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Zooplankton Community of the Coastal Zone of Azerbaijan Sector of the Caspian Sea

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ABSTRACT

The triennial investigation gave us right not only in completion of taxonomic structure of zooplankton of the Middle Caspian, but also revealed that, under optimum environmental conditions the dominance in communities are divided on a sufficiently number of zooplankton species which leads to an increase of species diversity. According to the results of test on the portion of rotifers include 20 species which are represented mainly by such genera as Trichocerca, Brachionus, Synchaeta and 13 species of Copepoda and 11 species of Cladoceran. On the basis of these data there carried out comparision of the species of composition of Ciliophora, Rototoria, Copepoda and Cladocera for each pair of points of collection.
The analyses showed that the maximum value of the index of species composition of community is in the range from 35% to 72 %, and maximum value from 11% to 21% was observed in Sumgait littoral, which was first of all deals with the strong stress of technogeneous pollution and oil products of the Southern coast of the Absheron Peninsula.
KEYWORDS: *zooplankton, Caspian Sea, hydrobionts, zooplankter, ecology*

1.INTRODUCTION

It is known that, communities of animals of sea plankton from the point of ecological view introduces more complex biological systems. Compound parts of these planktonic communities are separate populations residing together in a dynamic balance of different hydrobionts species which are determined by the combination of abiotic and biotic factors. It should be noted that, the perennial research of Caspian Sea zooplankton based on the main factors affecting the stability of the abiotic zooplankton are periodic fluctuations of sea level and the permanent stress from human pollution, and from biotic factors, the most important one is trophic. Just that is why in the studies of Caspian Sea zooplankton we have to include the influence of technogen pollution on the community and the major food relationship between the separate groups of zooplankton at different points in the littoral zone of Azerbaijan sector of Caspian Sea.

2. MATERIALS AND THE METHODS OF STUDY

The collection of samples from 6 points of littoral zone of the Azerbaijan sector of Caspian Sea for the various groups of zooplankton was carried out in 2010- 2012 (Figure 1).

Fig. 1. Sample points from the Caspian Sea

During this time totally 240 plankton samples were collected and processed. It were collected in coastal area from the boat with the help of the bathometer and the plankton net and processed by hydrobiological standard methods - for counting free ciliates used the method of calculation living specimens in the Bogorov's chamber from 3 to 10 times, for taxonomic identification of ciliates used methods of kinetoma silver impregnation [3,7]. Bogorov camber is a thick plate made of glass or plexiglass, perfect size to hold a small volume of sample - about 6 ml. The shape and configuration of the shallow, etched groove (1/8" deep and 3/16" thick) help locate specific areas on the chamber. A compact 3-1/2" by 4-1/2" in size, it slips

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easily under a dissecting microscope. Straight sides mean you don't have to focus up and down. Rounded edges prevent specimens from catching. For fixation other groups (Rotatoria, Cladocera, Copepoda) used 4% formol solution, and sometimes corrosive sublimate. For painting hydrobionts in the fixing fluid a small amount of dye «Bengal Rose». For species determinantion mainly used books an "Atlas of Invertebrates of the Caspian Sea" [9] and "Atlas free-living ciliates" [4] as well as a number of other publications. Of the ecological analysis we used common indexes - Simpson dominance, species diversity by Margalef Sorensen.

3. RESULTS AND THEIR DISCUSSION

At present in microplankton of the Caspian Sea there is known only 140 species of free – living ciliates [1, 6] 110 of which is marine, and 30 – freshwater species. According to [8] in the Caspian Sea mesoplankton in all 187 species, 157 species of which are found in the Northern part, 85 species in the Middle and 82 species in the Southern Caspian Sea. It seems that in the species diversity in mezoplankton the fist dominated species is Rotatoria (40.6%), further Cladocera (31.6%) and then Copepoda (25.1%). For all other groups of hydrobionts there have some less than 3% species. In table below we present the species composition and distribution of the collection of dominant species of main planktonic groups in the Caspian Sea points.

Table: The main planktonic groups dominant species composition and its distribution of the sample points in the Caspian Sea.

