphism index of the ratio of infraspecies to species taxa in altitude clusters' diversity. Figure 14 shows that species richness in altitude clusters fluctuated, but had a negative trend with altitude. Sometimes infraspecific variation in algal species had the opposite trend, i.e. infraspecific variation increased with altitude. Altitude-related environmental variables are stress factors that enhance the infraspecific variation. Therefore, we can see in the electronic Appendix that in the studied flora the most polymorphic species are from the genera *Cosmarium*, *Closterium* (desmids), *Lepocinclis*, *Euglena*, *Trachelomonas* (euglenoids), *Gomphonema*, *Nitzschia* (diatoms), and *Scenedesmus* (green algae).

#### 4. Discussion

Our approach to analyze species preferences with the help of bioindication, statistical programs, and comparative floristic analyses was used to determine altitude distribution of algal communities in the South-Tajik mountain area. We identified 1190 taxa from 9 taxonomic divisions, in which Heterokontophyta, Chlorophyta, and Cyanoprokaryota prevailed. Species richness in the studied area's water bodies is very high and can be compared with surrounding mountain areas of freshwater diversity in Georgia (1063) (Barinova et al., 2011a), the Aragvi River (644) (Barinova and Kukhaleishvili, 2014), Israel (1621) (Barinova, 2011a), Mongolia (1574) (Dorofeyuk and Tsetsegmaa, 2002), and



**Figure 13.** Canonical correspondence analysis (CCA) of algal species in taxonomic divisions and altitude-related climatic variable relationships in the South-Tajik Depression.



**Figure 14.** Subspecies/species index and species number over altitudes of habitats in the South-Tajik Depression.

Turkey (2300) (Aysel, 2005). It seems that the algal flora of the studied regions is characterized not only by these three river basins, but also by the Upper Amu Darya 631 ecoregion in the FEOW as a whole. In this region of Asia the attention of researchers has been focused on the algal communities' changes with altitude and environmental gradients in the mountain lakes and reservoirs of Turkey (Atıcı, 2002; Atıcı and Obalı, 2006, 2010; Şahin, 1998, 2000, 2001) and Iran (Shams et al., 2012). We implemented integral altitude-related analyses that were carried out for the first time in the studied areas. Our assessments for the successive altitudinal belts include the anthropogenic effects that scale to climatic differences rather than being separated from the climatic control. We consider this as a crucial point of the present study because traditionally

pollution is thought to be one factor and climate another. In reality, their effects intermingle and correlate. It can be seen that altitude and altitude-related climatic variables play the major role in species distribution. In all of the mentioned surrounding floras, the Heterokontophyta species prevailed. In the studied flora we noted a trend of Chlorophyta and Cyanoprokaryota species numbers decreasing with altitude, as in Mongolia, Turkey, and the Hindu Kush (Barinova et al., 2013); however, this trend is the opposite in Israel and Georgia. The results of studies of the diversity of mountain lakes (1200–2700 m a.s.l.) in Turkey (Şahin, 1998, 2000, 2001) confirm our conclusion that the role of desmids increases with the altitude of the lake, whereas euglenoids decrease. Bioindication analysis characterizes the studied rivers and lakes as low-alkaline and low-saline, temperate, medium-oxygenated, of low- and medium-polluted Class II and III water quality, inhabited by algae with strongly prevailing autotrophic nutrition and reflecting an oligotrophic to hypertrophic state.

An altitude gradient can be seen increasing the role of algal species with planktobenthic, photosynthetic ecology inhabiting temperate, medium-oxygenated, fresh, alkaline, and eutrophic to mesotrophic waters of Class III quality.

A comparison of the algal diversity that we grouped according to habitat altitudes showed that each river basin has its own algal species diversity. Lentic water body diversity correlated mostly with its trophic level. CCA showed that climate-related variables are clustered as two opposite groups that stimulated (temperature) or suppressed (precipitation and altitude) algal species diversity. Intraspecific variation is an ecologically significant characteristic relevant to the biotic community's adaptive strategy as revealed with respect to latitudinal and altitudinal differentiation of freshwater floras (Barinova et al., 2011a, 2011b, 2013). In the present study we obtained only preliminary results, which may not be fully convincing, but are still worth mentioning as they are congruent with our previous conclusion on the increase of infraspecific polymorphism with altitude. Our calculation of the infraspecific polymorphism index showed increases with altitude from 1.12 to 1.20. It also showed that altitude-related environmental variables placed stress on algal species development by provoking infraspecific variation. The same trend in the index value was found in the Israeli (Barinova et al., 2011b), Hindu Kush (Barinova et al., 2013), and Georgian (Barinova et al., 2011a) altitude gradients. This information reveals that high altitudes not only stress algal communities, but also stimulate species polymorphism as a compensatory mechanism for the survival of algal species.

