РОЗДІЛ ІІ. ЗООЛОГІЯ ТА ЕКОЛОГІЯ ТВАРИН

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STRUCTURE OF THE BENTHIC CILIATE COMMUNITY (*CILIOPHORA*) ON THE SUMGAYIT CASPIAN SEA COAST (AZERBAIJAN)

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During the period 2012-2014 the study of benthic ciliates was conductedalong the Sumgayit coast of the Caspian Sea in sites different in degree of pollution. In total 168 ciliate species were noted.Based on the analysis of the data on the indicator species ratio the studied sites of the coast were specified regarding the saprobity degree.

Key words: ciliates, Caspian Sea, Sumgait, benthos, community.

Агаєва А., [1]Алекперов І. СТРУКТУРА БЕНТИЧНИХ СПІЛЬНОТ ІНФУЗОРІЙ (*CILIOPHORA*) СУМГАЇТСЬКОГО УЗБЕРЕЖЖЯ КАСПІЙСЬКОГО МОРЯ (АЗЕРБАЙДЖАН) / Сумгаїтський державний університет, Az5008, Азербайджан, Сумгаїт, квартал 43; [1]Інститут зоології НАНА, Az1073, Азербайджан, проїзд 1128, квартал 504

У період 2012-2014 рр. вивчені бентичні інфузорії уздовж Сумгаїтського узбережжя Каспійського моря на ділянках із різним ступенем техногенного забруднення. Усього відмічено 168 видів інфузорій. На підставі даних про співвідношення видів-індикаторів різних зон сапробності подано аналіз ступеня забруднення різних ділянок Сумгаїтського узбережжя Каспію.

Ключові слова: інфузорії, Каспійське море, Сумгаїт, бентос, спільноти.

Агаева А., [1]Алекперов И. СТРУКТУРА БЕНТИЧЕСКИХ СООБЩЕСТВ ИНФУЗОРИЙ (*CILIOPHORA*) СУМГАИТСКОГО ПОБЕРЕЖЬЯ КАСПИЙСКОГО МОРЯ (АЗЕРБАЙДЖАН) / [1]Сумгаитский государственный университет, Az5008, Азербайджан, Сумгаит, квартал 43; [1]Институт зоологии НАНА, Az1073, Азербайджан, проезд 1128, квартал 504

В период 2012-2014 гг. изучены бентические инфузории вдоль сумгаитского побережья Каспийского моря на участках с различной степенью техногенного загрязнения. Всего отмечено 168 видов инфузорий. На основании данных о соотношении видов-индикаторов различных зон сапробности дан анализ степени загрязнения различных участков сумгаитского побережья Каспия.

Ключевые слова: инфузории, Каспийское море, Сумгаит, бентос, сообщества.

INTRODUCTION

Community is usually defined as group of various species in a common location. In a broader sense natural community can be considered as a complex of populations of various species which are in multifarious relations. Study of microbenthic communities, changes of their structure, space and time characters and other parameters are currently successfully used for ecological analysis of the degree of environment pollution. For thispurpose are used usual ecological parameters which are generally applied for estimation of the functional state of animal communities: indices of dominationand speciesdiversity. For comparative estimation of single sites index of resemblance and distinction is used, i.e., the coefficient of species similarity.

It is known that despite a number of measures taken the oil exploration and production in the Caspian See during past years resulted in heavy industrial pollution of many sites of its water area especially in the area of Absheron peninsula and adjacent territory. Special attention deserves the coast of Sumgayit City which was before a chemical industry center of federal importance in former USSR. Till now the Sumgayit coast is considered a heavy polluted part of the Caspian water area with many dead zones [1].

Based on the forgoing during the period 2012-2014 we conducted the study of the microbenthos ciliate community from various sites of the Sumgayit coast of the Caspian Sea.

The purpose of our study to clarify the possibility of evaluation and biomonitoring of antropogenic pollution degree of the marine biota using changes structure of benthic ciliates communities.

MATERIAL AND METHODS

Samples of microbenthos were taken seasonally in the coast zone from 12 points from Haji ZeynalabdinTagiyev settlement, along the Sumgayit City zone and till Novhany settlement (Fig.1). The twelve stationary points of collection presented in Fig. 1 are divided in the following groups:

1) Collection points 1-3. It is the coast of the Caspian Sea at the Haji ZeynalabdinTagiyev settlement with relatively pure water area.
2) Collection points 4-6.This site is situated in the industrial zone of Sumgayit and experienced long-term industrial pollution.
3) Collection points 7-9. The part of the coast at the Sumgayit City itself.
4) Collection points 10-12. The part of the Caspian coast from the border of Sumgayit City till Novhany settlement with sufficiently pure water area.

