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Research Article

Algocenosis of The Sviyaga River (The Right Tributary of the Volga River, The Republic Of Tatarstan)

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ABSTRACT.

The article presents the results of studies of species composition, and seasonal dynamics of taxonomic structure of plankton algae. The Sviyaga River is the right tributary of the Volga River. It joins the Volga on the territory of the Republic of Tatarstan, in the Sviyazhsky Bay of the Kuibyshev Reservoir. The Sviyaga and all its sources are the monument of nature of regional importance.Hydrobiological studies were carried out at two permanent stations: in the open water zone and in the thickets of macrophytes(*Typhaangustifolia* L.).116 species of algae from 7 divisions were found in the investigated areas of the Sviyaga River during the period of study. Bacillariophyta (35.3%) and Chlorophyta (35.3%) predominate in species diversity. Other groups are less diverse: Cyanophyta - 8.6%, Euglenophyta - 12.9%, Chrysophyta - 1.7%, Dinophyta - 3.4% and Cryptophyta - 2.6%. The species diversity of biotopes varies not significantly.

KEYWORDS:algocenosis, phytoplankton, algae, the Sviyaga River.

INTRODUCTION.

The ecological, economic and recreational importance of small rivers and their role as tributaries can't be overestimated. Small rivers are the places of concentration of the greatest biodiversity. They are the biotopes for many living organisms. One of such rivers is the Sviyaga - the right tributary of the Volga River. It joins the Volga on the territory of the Republic of Tatarstan, in the Sviyazhsky Bay of the Kuibyshev Reservoir. The Sviyaga and all its sources are the monument of nature of regional importance (Resolution of the Council of Ministers of the Tatar Autonomous Soviet Socialist Republic of January 10, 1978 No. 25, Resolution of the Cabinet of Ministers of the Republic of Tatarstanof December 29, 2005 No. 644). The river locates on the territory of administrative districts Drozhzhanovsky, Buinsky, Tetyushsky, Apastovsky, Kaibitsky, Kamsko-Ustiinsky ,Verkhneuslonsky, Zelenodolsky municipal districts of the Republic of Tatarstan. The source is in the Ulyanovsk region, the estuary is below the villageSobolevskoe of Verkhneuslonsky municipal district of the Republic of Tatarstan. The status of the river presupposes compliance with the protection of territory of the nature monument, as well as the regime of use of water protection zones, in accordance with the procedure, established by law. However, in the river basin there are numerous industrial and agricultural enterprises, using the waters of the river, which have a huge impact on the water quality of this watercourse [Information bulletin on the state of surface water bodies, 2007; Nikanorov A.A., Zakharov S.D., Bryzgalo V.A., Zhdanova G.N. 2010].

Plankton algae – phytoplankton – are one of the primary producers of organic matter in aquatic communities. A detailed study of their structure has both general ecological and environmental significance. Last non-recurring algological studies on the SviyagaRiver were conducted by the researchers of the Institute of Ecology of Natural Systems of the Academy of Sciences of the Republic of Tatarstanin 2000 [Ecological problems of small rivers of the Republic of Tatarstan ,2003]. There is no information on the current state and taxonomic structure of plankton algae in the literature.

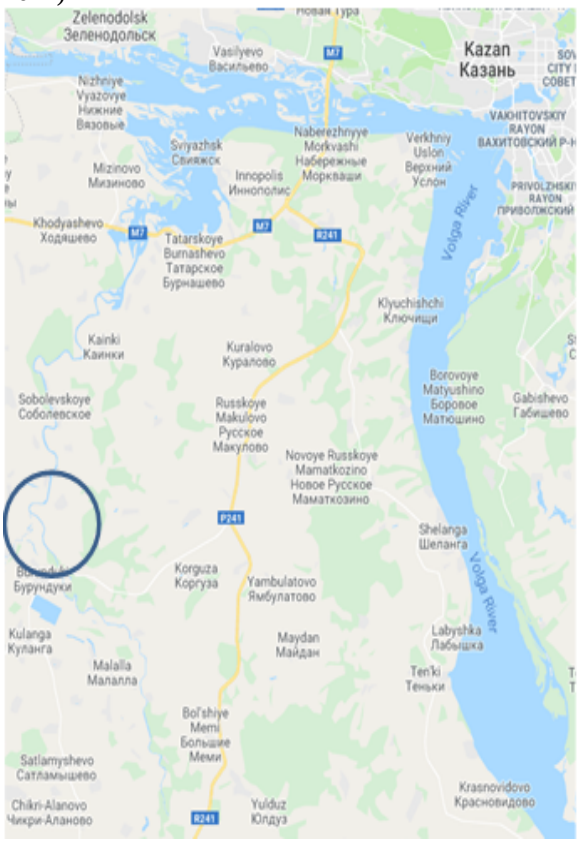
MATERIALS AND METHODS.