As a result of this study, we conclude that species distribution and ecological preferences of algal

communities in the rivers and lakes of the South-Tajik Depression area are strongly affected by altitude and altitude-related climatic variables. High species richness gives us the basis for relevant use of statistical programs. We implemented a multivariate analysis approach using quantitative estimates for the ecological tolerance ranges of critical species and communities as well as detecting cardinal factors and trends from local water bodies to global levels of biodiversity evolution. A comparison of the Tajik Depression freshwater algae with other regional algal floras of high mountains shows that altitude and altitude-related climatic variables play a major role in species distribution. We determined that temperature stimulated algal diversity, while precipitation and altitude suppressed it. One of the floristic complexity criteria is the average species richness of the algal genera or the genera to species ratio. The study of high-mountain algal flora showed increases of structural complexity with altitude.

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- This means that many species per genus in lower-altitude habitats showed evidence of stable development, whereas a high ratio of monotypic genera can be related to geological, climatic, or anthropogenic impacts such as what was seen in the high-altitude communities of the South-Tajik Depression. Therefore, high altitudes not only stress algal communities but also stimulate species polymorphism as a compensatory mechanism for the survival of algal species.
- Our approach to analyzing the freshwater algal communities of mountain regions is pertinent to the problem of floristic differentiation under climate change, in particular because the high-mountain areas are species richness reserves (Hewitt, 1996) in a time of climatic instability.

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<i>Lepocinclis ovum</i> var. <i>dimidio-minor</i> (Deflandre) Conr.	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
<i>Lepocinclis ovum</i> var. <i>discifera</i> Conr.	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
<i>Lepocinclis ovum</i> var. <i>major</i> Kufferath	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Lepocinclis oxyuris</i> (Schmarda) Marin et Melkonian	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0
<i>Lepocinclis playfairiana</i> Defl.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Lepocinclis spirogyroides</i> Marin et Melkonian	1	1	1	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0
<i>Lepocinclis spiroides</i> (Lemm.) Marin et Melkonian	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Lepocinclis steinii</i> Lemm.	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Lepocinclis teres</i> (Schmitz) Francé	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0
<i>Lepocinclis tripteris</i> (Dujardin) Marin et Melkonian	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Menoidium pellucidum</i> Perty var. <i>pellucidum</i>	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Menoidium pellucidum</i> var. <i>steinii</i> Popova	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Menoidium tortuosum</i> (Stokes) Senn	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Monomorpha aenigmatica</i> (Drezepolski) Nudelman et Triemer	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Monomorpha lepicinloides</i> (Pochmann) Marin et Melkonian	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Monomorpha pyrum</i> (Ehrb.) Mereschk.	1	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0
<i>Notosolenus apocamptus</i> Stokes	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Petalomonas mediocanellata</i> Stein	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus acuminatus</i> Stokes	1	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Phacus acutus</i> Pochm.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus anomalus</i> Fritsch et Rich	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Phacus caudatus</i> Hübn.	1	1	1	1	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1	1	0	0
<i>Phacus circulatus</i> Pochmann	1	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1	0
<i>Phacus curvicauda</i> Swir.	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Phacus dangardii</i> Lemm.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus gigas</i> A.M.Cunha	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Phacus granum</i> Drez.	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Phacus hamelii</i> P.Allorge et M.Lefèvre	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus hispidulus</i> (Eichw.) Pochm. var. <i>hispidulus</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus hispidulus</i> var. <i>glabrus</i> Deflandre	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus inflexus</i> (Kisel.) Pochm.	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Phacus longicauda</i> (Ehrb.) Duj. var. <i>longicauda</i>	1	1	1	0	1	0	0	1	0	0	1	1	1	0	0	1	0	0	0	1	1	1
<i>Phacus longicauda</i> var. <i>insecta</i> Huber-Pestalozzi	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus oscillans</i> Klebs	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus parvulus</i> Klebs	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus pleuronectes</i> (O.F.Müller) Nitzsch ex Dujardin	1	1	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	1	0
<i>Phacus pusillus</i> Lemm.	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
<i>Phacus pyrum</i> var. <i>pseudonordstedtii</i> (Pochmann) Popova	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus setosus</i> Francé	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus spirogyra</i> Drez.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus tortuosus</i> Roll	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Phacus tortus</i> (Lemm.) Skwortz.	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
<i>Phacus unguis</i> Pochmann	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Pseudoperanema trichophorum</i> (Ehrb.) Christen	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Strombomonas acuminata</i> (Schmarda) Defl.	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
<i>Strombomonas deflandrei</i> (Roll) Defl.	1	0	1	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	1	1	1	0
<i>Strombomonas fluviatilis</i> (Lemm.) Defl.	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
<i>Strombomonas planctonica</i> (Wolosz.) Popova var. <i>planctonica</i>	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0
<i>Strombomonas planctonica</i> var. <i>bucharica</i> (Kisselev) Popova	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
<i>Trachelomonas abrupta</i> Swir.	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
<i>Trachelomonas allia</i> Drez.	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Trachelomonas caudata</i> (Ehrb.) Stein	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Trachelomonas granulata</i> Svirengo	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Trachelomonas granulosa</i> Playf.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Trachelomonas hispida</i> (Perty) Stein ex Delf. var. <i>hispida</i>	0	1	1	1	1	0	0	0	0	0	1	1	1	0	1	0	0	0	0	1	1	0
<i>Trachelomonas hispida</i> var. <i>crenulatocollis</i> (Maskell) Lemm	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0















