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### **Phytoplankton of salt lakes of the Pavlodar region**

**Abstract:** Due to the significant mineralization of water, phytoplankton of lakes in Pavlodar region is distinguished by low species richness. The species diversity of algal flora and the proportion of different halophilic groups of phytoplankton depend, among other things, on the presence of different ecotopes in reservoirs.

**Keywords:** artemia, phytoplankton, salt lakes, mineralization, ecotops.

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From spring to autumn 2018, complex environmental studies were carried out in salt water bodies of Pavlodar region. This paper presents materials on the food supply of the salt-crustacean *Artemia parthenogenetica* Barigozzi, 1974, living in the waters of Northern Kazakhstan (1,2,3).

In ultrahaline lakes, due to the peculiar chemical composition of water, high mineralization (up to 340 g / l), certain trophic relationships have developed, which are unique to this type of water body. In salt ponds with a brine concentration of more than 70 g / l, there is only one representative of the consumers, which is artemia. Such lakes are characterized by an exceptionally short food chain: autotrophs and the primary single-species consumer. According to the method of feeding, artemia refers to active filter feeders, capable of passing a certain volume of water through the filtering apparatus, draining the mass of substances contained in it. The most complete food for artemia is phytoplankton. (4,5,6,7,8) The first trophic level in salt lakes is represented by primary producers (autotrophs) and this important part of the aquatic community is mainly represented by various types of phytoplankton. Available information on the state of algal flora of salt lakes (6,7,9,10,11,12,13,14) testifies that its qualitative composition is much narrower than in fresh and eugalin reservoirs. In terms of their size composition, phytoplankton belongs to nanoplankton, it has a low density in quantitative terms, however, it is highly productive in terms of physiology. (11). At the same time, the qualitative and quantitative composition of plankton autotrophs differs to a large extent in individual water bodies. Thus, in the Caspian lagoon of Kara-Bogaz-Gol, about 80 species and intraspecific taxa of algae were identified, belonging to 4 divisions in the lake Eybay, which is located to the north, 56 species were found the lakes of Zauralye and Altai, which are even further to the north, are inhabited, respectively, only by 11 to 19 phytoplankton species. (6,7,10,11,15,16). Almost all researchers note seasonal fluctuation of phytoplankton depending on abiotic and biotic factors.

Due to the significant mineralization of water, phytoplankton of lakes in the Pavlodar region is distinguished by low species richness: 32 species and intraspecific taxa belonging to 3 divisions were found in it: Bacillariophyta (16), Cyanoprokaryota (15) and Euglenophyta (1) (table 1). Diatoms and cyanoprokaryotes reached the greatest diversity in the number of species.

Algal divisions	Classes	Orders	Families	Genera	Species	% of total species count
Bacillariophyta	1	2	4	8	16	50,0
Cyanoprocaryota	2	2	4	6	15	46,9
Euglenophyta	1	1	1	1	1	3,1
Total	4	5	5	15	32	100

Таблица 1 – The ratio of the main systematic groups of algal flora of the lakes under study

The results of the analysis of the taxonomy of the matrix of the investigated lakes show that 32 species of waterways, belong to 15 genera, 5 families, 5 orders and 3 divisions. The algae that belong to the diatoms division, differ in species diversity, their number of species makes half the taxonomic list (16 species or 50%). Cyanoprocaryotes are represented by 15 species and varieties (46.9%) and occupy the second place due to divergence. The representatives of the Euglenians occupy the third place according to the diversity - 1 species (3.1%).

All three divisions are represented in a Saubaisor lake: a division of Bacillariophyta - 3 species, Cyanoprocaryota is represented by 3 species and one species of *Euglena mutabilis* Schmitz. related to Euglenophyta.

Two divisions of Bacillariophyta and Cyanoprocaryota are represented in lakes:

- the phytoplankton of Lake Kazi is represented by 6 species and varieties of Cyanoprocaryota and 11 species of Bacillariophyta.

- the phytoplankton of Lake Seiten is represented by 7 species and varieties of Cyanoprocaryota and 2 species of Bacillariophyta.

- 6 cyanoprocaryotes and 1 species of diatoms found in Lake Koksor.

- 4 representatives of the Cyanoprocaryota and 2 species of Bacillariophyta were found in Lake Ashitaky.

- in the lake Kalcha, the divisions are represented by 1 species of *Microcystis aeruginosa* f.flos-aquae (Wittr.) Kirchn. (Cyanoprocaryota) and *Navicula longirostris* Hust. (Bacillariophyta)

Representatives of only one division of Cyanoprocaryota were found in lakes: 2 species each in lakes - Kyzyltuz, Akkulinsky District, Maliy Kossor, Zhamantuz; 3 types of cyanoprocaryotes in the lakes of Balkashsor, Bulaktysor, Muzdykol, Karakaska; 4 types of cyanoprocaryotes are found in the Bolshoy Kossor lakes (Kyzyltuz (Zhelezinsky district).