This article analyzes the results of studies of species composition and seasonal dynamics of species structure of plankton algaeof theSviyaga River.

Catchment area of the Sviyaga River is located on the high right bank of the middle reach of the Volga River, in the northeast of the Volga Upland. The total area of the river basin is 16,700 km^2. The greatest length from the south to the north is about 260 km, from the west to the east - 120 km.The river basin is stretched as a narrow strip in the meridian direction, and its territory has a slope from the south to the north. The Sviyaga flows into the Sviyazhsky Bay of the Kuibyshev Reservoir (the Volga River) opposite to the village Vasilievoof Zelenodolsk District of the Republic of Tatarstan. The length of the river is 375 km. The width of the river varies from 5 to 40 m;the depth is from 0.3 to 4.0 m;the current speed is 0.1-1 m/s [Ecological problems of small rivers of the Republic of Tatarstan ,2003]. The river is abundant. The nourishment of river is mixed, mostly snow (up to 52%). The average annual water consumption is 34 m^3/s (in 26 km from the estuary). The hydrological regime is characterized by high flood and low long dry-weather period. The river has 79 tributaries, 10 of which have a length from 40 to 165 km. The qualitative composition of water varies from hydrocarbonate-sulphate-calcium (up to the Birlya River) to sulfate-hydrocarbonate-sodium to the mouth. The hardness of water varies from 1.5-3.0 meq/l in spring, to 3.0-6.0 meq/l in the dry-weather period. The water has low hardness in spring (1.5 - 3.0 meq/l), and moderate hardness in the dry-weather period (3.0 - 6.0 meq/l). It has high salinity (400 - 1100 mg/l) during the year. For most of the year the Sviyaga refers to rivers with high mineralization. During the period of spring flood the total content of ions decreases to 150-200 mg/l [Ivanov D.V., Shagidullin R.R., Ziganshin I.I., Osmelkin E.V. 2011].

The investigations of phytoplankton of the Sviyaga River (middle-lower course) were carried out in August 2013, and during the period from May to September 2014, near the settlement Cherki-Kildurazyof the Buinsky district of the Republic of Tatarstan. The sampling area is shown in Figure 1.

Figure 1. Location map of the research area on the Sviyaga River, near the settlement Cherki-Kildurazy (the Republic of Tatarstan, Buinsky district, 2013-2014)



The selection of integrated samples was carried out at two permanent stations, in the open water area without thickets of macrophytes, and in the macrophytesthickets (narrow-leaved catoptric - *Typhaangustifolia L.*). Sampling and laboratory investigation of phytoplankton samples were carried out according to the generally accepted methods [The methodology of studying the

biogeocenoses of inland water bodies. 1975;Sadchikov A.P. 2003.]. The samples of phytoplankton were taken using the Molchanov bathometer. 40 quantitative and qualitative samples of plankton algae were collected in total. All quantitative samples, having the volume 0.5 litre, were fixed with 4% formalin solution. Fixed samples were concentrated in 2 stages, using settling method, to 10-20 ml. Qualitative water samples were concentrated by direct filtration through membrane filters in two stages - with a pore diameter of 3-5 μm and 1.2-1.5 μm, and they were studied being alive.

RESULTS AND DISCUSSIONS.