<i>Navicula exigua</i> (Greg.) Grun.	1	1	1	1	0	0	1	1	0	1	0	1	1	1	0	0	0	0	1	1	0	0
<i>Navicula exilis</i> Kütz.	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Navicula gothlandica</i> Grun.	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
<i>Navicula grimmei</i> Krasske	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
<i>Navicula lacustris</i> var. <i>paulseniana</i> (B.-Peters.) Zabelina	1	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0
<i>Navicula laterostrata</i> Hust.	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Navicula libonensis</i> Schoeman	1	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
<i>Navicula menisculus</i> Schum.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Navicula microcephala</i> Grun.	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
<i>Navicula minima</i> Grun.	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
<i>Navicula oblonga</i> Kütz.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Navicula peregrina</i> var. <i>lanceolata</i> Skv.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Navicula placentula</i> (Ehrb.) Kütz.	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Navicula protracta</i> (Grun.) Cl.	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Navicula pupula</i> var. <i>rostrata</i> Hust.	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
<i>Navicula radiosa</i> Kütz.	1	1	1	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0
<i>Navicula reinhardtii</i> Grun.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Navicula rhynchocephala</i> Kütz.	1	1	1	1	1	0	0	1	0	0	1	1	0	0	0	0	0	1	1	1	0	0
<i>Navicula rotaeana</i> (Rabenh.) Grun.	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Navicula salinarum</i> Grun.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Navicula subplacentula</i> Hustedt	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Navicula tripunctata</i> (O. Müll.) Bory	1	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Navicula viridula</i> (Kütz.) Ehrb.	1	0	1	1	1	0	0	1	0	0	1	1	1	0	0	0	0	1	1	0	0	0
<i>Navicula vulpina</i> Kütz.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Navicymbula pusilla</i> (Grunow) K.Krammer	1	1	1	0	0	0	1	0	0	1	0	1	1	1	0	0	0	1	1	0	0	0
<i>Neidiomorpha binodis</i> (Ehrenberg) M.Cantonati, H.Lange-Bertalot et N.Angeli	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Neidium affine</i> (Ehrb.) Pfitz.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Neidium binode</i> (Ehrb.) Hust.	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Neidium bisulcatum</i> (Lagerst.) Cleve	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Neidium dubium</i> (Ehrb.) Cl.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Neidium punctulatum</i> Hust.	1	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia acicularis</i> (Kütz.) W. Sm.	1	0	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia amphibia</i> Grun.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia angustata</i> var. <i>acuta</i> Grun.	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0
<i>Nitzschia angustata</i> var. <i>curta</i> Cl.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia angustata</i> var. <i>protracta</i> Pant.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia brevissima</i> Grun.	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia communis</i> Rabenh. var. <i>communis</i>	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia communis</i> var. <i>abbreviata</i> Grun.	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
<i>Nitzschia commutata</i> Grun.	0	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0
<i>Nitzschia dubia</i> W. Sm.	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
<i>Nitzschia fasciculata</i> (Grun.) Grun.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia filiformis</i> (W.Sm.) Hust.	1	0	1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0
<i>Nitzschia fonticola</i> Grun.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia frustulum</i> (Kütz.) Grun. var. <i>frustulum</i>	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0
<i>Nitzschia frustulum</i> var. <i>asiatica</i> (Grun.) Perag.	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia frustulum</i> var. <i>subsalsina</i> Hust.	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia gracilis</i> Hantzsch	0	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia heufliana</i> Grun.	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
<i>Nitzschia holsatica</i> Hust.	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
<i>Nitzschia lanceolata</i> W. Sm.	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia linearis</i> (Ag.) W. Sm.	1	1	1	0	1	0	0	1	0	1	0	1	1	0	0	0	1	1	0	0	0	0
<i>Nitzschia lorenziana</i> var. <i>subtilis</i> Grun.	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
<i>Nitzschia microcephala</i> Grun.	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia obtusa</i> var. <i>scalpelliformis</i> Grun.	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Nitzschia obtusa</i> W. Sm. var. <i>obtusa</i>	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0