According to the salinity of water they live in, there are 5 groups of algae; 6 species and varieties or 18.7% are freshwater inhabitants (FW), freshwater-brackish water (FW-BW) - 6 or 18.7%, brakish water (BW) - 18 or 56.4 %, brakish water-freshwater (BW-FW) - 1 or 3.1%, brakish water-seawater (BW-SW) - 1 species or 3.1% (Figure 1).

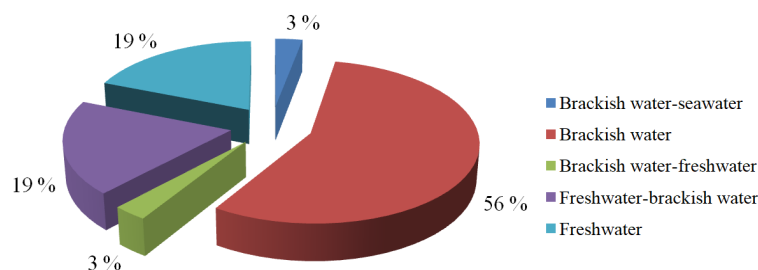


Рисунок 1 – Distribution of algae in the investigated lakes in relation to water salinity

Environmental analysis of algae divisions of investigated reservoirs shows that 11 species are brakish water, 3 are freshwater-brakish water, 1 species of both brakish water-freshwater and brakish water-seawater, out of 16 species of Bacillariophyta (Table 2).

Of the 15 species and varieties of algae of the Cyanoprocaryota: 7 are brakish water, 6 are freshwater and 2 are freshwater-brakish water.

1 species of the Euglenophyta division - *Euglena mutabilis* Schmitz. refers to freshwater-brakish water.

Algae division	FW	FW-BW	BW-FW	BW	BW-SW
Bacillariophyta	-	3	1	11	1
Cyanoprocarvota	6	2	-	7	-
Euglenophyta	-	1	-	-	-
Total	6	6	1	18	1

ТАБЛИЦА 2 – Ecological distribution of the total number of species with respect to water salinity

Ecological distribution of algae in relation to the saltiness, in the studied lakes are presented in table 3.

Lake	Salinity, g / l		Species in to- tal	FW	FW- BW	BW- FW	BW	BW- SW
	during the col- lection period	during the season						
Spring collection								
Malyi Kossor	60	60-180	2	-	-	-	2	-
Bolshoi Kossor	100	73-199	4	1	-	-	3	-
Koksor	110	98-305	7	3	-	-	4	-
Saubaisor	110	102-193	7	2	3	1	1	-
Balkashsor	141	133-141	3	1	1	-	1	-
Bulaktysor	190	172-177	3	1	1	-	1	-
Muzdykol	210	200-319	3	-	1	-	2	-
Kyzyltuz*	210	207-369	4	-	1	-	3	-
Autumn collection								
Ashytakyr	72	72-85	6	3	-	1	2	-
Seiten	140	115-124	9	3	1		5	-
Kalcha	160	87-136	2	1			1	-
Kazy	210	179-221	17	-	2	1	13	1
Kyzyltuz**	260	239-282	2	-	-	-	2	-
Karakaska	310	243-257	3	-	1	-	2	
Zhamantuz	310	331-338	2	-	-	-	2	

Note: \*-Zhelezinsky district; \*\*- Akkulinsky district

Table 3 – Ecological distribution of algae in relation to the salinity in the lakes under study

Considering that salinity plays a primary role in the amount of the species composition of the algal flora of water bodies, photosynthetic activity, productivity, it is natural to assume that there is a high degree of correlation between the salinity indicators and the number of phytoplankton species. However, for the lakes we studied, the Pearson correlation coefficient turned out to be low and amounted to minus 0.14. ( $p > 0.1$ ).

In our opinion, this depends on the presence of peculiar ecotops in salt water bodies with different mineralization of water and, of course, with various phytoplankton representatives.

Reservoirs with the presence of such ecotops are characterized by the spatial separation of individuals of a single gene pool, which contributes to the deployment of potential features of aquatic organisms in a variety of habitats, accompanied by variability on a number of grounds, and the environmental conditions do not go beyond their reaction norms. Thus, the lake population of *Artemia* was previously described (1) with groups of phenotypes sharply distinguished by their appearance, which are located in different ecotops of the reservoir. With a practically similar size of body, individuals of different groups significantly differed in the length of the abdomen, the C:A ratio, and especially in the biometric parameters of the furca. The length of the furcal ramus of *Artemia* living in a desalinated ecotope was 6 times longer than that of the individuals from the main lake and 3 times longer than the width and number of setae.