Виды	Lenkoran	Neftchala	Apsheron Peninsula	Shabran	Nabran
Ciliates					
1. *Holophrya pelagica* Lohman	+	+	+	---	---
2. *H.saginata* Penard	+	+	+	---	+
3. *Mesodinium pulex* Cl.et L.	+	+	+	+	+
***M.apsheronicum* Alekperov and Asadullayeva.**	+	---	+	---	---
5. *Cyclotrichium ovatum* Fauré-Fremiet	---	---	+	---	+
6. *C.cyclocaryon* Munier	+	---	---	---	---
7. *C.inflatum* Alekperov	+	---	+	+	+
8. *Askenasia elegans* Fauré-Fremiet	+	+	+	+	+
***9.* *A.stellaris*(Leegaard)**	+	+	+	+	+
10. *Monodinium balbianii* Fabr.-Dom.	+	+	+	+	+
11. *Didinium nasutum* Müll.	+	+	+	+	+
12. *Zosterodasys agamalievi* Deroux	---	---	+	---	---
13. *Z.caspica* Fern.-Leb. et Alekperov	+	---	+	+	---
14. *Z.cantabrica* Fern.-Leb. et Alekperov	---	---	+	+	+
15. *Nassula marina* Alek. and Asad.	+	---	+	+	+
16. *Chlamydodon mnemosyne* Ehrb.	---	---	+	---	+
17. *Ch.rectus* Ozaki and Yagiu	+	---	+	---	---
18. *Frontonia marina* Fabr.-Dom.	+	+	+	+	+
19. *F.salmastra* Dragesco et Dragesco-Kerneis	+	---	+	---	---
20. *Uronema nigricans* (Müll.)	+	+	+	+	+
21. *U.marinum* Dujardin	+	+	+	+	+
22. *Uronemella filificium* (Kahl.)	+	+	+	+	+
23. *Pleuronema marinum* Dujardin	+	+	+	+	+
***24.* *Blepharisma hyalinum* Perty**	---	---	+	---	+
25. *Pelagohalteria caspica* Alek.et Asad.	+	---	+	+	+
26. *Halteria grandinella* Müll.	---	+	+	+	+
27. *Novistrombidium apsheronicum* Alek.et Asad.	---	---	+	---	---
28. *S.sulcatum* Cl.et L.	+	+	+	+	+
29. *S.caspicum* Alekperov.	+	+	+	+	+
30. *S.obliquum* Kahl.	+	+	+	+	+
31. *S.nabranicum* Alek., Buskey, Sneg.	---	---	---	---	+
32. *Strombidiopsis azerbaijanica* Alekperov	+	+	+	+	+
33. *Strobilidium lacustris* Foissner, Sand.P.	+	+	+	+	+
34. *Tintinnopsis tabulosa* Levander	---	---	+	+	+
35. *T.cylindrica* Daday	+	+	---	---	+
36. *T.meunieri* Kof.et Campb.	+	+	+	+	+
37. *T.baltica* Brandt	+	+	+	+	+
38. *Codonella relicta* Minkiew	+	+	+	+	+
39. *C.lagenula* (Cl.et L.)	+	+	+	+	+
40. *Favella ehrenbergi* (Cl.et L.)	---	---	---	+	+
41. *Parafavella obtusa* Kahl	---	---	+	+	+
42. *Diophrys pentacirratus* Alekperov	+	+	+	+	+
43. *Euplotes alatus* Kahl	---	---	---	---	+