<i>Surirella robusta</i> Ehrb.	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0
<i>Surirella spiralis</i> Kütz.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Surirella splendida</i> (Ehrb.) Kütz.	1	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Surirella tenera</i> Greg. var. <i>tenera</i>	1	1	1	1	1	0	0	0	0	0	0	1	1	0	1	0	0	1	1	1	0	0
<i>Surirella tenera</i> var. <i>nervosa</i> A. Schmidt	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Surirella turgida</i> W. Sm.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Synedra cyclopus</i> Brutschy	1	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0
<i>Synedra montana</i> Krasske ex Hust	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Synedra ulna</i> (Nitzsch) Ehrb. var. <i>ulna</i>	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1
<i>Synedra ulna</i> var. <i>impressa</i> Hust.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Synedra vaucheriae</i> var. <i>truncata</i> (Grev.) Grun.	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Synochromonas pallida</i> Korsch.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Synura globosa</i> (Schiller) Starmach	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Tabellaria fenestrata</i> (Lyngb.) Kütz.	1	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0
<i>Tabellaria flocculosa</i> (Roth) Kütz.	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	1	0	0	0
<i>Tabularia fasciculata</i> (Ag.) Williams et Round	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
<i>Tetracyclus rupestris</i> (Braun) Grun.	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Tribonema affine</i> (Kütz.) G.S.West	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
<i>Tribonema minus</i> Hazen	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Tribonema viride</i> Pasch.	0	1	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0
<i>Tribonema vulgare</i> Pasch.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Tryblionella acuminata</i> W. Sm.	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
<i>Tryblionella angustata</i> W. Sm.	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
<i>Tryblionella apiculata</i> Greg.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Tryblionella hungarica</i> (Grun.) Frenguelli	1	1	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0
<i>Tryblionella scalaris</i> (Ehrb.) P.Siver et P.B.Hamilton	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0
<i>Ulnaria amphirhynchus</i> (Ehrb.) Compère et Bukhtiyarova	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Ulnaria biceps</i> (Kütz.) Compère	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Ulnaria capitata</i> (Ehrb.) Compère	1	1	1	1	0	1	1	1	0	0	1	1	1	0	0	0	0	1	1	1	0	0
<i>Ulnaria contracta</i> (Østrup) E.A.Morales et M.L.Vis	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Ulnaria danica</i> (Kütz.) Compère et Bukhtiyarova	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Ulnaria delicatissima</i> var. <i>angustissima</i> (Grun.) Aboal et Silva	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Ulnaria oxyrhynchus</i> (Kütz.) M.Aboal	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Ulnaria ulna</i> var. <i>aequalis</i> (Kütz.) M.Aboal	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
<i>Ulnaria ulna</i> var. <i>spathulifera</i> (Grun.) M.Aboal	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0
<i>Uroglena glabra</i> O.M.Matv	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Uroglena volvox</i> Ehrb.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Vaucheria geminata</i> (Vaucher) Decand.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Vaucheria sessilis</i> (Vaucher) Decand. f. <i>sessilis</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
<i>Vaucheria sessilis</i> f. <i>clavata</i> (Decand) Heering	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
<i>Volvochrysis xantha</i> Schill.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Xanthonema ulotrichoides</i> (Pasch.) Silva	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<b>Chlorophyta</b>																						
<i>Actinastrum hantzschii</i> Lagerh.	1	1	1	0	0	0	0	1	1	0	1	0	0	0	1	0	0	1	1	0	0	0
<i>Acutodesmus acuminatus</i> (Lagerh.) Tsar	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1
<i>Acutodesmus incrassatus</i> (Bohlin) Tsar.	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Acutodesmus obliquus</i> (Turpin) Hegewald et Hanagata	1	1	1	1	1	0	1	1	0	1	1	1	1	0	1	0	1	0	1	0	0	0
<i>Ankistrodesmus densus</i> Corda.	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Ankistrodesmus falcatus</i> (Corda) Ralfs var. <i>falcatus</i>	1	1	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0
<i>Ankistrodesmus falcatus</i> var. <i>turfosus</i> (Chod.) Korsch.	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Ankistrodesmus fusiformis</i> Corda	1	1	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0
<i>Ankyra ancora</i> f. <i>issajevii</i> (Kisselev) Fott	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0
<i>Ankyra judai</i> (G.M. Smith) Fott	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
<i>Aphanochaete repens</i> A. Br.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Botryococcus braunii</i> Kütz.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Carteria bucharica</i> I. Kissel.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0