116 species of plankton algae from 7 divisions were detected in the phytoplankton of the studied areas during the observation period (Table 1). Data on the taxonomic structure of phytoplankton are given in Table 2.

Bacillariophyta(35.3%) and Chlorophyta(35.3%) dominate among the phytoplankton species. Other groups are less diverse: Cyanophyta- 8.6%, Euglenophyta- 12.9%, Chrysophyta- 1.7%, Dinophyta- 3.4% and Cryptophyta- 2.6%. The greatest number of orders is revealed among the divisions Chlorophyta and Bacillariophyta (Table 3). The most frequent occurrence is characteristic for the species from the divisions Cyanophyta, Bacillariophyta, Euglenophytaand ChlorophytaChlorococcales.

Table 1. The main systematic groups of plankton algaeof theSviyaga River (2013-2014)

Division	Class	Order
Cyanophyta	Chroococcophyceae	*Chroococcales*
	Hormogoniophyceae	*Oscillatoriales*
		Nostocales
Cryptophyta	Cryptophyceae	*Cryptomonadales*
Dinophyta	Dinophyceae	*Gymnodiniales*
		Peridiniales
Chrysophyta	Chrysophyceae	*Chromulinales*
		Ochromonadales
Bacillariophyta	Centrophyceae	*Thalassiosirales*
		Melosirales
		Aulacoseirales
	Pennatophyceae	*Araphales*
		Raphales
Euglenophyta	Euglenophyceae	*Euglenonales*
Chlorophyta	Volvocophyceae	*Chlamydomonadales*
		Volvocales
	Protococcophyceae	*Chlorococcales*
	Conjugatophyceae	*Desmidiales*

Table 2. The list of taxa of plankton algae at the studied biotopes of the Sviyaga River (2013-2014)

Item No	Taxon	Areas	
		macrophytes thickets	open water area
	2		
	Division Cyanophyta		
	Class *Chroococcophyceae*		
	Order *Chroococcales*		
1	*Dactylococcopsis raphidioides* Hansg.		+
2	*Merismopedia minima* G.Beck.	+	+
3	*Microcystis aeruginosa* Kutz. emend. Elenk.	+	+
4	*Microcystis aeruginosa* f. *flos-aquae* (Wittr.) Elenk.		
5	*Gomphosphaeria lacustris* Chod.		+
	Class *Hormogoniophyceae*		
	Order *Oscillatoriales*		
6	*Oscillatoria planctonica* Wotosz.	+	+
7	*Oscillatoria* sp.	+	
	Order *Nostocales*		
8	*Anabaena flos-aquae* Breb.	+	+
9	*Anabaena scheremetievi* Elenc.	+	+
10	*Aphanizomenonflos-aquae*(l.) Ralfs.	+	+
	Division Cryptophyta		
	Class *Cryptophyceae*		
	Order *Cryptomonadales*		
11	*Cryptomonas ovata* Ehr.	+	+
12	*Cryptomonas* sp.1	+	
13	*Cryptomonas* sp.2		+
	Division Dinophyta		
	Class *Dinophyceae*		
	Order *Gymnodiniales*		
14	*Gymnodinium* sp.	+	

15	*Peridinium cinctum* (O.F.M.) Ehr.	+	+
16	*Peridinium* sp.1	+	
17	*Peridinium* sp.2		+
	Division Chrysophyta		
	Class *Chrysophyceae*		
	Order *Chromulinales*		
18	*Chromulina* sp.	+	+
	Order *Ochromonadales*		
19	*Uroglena volvox* Ehr.	+	
	Division Bacillariophyta		
	Class *Centrophyceae*		
	Order *Thalassiosirales*		
20	*Stephanodiscus hantzschii* Crun.	+	+
21	*Cyclotella meneghiniana* Kiitz.	+	+
22	*Cyclotella comta*(Ehr.) Kiitz.	+	+
	Order *Melosirales*		
23	*Melosira varians* Ag.	+	+
	Order *Aulacosirales*		
24	*Aulacoseira granulata* (Ehr.) Sim.	+	+
25	*Aulacoseira islandica* (O. Mull.) Sim.		+
26	*Aulacoseira italica*(Kiitz.) Sim.	+	+
27	*Aulacoseira distans*(Ehr.) Sim.		+
	Class*Pennatophyceae*		
	Order *Araphales*		
28	*Fragilaria construens* (Ehr.) Grun.	+	
29	*Synedra acus* Kiitz.	+	
30	*Synedra ulna* (Nitzsch.) Ehr.	+	+
31	*Diatoma elongatum* (Lyngb.) Ag. var. *elongatum*		+
32	*Diatoma vulgare* Bory.	+	+
33	*Tabellaria fenestrata* (Lyngb.) Kiitz.	+	
	Order *Raphales*		