44.	***E.pseudoraikovi* Alekperov**	---	---	---	---	+
45.	***Uronychia caspica* (Alekperov and Asadullayeva)**	+	+	+	+	+
	Rotifers					
46.	***Trichocerca caspica caspica* (Tschug.)**	+	+	+	+	+
47.	***T.caspica longicaudata* (Tschug.)**	---	---	+	+	---
48.	***T.pusilla* (Laut.)**	---	---	---	+	+
49.	***T.heterodactyla* (Tschug.)**	+	+	+	+	+
50.	***Synchaeta stylata* Wierz.**	+	+	+	+	+
51.	***S.tremula* (Müll.)**	+	+	+	+	+
52.	***S.pectinata* Ehrb.**	+	---	---	---	----
53.	***Polyarthra vulgaris* Carlin**	+	+	+	+	+
54.	***Asplancha priodonta priodonta* Gosse**	+	+	+	+	+
55.	***A.priodonta* helvetica Imhof**	+	+	+	+	+
56.	***Lecane luna luna* (Müll.)**	---	---	---	+	+
57.	***L.crepida* Harr.**	---	---	---	+	+
58.	***Euchlanis dilatata* Ehrb.**	---	---	---	+	+
59.	***Brachionus angularis angularis* Gosse**	+	+	+	+	+
60.	***B.angularis bidens* Plate**	---	---	+	+	+
61.	***B.rubens* Ehrb.**	---	---	---	+	+
62.	***B.urseus urseus* (L.)**	---	---	---	+	+
63.	***Keratella tropica* (Aps.)**	+	+	+	+	+
64.	***K.quadrata* (Müll.)**	+	---	+	+	+
65.	***Notholca squamula* (Müll.)**	+	+	---	+	+
	Cladocers					
66.	***Daphnia longispina* (Müll.)**	---	---	+	+	+
67.	***Moina micrura* Hellich**	---	+	+	+	+
68.	***Ceriodaphnia quadrangula* (Müll.)**	---	---	---	+	+
69.	***Chydorus sphaericus* (Müll.)**	---	---	+	+	+
70.	***Bosmina longirostris* (Müll.)**	---	---	---	+	+
71.	***Polyphemus exiguus* Sars**	+	+	+	+	+
72.	***Evadne anonyx typical* Sars**	+	+	+	+	+
73.	***E.anonyx prolongata* Behn.**	+	+	---	---	---
74.	***Podonevadne trigona* Sars**	+	+	+	+	+
75.	***P.trigona typica* (Sars)**	+	+	+	+	+
76.	***Caspievadne maximowitschi* (Sars)**	+	+	---	---	---
	Copepods					
77.	***Limnocalanus grimaldii* (Guerne)**	+	+	---	---	---
78.	***Calanipeda aquae dulcis* Kritsch.**	+	+	+	+	+
79.	***Eurytemora grimmi* Sars**	+	+	+	+	+
80.	***E.minor* Sars**	+	+	+	---	---
81.	***E.velox* Lillj.**	---	---	---	+	+
82.	***E.affinis* (Poppe)**	---	---	---	+	+
83.	***Eucyclops orthostylus* (Lind.)**	---	---	---	+	+
84.	***E.serrulatus speratus* (Lillj.)**	---	---	---	+	+
85.	***Paracyclops fimbriatus* (Eischer)**	---	---	---	+	+
86.	***Caspiocyclops mirabilis* Kiefer**	---	---	+	+	---
87.	***Acanthocyclops gigas* (Clus)**	---	---	+	+	+
88.	***Acartia tonsa* Dana**	+	+	+	+	+
89.	***A.clausi* Gigb.**	+	+	+	+	+

As seen from Table, the largest number of dominant species belongs to a group of free-living ciliates. Interestingly, in the total number of species - dominant in this group (45) includes representatives of real planktonic species and group of ciliates usually found in the benthos. These include species such as Zosterodasys agamalievi, Z.caspica, Nassula marina, Chlamydodon mnemosyne, Blepharisma hyalinum and some hipotrihes. It should be noted that all these species have been observed in close proximity to the shore, where the depth is 1-3 m. We believe that it is facultative for the types of plankton communities and their presence in the samples is probably due to the transition time of benthos by waves of the surf, active mixing littoral water layers. The following number of species it is dominant group of rotifers, which account for a total of 20 species. Of the total number of the most abundant of species of the genera were Trichocerca (4 species), Brachionus (4 species) and Synchaeta (3species). Most Rotatoria species were recorded in plankton everywhere, but quantitatively the largest total number observed in the shallow bays overgrown with aquatic plants. Of crustaceans in plankton communities were marked 13 species of Copepoda and 11 species of Cladocera. Of copepods showed the highest species diversity representatives of the genera Eurytemora (4 species) and Acortia (2 species), and from cladocerans – Evadne and Podonevadne - each 2species.

In the early spring due to increased ambient temperature the number of planktonic animals grows and reaches maximum development in spring and autumn. As shown by previous research [5], the quantitative development of planktonic ciliates by season revealed two peaks of development - in spring and autumn. Spring maximum of ciliates plankton in the Middle Caspian depend on the development of species such as Mesodinium apsheronicum, M.pulex, Strombidium sulcatum Novistrombidium apsheronicum, with a total number at this time 12.8 thousand specimen/L.