To ascertain the species composition of the benthic ciliates alive samples from 10 cm bottom water layer were processed. These samples were taken with glass tubes. For quantitative analysis small portions of ground were analyzed under binocular microscope. For ciliate species ascertainment the techniques of impregnation with silver nitrate [2] and silver proteinate [3] were widely used.

For ecological analysis of functional state of ciliate benthic communities we used indices of Simpson dominance and Margalef species diversity and for comparative estimation of species composition similarity of different sites of the coast – Bray-Curtis cluster analysis.

We can see from Table 1 that species diversity of benthic ciliates varies very much in different sites of Sumgayit coast. The most highest species diversity we noted at the Haji Zeynalabdin Tagiyev settlement (104 species) and outside of the Sumgayit City zone at the coast of the Novhany settlement (96 species). The lowest species diversity (62 species) was noted in the area of industrial zone. Somewhat higher species diversity was found at the coast of the Sumgayit City (86 species).

In our previous studies we composed diagrams of groups of psammophilous ciliates, indicators of various saprobity zones for every of the studied sites of the Sumgayit coast [1]. These data were supplemented with new studies and more precise conclusions were made. Based on them we present below diagrams of ratio of ciliate indicator groups of various saprobity zones for every of the studied sites of the Caspian coast.

1. Coast of Haji ZeynalabdinTagiyev settlement
2. Coastof the industrial zone.
3. Coast of Sumgayit City.
4. Coast of Novhany settlement.

Fig. 1. The samples points collection from the Sumgayit coast of the Caspian Sea

RESULTS AND DISCUSSION

In total during the study period we found 168 freeliving ciliates species. In all 13 species should be noted as new for the Caspian fauna (marked * in Table 1).

Table 1 – Ciliates species distribution on the sample collection points

Species composition of ciliates		**Sample collection points**			
		1-3	**4-6**	**7-9**	**10-12**
Fam. Tracheloceridae Kent, 1881					
1.	*Trachelocercain caudata* Kahl, 1933	+		+	+
2.	*T.cylindricolis* Lepsi, 1962	+	+	+	+
3.	*Kovalevaiasulcata* (Kovaleva, 1966)	+			
Fam. Kentrophoridae Jankowski, 1980					
4.	*Tracheloraphispoljanskyi* (Raikov, 1963)	+		+	+
5.	*T.colubis (*Kahl in Raikov, *1963)*				+
6.	*T.aragoi* (Dragesco, 1954)				+
7.	*T.sarmatica* (Agamaliev and Kovaleva, 1966)				+
8.	*T.vermiformis* Raikov, 1962	+		+	+
9.	*T.kahli* Raikov, 1962	+		+	
10.	*T.bimicronucleata* Raikov, 1969	+			
11.	*T.discolor* Raikov, 1962	+			
12.	*T.haloetes* Borror, 1973		+		+
13.	*Kentrophorosfistulosus* (Fauré-Fremiet, 1950)	+			
14.	*K.flavus* Raikov and Kovaleva, 1968	+			+
15.	*K.minutus* (Dragesco, 1960)			+	
16.	*K.latus* Raikov, 1962	+			
17.	*K.ponticus* Kovaleva, 1966	+		+	+
18.	*K.gracile* Raikov, 1962	+			+
19.	*K.uninucleatus* Raikov, 1962	+			
20.	*K.canalis* Wright, 1982	+			
Fam. Loxodidae Bütschli, 1889					
21.	*Remanellafaurei* (Dragesco, 1954)	+	+	+	+
22.	*R.brunnea* (Kahl, 1933)*	+		+	+
23.	*R,rugosa* (Kahl, 1933)	+			
24.	*R.unirugosa* (Hartwig, 1973)*				+
25.	*R.gigas* (Dragesco, 1954)			+	+
26.	*R.margaritifera* (Kahl, 1933)	+			
27.	*R.minuta* (Dragesco, 1954)			+	+
28.	*R.swedmarki* (Dragesco, 1954)	+			
29.	*R.multinucleata* (Kahl, 193)			+	

Table 1 (continued)