34	*Navicula cryptocephala* Kiitz.	+	
35	*Navicula nivalis* Ehr.	+	
36	*Navicula peregrina* (Ehr.) Kiitz.		+
37	*Navicula rhynchocephala* Kiitz.		+
38	*Navicula* sp.	+	+
39	*Gyrosigma acuminatum* (Kiitz.) Rabenh.		+
40	*Pinnulariamesolepta*(Her.)W.Sm.	+	+
41	*Caloneis amphisbaena* (Bory) Cl.	+	+
42	*Cocconeis placentula* Ehr.	+	+
43	*Achnanthes* sp.	+	+
44	*Eunotia fallax* A. Cl.	+	
45	*Eunotia* sp.	+	+
46	*Cymbella* sp.	+	+
47	*Amphora ovalis* Kiitz.	+	+
48	*Gomphonema olivaceum* (Lyngb.) Kiitz.		+
49	*Epithemia turgida* (Ehr.) Kiitz.	+	
50	*Epithemia*sp.	+	
51	*Gyrosigmaacuminatum* (Kütz.) Rabenh.	+	
52	*Nitzschia acicularis* W.Sm.	+	+
53	*Nitzschiapalea*(Kiitz). W.Sm.	+	+
54	*Nitzschiasigmoidea*(Nitzsch.) W.Sm.	+	
55	*Nitzschia vermicularis* (Kiitz.) Grun.	+	+
56	*Nitzschia* sp.	+	
57	*Surirellabrebissonii*Krammer et Lange-Bertalot.		+
58	*Surirella linearis* W.Sm.		+
59	*Cymatopleuraelliptica*(Breb.) W.Sm.	+	
60	*Cymatopleurasolea*(Breb.) W.Sm.	+	
	Division Euglenophyta		
	Class *Euglenophyceae*		
	Order *Euglenonales*		
61	*Trachelomonas armata*(Ehr.) Stein.		+

62	*Trachelomonashispida*(Perty.) Stein emend. Defl.	+	
63	*Trachelomonas horrida* Palmer.		
64	*Trachelomonas intermedia* Dang.	+	
65	*Trachelomonas planctonica* Swir.		+
66	*Trachelomonas volvocina* Ehr.	+	+
67	*Strombomonas fluviatilis* (Lemm.) Defl.		+
68	*Strombomonas Scauinslandii* (Lemm.) Defl.		+
69	*Strombomonas volgensis* (Lemm.) Defl.	+	
70	*Euglena acus* Ehr.		+
71	*Euglena viridis* Ehr.	+	+
72	*Euglena* sp. 1	+	
73	*Euglena* sp. 2	+	+
74	*Phacus pleuronectes* (Ehr.) Daj.		+
75	*Phacus* sp.	+	
	Division Chlorophyta		
	Class *Volvocophyceae*		
	Order *Chlamydomonadales*		
76	*Chlamydomonas globosa* Snow.	+	+
77	*Chlamydomonasmonadina* Stein.	+	
78	*Chlamydomonas* sp.	+	+
79	*Carteria globosa* Korschik.		+
80	*Phacotus lenticularis* (Ehr.) Stein.	+	+
81	*Pteromonas aculeata* Lemm.		+
	Order *Volvocales*		
83	*Pandorina morum* (Mill.)Bory.		+
	Class *Protococcophyceae*		
	Order *Chlorococcales*		
84	*Chlorococcum* sp.		+
85	*Sphaerocystis planctonica* (Korsch.) Bourr.		+
86	*Treubariaplanctonica* (G.M.Smith.) Korschik.		+
87	*Pediastrum boryanum* (Turp.) Menegh.		+