<i>Golenkinia paucispina</i> W. et G.S. West	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0
<i>Golenkinia radiata</i> Chod.	1	1	1	1	0	1	0	1	1	1	0	1	0	0	0	0	0	0	1	1	0	0
<i>Golenkiniopsis longispina</i> (Korsch.) Korsch.	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
<i>Golenkiniopsis solitaria</i> (Korsch.) Korsch. var. <i>solitaria</i>	1	1	1	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0
<i>Golenkiniopsis solitaria</i> var. <i>mucoosa</i> Korsh.	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0
<i>Gonium pectorale</i> Müll.	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
<i>Granulocystis verrucosa</i> (Roll) Hind.	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Granulocystopsis decorata</i> (Svirenko) Tsar.	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Hariotina reticulata</i> P.A.Dang.	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Hegewaldia parvula</i> (Woronich.) Pröschold, C.Bock, W.Luo et L Krienitz	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Hyaloraphidium contortum</i> Pasch. et Korsch. var. <i>contortum</i>	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0
<i>Hyaloraphidium contortum</i> var. <i>tenuissimum</i> Korsch.	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Hyaloraphidium curvatum</i> Korsch.	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0
<i>Hyaloraphidium rectum</i> Korsh	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Hydrodictyon reticulatum</i> (Linnaeus) Bory de Saint-Vincent	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
<i>Keratococcus raphidioides</i> (Hansgirg) Pascher	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0
<i>Kirchneriella irregularis</i> (G.M. Smith) Korsch.	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Kirchneriella lunaris</i> (Kirchn.) Möb.	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Kirchneriella obesa</i> (West) W. et G.S. West	1	1	1	0	1	1	0	0	1	0	1	1	0	0	0	0	0	1	1	0	0	0
<i>Lagerheimia ciliata</i> (Lagerh.) Chod.	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0
<i>Lagerheimia citrifformis</i> (Snow) Coll.	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Lagerheimia genevensis</i> (Chod.) Chod.	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Lagerheimia longiseta</i> (Lemm.) Wille	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Lagerheimia marssonii</i> Lemm.	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Lagerheimia quadriseta</i> (Lemm.) G.M. Smith	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Lagerheimia wratislaviensis</i> Schröd.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Lambertia limnetica</i> (Lemm.) Korsch.	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Lambertia ocellata</i> (Korsh.) Korsh.	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0
<i>Macrochloris dissecta</i> Korsh.	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Micractinium pusillum</i> Fres.	1	0	1	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	1	1	0	0
<i>Microspora willeana</i> Lagerh.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Monactinus simplex</i> (Meyen) Corda	1	1	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0
<i>Monomastix opisthostigma</i> Scherff.	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Monoraphidium arcuatum</i> (Korsch.) Hind.	1	1	1	1	1	0	0	0	0	0	1	1	1	1	0	1	0	0	1	1	1	0
<i>Monoraphidium contortum</i> (Thur.) Kom.-Legn.	1	1	1	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	0	0
<i>Monoraphidium griffithii</i> (Berk.) Kom.-Legn.	1	1	1	0	0	1	0	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0
<i>Monoraphidium irregulare</i> (G.M.Sm.) Kom.-Legn.	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Monoraphidium minutum</i> (Näg.) Kom.-Legn.	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0
<i>Mucidosphaerium pulchellum</i> (H.C.Wood) C.Bock, Proschold et Krienitz	1	1	1	0	1	1	0	1	1	1	1	0	1	1	1	1	0	1	1	1	0	0
<i>Nautococcus caudatus</i> Korsh.	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Nephrochlamys allanthoidea</i> Korsch.	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Nephrochlamys rostrata</i> Nygaard, Kom., J.Kristiansen et O.M.Skulberg	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Oedogonium intermedium</i> Hirn	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0
<i>Oedogonium minus</i> Wittrock ex Hirn	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
<i>Oedogonium tumidulum</i> Wittr	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
<i>Oocystis borgei</i> Snow	1	1	1	0	1	0	0	1	0	0	1	1	1	1	0	1	0	0	1	1	0	0
<i>Oocystis elliptica</i> W. West	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0
<i>Oocystis lacustris</i> Chod.	1	0	1	0	1	0	1	0	1	1	0	0	0	0	1	0	0	1	1	0	0	0
<i>Oocystis novae-semiliae</i> Wille	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
<i>Oocystis parva</i> W. et G.S. West	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
<i>Oocystis pelagica</i> Lemm.	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Oocystis pusilla</i> Hansg.	0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0
<i>Oocystis solitaria</i> Wittr.	1	1	1	0	1	0	0	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0
<i>Oocystis submarina</i> Lagerh.	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
<i>Palmellopsis gelatinosa</i> Korsh	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Pandorina morum</i> (Müll.) Bory	1	1	1	0	1	1	0	0	1	1	1	1	1	1	0	1	0	0	1	1	1	0