Fam. Geleidae Kahl, 1933					
30.	*Aveliagigas* Dragesco, 1960	+			+
31.	*A.orbis* (Fauré-Fremiet, 1950)*			+	
32.	*A.martinicense* Nouzaréde, 1975			+	
33.	*Geleia simplex* Fauré-Fremiet, 1950	+	+		+
34.	*G.decolor* Kahl, 1931	+			+
35.	*G.orbis* Faure-Fremiet, 1950			+	
Blepharismidae Jankowski in Small and Lynn, 1985					
36.	*Anigsteiniasalinara* (Florentin, 1899)	+			+
37.	*Blepharismahyalinum* Perty, 1849				+
38.	*B.steini* Kahl, 1932	+			
Fam. Condylostomatidae Kahl in Dofflein and Reichenov, 1927					
39.	*Condylostomakasymovi* Alekperov, 1984		+	+	
40.	*C.arenarium* Spiegel, 1926	+			
41.	*C.magnum* Spiegel, 1926				+
42.	*C.spatiosum* Ozaki and Yagiu in Yagiu, 1944				+
43.	*C.reichi* Wilbert and Kahan, 1981*			+	
44.	*C.patens* Dujardin, 1841		+		
45.	*C.nigra* Dragesco, 1960	+		+	+
Fam. Spirostomidae Stein, 1867					
46.	*Spirostomum minus* Roux, 1901	+	+	+	+
47.	*S. ambiquum* (Müller, 1786)	+			+
48.	*Gruberiaaculeata* Ozaki and Yagiu, 1941			+	+
49.	*G.lanceolata* (Gruber, 1884)	+		+	+
50.	*G.uninucleata* Kahl, 1932	+			
Fam. Aspidiscidae Ehrenberg, 1838					
51.	*Aspidiscafusca* Kahl, 1928			+	+
52.	*A.leptaspis* Fresenius, 1865	+	+		+
53.	*A.pulcherrima* Kahl, 1932	+			
54.	*A.aculeata* (Ehrg., 1838)			+	
Fam. Uronychiidae Jankowski, 1975					
55.	*Uronychiatransfuga*	+	+	+	+
56.	*U.caspica* (Alekperov and Asadullayeva, 1999)	+	+	+	+
57.	*U.heinrothi* Buddenbrock, 1920	+			+
Fam. Euplotidae Ehrenberg, 1838					
58.	*Euplotesraikovi* Agamaliev, 1966	+			+
59.	*E.patella* (Müller, 1773)		+	+	

Table 1 (continued)

60.	*E.harpa* Stein, 1859	+	+	+	+
61.	*E.balteatus* Dujardin, 1842	+	+	+	+
62.	*E.eurystomus* Wrzesniowski, 1870	+	+		
63.	*E.gracilis* Kahl, 1932	+	+	+	+
64.	*E.minuta* Yocom, *1930*	+	+		+
65.	*E.vannus* (Müller, 1786)	+			
66.	*E.rariseta* Curds et al., 1974				+
67.	*E.focardii* Valbonesi and Luporini, 1990*				+
68.	*E.haron* (Müll., 1786)		+	+	
69.	*E.alatus* Kahl, 1932			+	
70.	*E.pseudoraikovi* Alekperov, 2005	+			+
71.	*E.khazarica* Alekperov, Buskey, Snegovaya, 2006		+	+	
Fam. Strobilidiidae Kahl in Dofflein and Reichenov, 1929					
72.	*Strobilidiumlacustris* Foissner, Skogstad, Pratt, 1988	+	+	+	+
73.	*S.elegans* (Kahl, 1932) Maeda and Carey, 1985	+	+	+	+
Fam. Strombidinopsidae Small and Lynn, 1985					
74.	*Novistrombidium apsheronicum* Alekperov and Asadullayeva, 1997	+		+	+
75.	*Strombidinopsis azerbaijanica* Alekperov and Asadullayeva, 1997	+		+	+
Fam. Amphisiellidae Jankowski, 1979					
76.	*Amphisiellaannulata* (Kahl, 1928)	+			+
77.	*A.turanica* Alekperov and Asadullayeva, 1999		+	+	
78.	*A.milnei* Kahl, 1932	+			+
79.	*A.marioni* Wicklow, 1982	+			+
Fam. Keronopsidae Jankowski, 1979					
80.	*Keronopsisgracilis* Dragesco 1954			+	
81.	*K.pernix* Wrzesniowski, 1877	+			
82.	*Pseudokeronopsisrubra* (Ehrb.1838)	+	+		
83.	*P.flava* (Berger, 2006)	+			+
84.	*Pseudobakuella salinarum* (Michailowitsch and Wilbert, 1990)	+			+
85.	*Holostycha azerbaijanica* (Alekperov and Asadullayeva, 1999)	+		+	+
Fam. Urostylidae Bütschli, 1889					
86.	*Urostyla marina* Kahl, 1932	+			+
87.	*U.grandis* Ehrb, 1830	+		+	+
88.	*U.dispa* Kahl, 1932	+	+	+	+