88	*Pediastrum duplex*Meyen.		+
89	*Tetraedron arthrodesmiforme* Chod.		+
90	*Tetraedron caudatum* (Corda.) Hansg.	+	
91	*Tetraedron enorme* Hansg.		+
92	*Coenocystis obtusa* Korschik.		+
93	*Dictyosphaerium pulchellum* Wood.	+	+
94	*Dictyosphaerium* sp.		+
95	*Siderocelis ornata* (Fott.) Fott.		+
96	*Chodatella longiseta* Lemm.		+
97	*Oocystis natans* Wille.	+	+
98	*Coelastrum proboscideum* Bohl.		+
99	*Scenedesmus acuminatus* (Lagerh.) Chod.		+
100	*Scenedesmus guadricauda* (Turp.)Breb.	+	+
101	*Scenedesmus naegelii* Breb.		+
102	*Scenedesmus* sp.		+
103	*Tetrastrum alpinum* Korschik.		+
104	*Tetrastrum triacanthum* Korschik.		+
105	*Crucigeniatetrapedia*(Kirchn.) W.et.W.	+	+
106	*Crucigeniarectangularis*(A..Br.) Gay.		+
107	*Actinastrum hantzschii* Lagerh.		+
108	*Didimocystis planctonica* Korschikoff.	+	
109	*Monoraphidium arcuatum* (Korsch.) Hind.	+	
110	*Monoraphidiumminutum*(Nag.) Kom.-Legn.	+	+
111	*Kirchneriella lunaris* (Kirhn.)Moeb.	+	+
112	*Plancosphaeria gelatinosa* G.Sm.	+	
113	*Raphidocelis sigmoidea* Hindak.		+
	Class *Conjugatophyceae*		
	Order *Desmidiales*		
114	*Closterium* sp.	+	
115	*Cosmarium margaritiferum* Menegh.	+	
116	*Staurastrum paradoxum* Meyen.	+	

Table 3. Quantitative indicators of systematic groups of plankton algaeof the Sviyaga River (2013-2014)

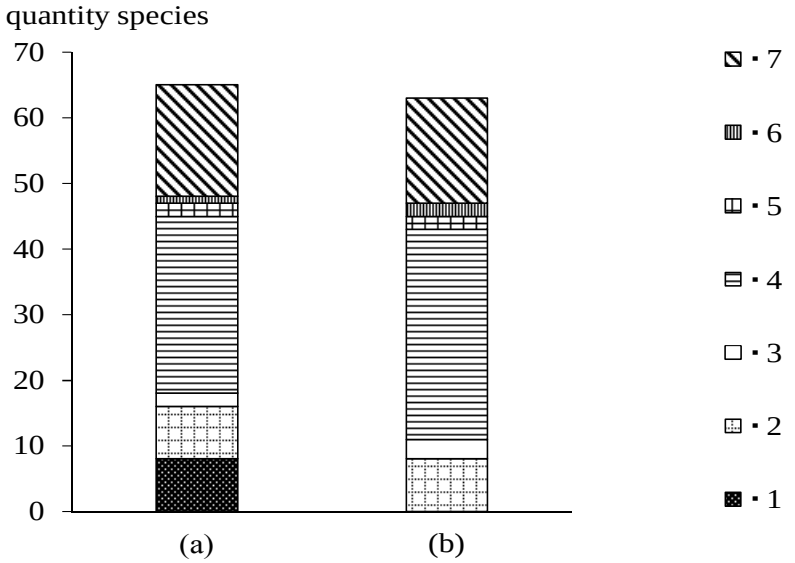
Division	Class	Order	Genus	Species
Cyanophyta	2	3	7	10
Euglenophyta	1	1		15
Dinophyta	1	1	2	4
Bacillariophyta	2	5	23	41
Cryptophyta	1	1	1	3
Chrysophyta	1	2	2	2
Chlorophyta	3	4	28	41
Total	11	17	63	116

The species diversity of considered biotopes differs not significantly (Figure 2). Probably, in flowing reservoirs with a rather high current speed as theSviyaga River, the communities of plankton algae, confined to a certain biotope, are not formed, or they are quite unstable, and in case of the slightest changes in currents due to weather conditions, the structure of these communities is disturbed and leveled.