<i>Pleurotaenium maximum</i> (Reinsch) Lundell	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Pleurotaenium trabecula</i> Näg.	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Spirogyra affinis</i> (Hassall) Petit	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Spirogyra decimina</i> (O.F.Müll.) Dumortier	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Spirogyra elongata</i> (Vaucher) Kütz.	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Spirogyra inflata</i> (Vauch.) Kütz.	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Spirogyra maxima</i> (Hass.) Witt.	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
<i>Spirogyra mirabilis</i> (Hass.) Kütz.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Spirogyra varians</i> (Hass.) Kütz.	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0
<i>Staurastrum bieneanum</i> Rabenh	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurastrum brevispinum</i> (Bréb.) Ralfs	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Staurastrum chaetoceras</i> (Schröd.) G.M. Smith	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0
<i>Staurastrum gracile</i> Ralfs	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0
<i>Staurastrum laeve</i> Ralfs	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurastrum muticum</i> Bréb.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Staurastrum orbiculare</i> Menegh	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Staurastrum paradoxum</i> Meyen	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Staurastrum polymorphum</i> Bréb.	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurastrum punctulatum</i> (Bréb.) Pal.-Mordv. var. <i>pygmaeum</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurastrum punctulatum</i> Bréb. var. <i>punctulatum</i>	0	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurastrum striolatum</i> (Nag.) Pal.-Mordv.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurastrum tetracerum</i> Ralfs	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurastrum trachytithophorum</i> W. et G.S.West	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurodesmus cuspidatus</i> (Bréb.) Teil.	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurodesmus dejectus</i> (Bréb.) Teil. var. <i>dejectus</i>	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Staurodesmus dejectus</i> var. <i>apicularis</i> (Bréb.) Croasdale	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Tortitaenia trabeculata</i> (A.Br.) A.J.Brook	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Xanthidium aralense</i> I.A.Kisselev	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Xanthidium armatum</i> Bréb. ex Ralfs	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Xanthidium smithii</i> W.Archer	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<b>Rhodophyta</b>																								
<i>Batrachospermum gelatinosum</i> (L.) De Cand.	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Batrachospermum helminthosum</i> Bory emend. Sheath et al.	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0