Though a second lesser than the spring, the peak of the quantitative development was observed in autumn, and stipulated by the development of representative genera Mesodinium, Halteria, Pelagohalteria, Strombidium and others. The total number of ciliates plankton in autumn was 4-5 thousand specimen/L. In winter, the quantitative development of planktonic ciliates are extremely low in all investigated areas of the Caspian Sea. On average, the total number does not exceed 100-250 specimen/L. Besides it the most of the dominant species drop out in winter from ciliate plankton and species diversity limited 9-15 species belonging to the genera Monodium, Uronema and Cyclidium. Analysis of the data on the qualitative and quantitative development of mesoplankton showed that the minimum development of all hydrobionts were observed in winter and up to April, and the maximum observed in August and September. Therefore it should be noted that Rotatoria and Copepoda which biomass stood out Eurytemora grimmi was dominated all the year-round in the Middle Caspian. Taxonomic structure of zooplankton communities of the Middle Caspian was compiled on the basis of our data (obtained results are shown in Figure 2).

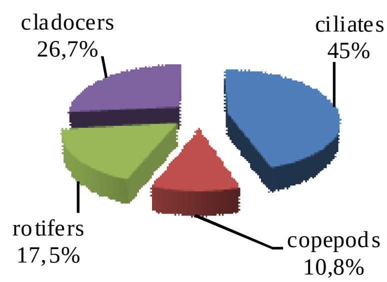
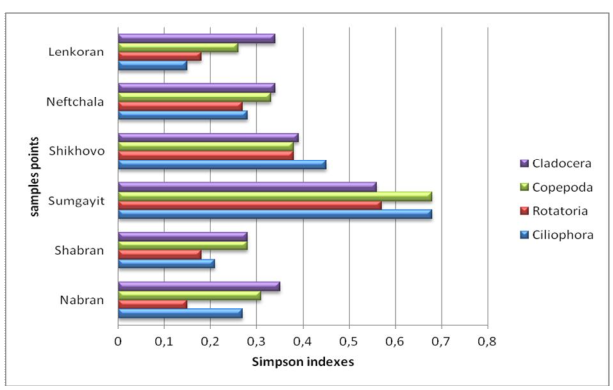
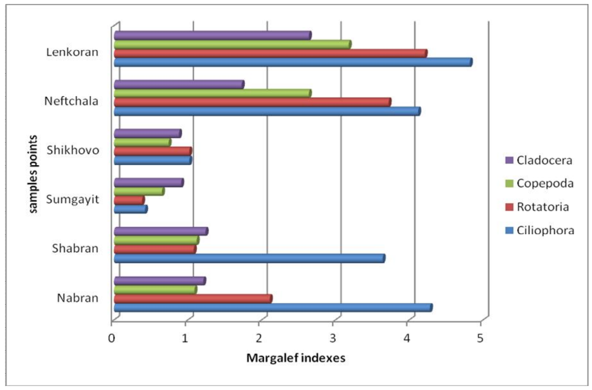


Fig. 2. Taxonomic structure (in %) of zooplankton communities of the Middle Caspian
(ciliates, rotifers, cladocerans, copepods)

As seen from Figure 2, the highest species diversity in the zooplankton community was noted for the group of free-living ciliates and compounded 45%. Next on the species diversity follows a group of rotifers, which amounted to 26.7%, then cladocerans which accounted for 17.5% and copepods, which constituted 10.8%. It should be noted that these main groups of Caspian zooplankton hydrobionts continuously are interconnected by close food relationships. Carried out early research showed that generally the maximum quantitative and qualitative development of the studied groups of zooplankton to be following in the development of phytoplankton that and logical due to the fact that different groups of algae are food items for almost all examined groups of zooplankton. They consume in large amounts by ciliates [2] rotifers and crustaceas Copepoda and Cladocera. It should be noted that the fastest reactions on the quantitative and qualitative diversity shown free-living ciliates of phytoplankton, due to more rate reaction of this group to change of the environment. Very often quantitative piks ciliates and algae phytoplankton almost coincide in time and place as rule the next group, whose numbers increased rapidly after the phytoplankton and ciliates are rotifers. It is known that a large number of Rotatoria used in food microscopic algae, and some ciliates. According to our data, the peak of the Rotatoria quantitative development depending on the water temperature occurs in about 15-25 days later than maximum development of phytoplankton and ciliates. Quantitative development of Copepoda and Cladocera determined primarily the development of phytoplankton organisms, which in large quantities are consumed by these groups of filter - feeders. It should be noted that the peak of Copepoda and Cladocera usually occurs at 1 - 1.5 months later than quantitative maxima of phytoplankton and free-living ciliates. For more representative data we colculate, the index of Simpson, Margalef and Sorensen, for different groups of zooplankton.



A



B

Fig. 3. Simpson dominance (A) and Margalefs species diversity (B) indexes changes in zooplankton communities in different coastal zone parts of the Caspian Sea.