The following genera have the highest species diversity: Cyanophyta*Oscillatoria,*Bacillariophyta*Cyclotella, Aulacoseira, Diatoma, Aulacoseira,Navicula, Nitzschia, Synedra,* Dinophyta*Peridinium,*Euglenophyta*Trachelomonas, Euglena,* Chlorophyta *Chlamydomonas, Pediastrum, Dictyosphaerium, Scenedesmus, Crucigenia, Monoraphidium.*

The following genera have the most frequent occurrence among all considered biotopes: Cyanophyta*Aphanizomenon,Oscillatoria,*Bacillariophyta*Cyclotella, Aulacoseira, Diatoma, Aulacoseira, Navicula, Nitzschia, Synedra, Caloneis, Melosira, Stephanodiscus, Amphora, Pinnularia, Cymbella*, Dinophyta *Peridinium,*Euglenophyta *Trachelomonas, Euglena,* Chrysophyta *Chromulina*, Chlorophyta *Chlamydomonas, Scenedesmus, Crucigenia, Monoraphidium*.

Figure 2. Distribution of phytoplankton taxa in separate groups of the Sviyaga River in various biotopes: a - open shallow area, b - thickets of macrophytes, 2014; 1 - Cyanophyta, 2 - Euglenophyta, 3 - Dinophyta, 4 - Bacillariophyta, 5 - Cryptophyta, 6 - Chrysophyta, 7 - Chlorophyta.