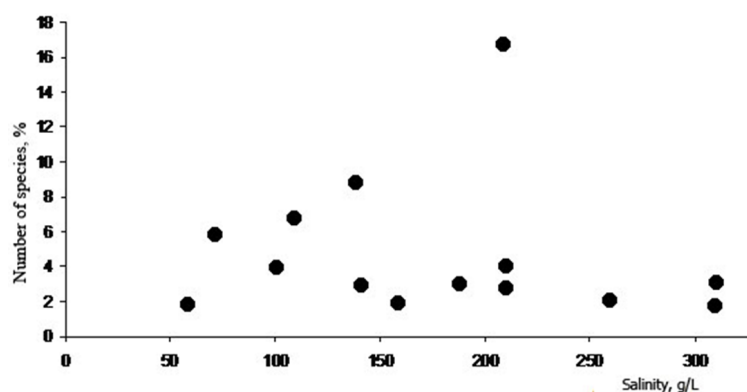


Рисунок 2 – Relationship of the number of phytoplankton species and water salinity

The presence of various ecotops in the studied water bodies also links the weak relationship between salinity and the proportion of salt-loving (halophilic) species (Figure 3). In general, the ecological analysis of algae in the studied lakes shows that with increasing water salinity, the proportion of freshwater brackish-water and brackish-water species increases (Pearson's correlation coefficient  $r = 0.30$ , Significance level for a one-sided criterion  $> 0.1$ ).

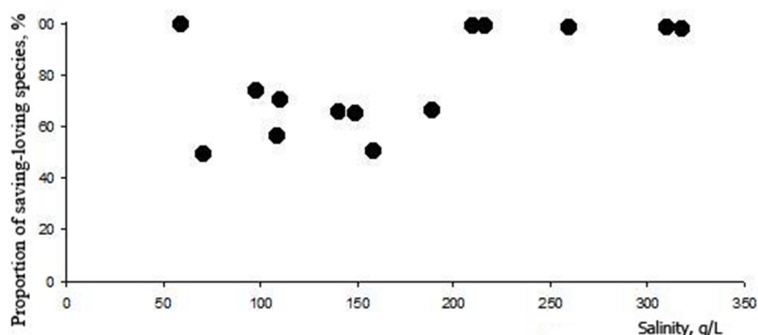


Рисунок 3 – Relationship of the proportion of salt-loving (halophilic) species and salinity

Ecological factors influence the formation of such ecological clusters (ecologic algosenoses), as phytoplankton, epiphytes, littoral species.

In the lakes under study, planktonic algae go up to 17 species and varieties. There are 12 littoral species and varieties, these include algae: *Amphora perpusilla* Grun., *Scoliopleura peisonis* Grun., *Navicula Komarovii* Poretzky, *Navicula longirostris* Hust., *Nitzschia vivax* var. *hyperborea* Grun., *Fragilaria pinnata* Ehr., *Fragilaria virescens* var. *subsalina* Grun., *Nitzschia punctata* var. *aralensis* Borszczow, *Nitzschia hungarica* Grun., *Navicula peregrina* (Ehr.) Skv., *Navicula peregrina* var. *hankensis* Skv., *Synedra pulchella* var. *naviculacea* Grun. Epiphytic forms: in the lakes studied,

there are 3 types and varieties of epiphytic algae: *Synedra tabulata* var. *fasciculata* (Kutz.) Grun., *Cocconeis placentula* Ehr. and *Cocconeis scutallum* Ehr. The ecological structure of the algal flora of the lakes under study is determined mainly by the ratio of the two main groups - planktonic (17) and littoral (12) species of algae.

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Фитопланктон соленых озер Павлодарской области

**Аннотация.** Вследствие значительной минерализации воды фитопланктон озер Павлодарской области отличается невысоким видовым богатством. Видовое разнообразие альгофлоры и доля различных галофильных групп фитопланктона зависят в том числе и от наличия в водоеме различных экотопов.

**Ключевые слова:** артемия, фитопланктон, соленые озера, минерализация, экотопы

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Павлодар облысы тұзды көлдерінің фитопланктоны

**Аңдатпа:** Судың едәуір минералдануы салдарынан Павлодар облысы көлдерінің фитопланктоны аз көлемді түр байлығымен ерекшеленеді. Альгофлораның түрлік әртүрлілігі және фитопланктонның түрлі галофильді топтарының үлесі су айдынында әртүрлі экотоптардың болуына тәуелді.

**Түйін сөздер:** артемия, фитопланктон, тұзды көлдер, минералдану, экотоптар

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