It is known that the optimum environmental condition dominance in communities divided by a sufficiently lot number of species. In condition case of deterioration of the environmental scondition, the number of dominant species in the community is sharply reduced. Mathematically, this is expressed in the increase of the index of dominance. Finally, in the case where there is only one dominant species community ceases to exist, and the index of dominance is equal to the maximum value - unity. Presented in all groups studied dominance indices calculated in the case of free-living ciliates showed almost universal satisfactory state of their communities. Simpson's index of dominance in almost all sampling points ranged from 0.21 (Shabran) to 0.45 (Shikh). Increase this figure in the latter case is explained complex man-made pollution of the southern coast of the Absheron Peninsula, the first hydrocarbon and waste water of nearby communities. Attention is drawn to the sharp increase in the index of dominance in Sumgait coast up 0.68. Such a high value of the index of dominance here clearly indicates the poor state of the environment and require chemical monitoring, given the massive long-term industrial pollution Sumgait coast waste here numerous chemical plants.

It should be noted that the data on the index of rotifers and crustaceans are generally correspond with the above mentioned (Figure 3). Simpson's dominance index especially clearly evident in the data obtained in the Sumgait coast. Here all studied groups of zooplankton was sufficiently high and ranged from 0.56 to 0.68 in Cladocera and Copepoda. Following the sea coast of Sumgait the relatively high value of the index dominance were marked on the Southern part of the Absheron Peninsula (Shikhova). Here, the index of dominance ranged from 0.38 in Rotatoria and Copepoda and 0.45 Ciliorhora. High values of the index of dominance in the given collection point as noted above are explained by flowing of nearby settlement including Sangachal terminal as well as several years of hydrocarbon pollution of the Caspian Sea. In order to receive more representative data diversity indexes of species for each sample point were calculated by us (Figure 3). The obtained results showed that according to this indexes the most optimal conditions observed in Lenkoran Caspian coast, where the index of species diversity ranged from 2.64 in Cladocera to 4.82 in Ciliophora. As it is expected, the minimum diversity for all the investigated groups of zooplankton was observed in Sumgait coast, where the value of this indicator does not even reach unit and ranged from 0.38 to 0.91 in Rotatoria, in Cladocera. To determine the degree of generality of the species composition of studied groups of zooplankton between separate 2 of collecting samples points we compared each pair of species composition of collected points. The results are shown in Figure 3. As can be seen from the Figure 3, according to the comparison which is carried out by us the index of community species composition between different parts of the Azerbaijan sector of the Caspian Sea coast except sampling point near Sumgait varied from 35% - to 72% which is quite high. Analysis of results showed that the minimum value of the index of community species composition were observed when comparing all other points of sampling with Sumgait coast. Index community of this plot of the Caspian Sea with the rest range from 11% to 21%, which was primarily connected extremely poor species diversity of all groups of zooplankton at the given plot. We must also point out the low values of the index of community between the plots on the South coast of Absheron (Shikh) and other collection point as well. Here the coefficient of the community species composition varied between 35% - 47%, with the exception of 14% in comparing with collection of Sumgait coast. Thus the data of community species composition of different point of the Caspian Sea coast have shown coincidence with the results of other environmental parameters, that is most unfavorable Caspian coast point should recognize Sumgait area which is under strong stress especially technogenous pollution and contaminated with perennial sewage water and oil products of the Southern coast of the Absheron Peninsula.

4.CONCLUSIONS

- As seen from Table, the largest number of dominant species belongs to a group of free-living ciliates. interestingly, in the total number of species - dominant in this group (45) includes representatives of real planktonic species and group of ciliates usually found in the benthos.

- Of crustaceans in plankton communities were marked 13 species of Copepoda and 11 species of Cladocera. Of copepods showed the highest species diversity representatives of the genera Eurytemora (4 species) and Acortia (2 species), and from cladocerans – Evadne and Podonevadne - each 2species.
- Analysis of the data on the qualitative and quantitative development mesoplankton showed that the minimum development of all hydrobionts were observed in the winter and up to april - 100-250 (speciment/L.), and the maximum observed in august and september - 12.8 thousand (specimen/L.)
- Spring maximum of ciliates depend on the development of species such as Mesodinium apsheronicum, M.pulex, Strombidium sulcatum Novistrombidium apsheronicum.
- Winter minimum is represented with genera of Monodinium, Uronema and Cyclidium

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