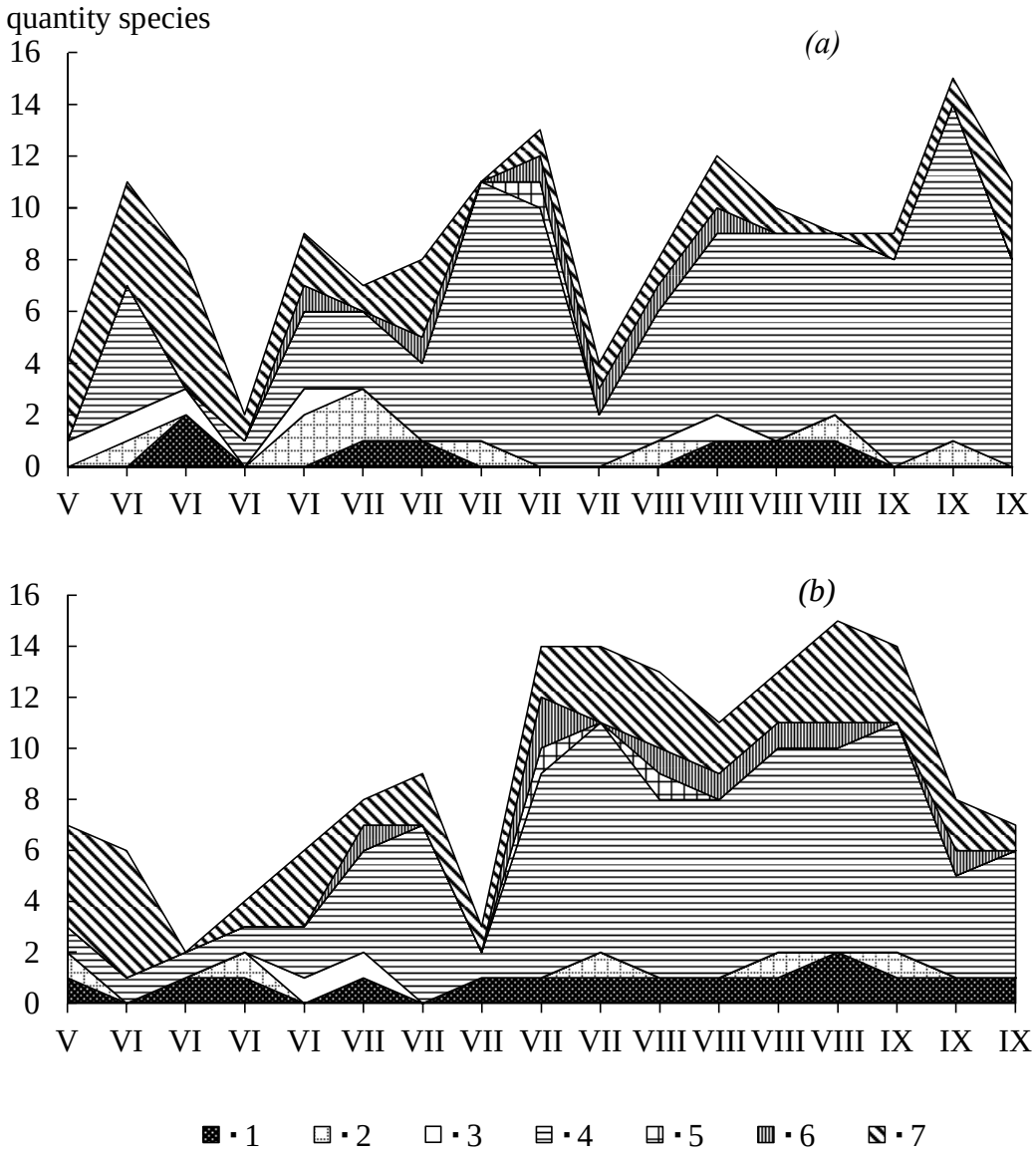


The aim of these studies was the phytoplankton of water column. Despite this, algae in the water samples were represented by various ecological groups, differing in species composition, growth conditions, dynamics of development, etc. They included algae of phytoplankton, epipelon, epiphyton and freely floating filaments or assemblies of filamentous algae. Some species of algae with a broad ecological spectrum are often present in phytoplankton communities, due to the hydrological conditions

in the current water bodies. Such species can also inhabit the plankton and benthos, since they are washed from the substrata by currents, and often remain in the phytoplankton composition.

During the growing season, the quantitative characteristics of species composition did not change significantly. The dynamics of seasonal changes in the species composition is shown in Figure 3. Reduction in the number of species in some samples is likely due to the changes in weather conditions (thunderstorms, rain and wind).

Figure 3. Seasonal dynamics of simultaneously found taxa of algae in the Sviyaga River (a) in open shallow area and (b) in thickets of macrophytes (2014): 1 - Cyanophyta, 2 - Euglenophyta, 3 - Dinophyta, 4 - Bacillariophyta, 5 - Cryptophyta, 6 - Chrysophyta, 7 - Chlorophyta.



SUMMARY .

According to the ecological and geographical characteristics, the cosmopolite and rheophilic species of algae prevail in the studied water body. Most of the species are indifferent in relation to halobility.With regard to pH, indifferent and alkaliphile+ alkalibiontic organisms occur the most often.

New and rare species of the flora of this region were not identified during the study. There are also the taxa, which require further specification and identification at the species level.

Thus, it can be concluded, that the phytoplankton of the investigated areas of the Sviyaga River is formed mostly byChlorophyta, Bacillariophyta, Euglenophyta and Cyanophyta. The taxonomic structure of the studied biotopes differs not significantly. Species diversity of phytoplankton in both areas of the research increases by the end of summer.

CONCLUSION.

Repeated seasonal researches are needed to reveal a complete list of species composition, and features of the algal flora structure of the Sviyaga River. Nevertheless, the data obtained can be used in multi-year monitoring and forecasting investigations of biodiversity and the state of water bodies of the Russian Federation. The study of biology and the structure of phytoplankton communities in aquatic ecosystems is the basis for monitoring and managing the quality of natural waters.

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