Table 1 (continued)

Fam. Oxytrichidae Ehrenberg, 1838					
89.	*Oxytricha marina* Kahl, 1932	+	+	+	+
90.	*O.pellionella* (Müll., 1773)		+		+
91.	*O.setigera* Stokes, 1891	+	+	+	+
92.	*O. aeruginosa* Wrzesniovski, *1870*				+
93.	*O.tenella* Song and Wilbert, 1989*	+			
94.	*O.longa* Gelei and Szabades, 1950	+		+	
95.	*O.gibba* (Müll., 1786)	+			+
Fam. Metopidae Kahl, 1927					
96.	*Metopuscaucasicus* Alekperov, 1984		+	+	
97.	*M.es* (Müller, 1786)		+	+	
98.	*M.contortus* (Quennerstedt, 1867)		+	+	
99.	*M.fuscoides* Alekperov, 1984		+	+	
Fam. Enchelyidae Ehrenberg, 1838					
100.	*Chaeneatesselata* (Kahl, 1935) Dragesco, 1965		+		+
101.	*C.teres* (Dujardin, 1841) Kahl, 1881	+	+	+	
102.	*C.robusta* Kahl, 1930	+			
103.	*C.psammophila* Dragesco, 1960		+		+
104.	*C.vorax* Quennerstedt, 1867		+	+	
105.	*C.similans* Kahl, 1930			+	
Fam. Lacrymariidae de Fromentel, 1876					
106.	*Lacrymariacoronata* Clap.et L., 1858	+	+		
107.	*L.minuta Dragesco, 1963*	+		+	+
Fam. Amphileptidae Bütschli, 1889					
108.	*Amphileptus marina* (Kahl, 1928)	+		+	
109.	*A.lanceolatus* (Dragesco, 1965)				+
110.	*Hemiophrysagilis* Penard, 1922		+		
111.	*H.filum* Gruber, 1884		+	+	
112.	*H.fusidens* Kahl, 1926	+			
113.	*H.marina* Kahl, 1930		+		+
Fam. Litonotidae Kent, 1882					
114.	*Litonotusemmerichi* Petz, Song and Wilbert, 1995*			+	+
115.	*L.korimorphus* Petz, Song and Wilbert, 1995*			+	+
116.	*L.dusarti* Dragesco, 1960*	+		+	
117.	*L.loxophylliforme* (Dragesco, 1960)		+	+	
118.	*Loxophyllummeleagris* (Ehrb., 1835)	+			+
119.	*L.asetosum* Burkovsky, 1970	+	+		+
120.	*L.uninucleatum* Kahl, 1928	+		+	+

Table 1 (continued)

Chilodonellidae Deroux, 1970					
121.	*Trithigmostomacucululus* (Müller, 1786) Jankowski, 1967		+	+	+
122.	*T.steini* (Blochmann, 1895)	+	+		
123.	*T.sramekei* (Sramek-Husek, 1952)*	+			+
Fam. Chlamydodontidae Stein, 1859					
124.	*Chlamydodonmnemosine* Ehrenberg, 1857	+	+	+	+
125.	*C.rectus* Ozaki and Yagiu, 1941	+	+	+	+
126.	*C.erythrorhynchus* (Perejaslawzewa, 1885)	+	+	+	+
Fam. Lynchellidae Jankowski, 1968					
127.	*Chlamydonellapseudochilodon* (Deroux, 1970)	+		+	
128.	*C.galeata* (Deroux, 1970)	+			
129.	*C.rostrata* (Vuxanovici, 1963)				+
Fam. Dysteriidae Claparede and Lachmann, 1858					
130.	*Dysteriaprocera* Kahl, 1931	+		+	+
131.	*D.pusilla* (Claparede and L., 1859)	+			
132.	*D.monostyla* (Ehrenberg, 1838)	+		+	+
Fam. Orthodonellidae Jankowski, 1968					
133.	*Zosterodasysagamalievi* Deroux, 1978	+		+	+
134.	*Z.caspica* Fernandez-Leborans and Alekperov, 1996	+	+	+	+
135.	*Z.cantabrica* Fernandez-Leborans and Alekperov, 1996	+			+
Fam. Holophryidae Perty, 1852					
136.	*Holophryaafricana* Dragesco, 1965	+			
137.	*H.vorax* Bragesco, 1960				+
138.	*H. pelagica Lohman, 1920*	+	+		+
139.	*H.lemani* Dragesco, 1960*		+	+	
140.	*H.marina* Mansfeld, 1923	+		+	+
Fam. Placidae Small and Lynn, 1985					
141.	*Placuslonginucleatus* Song and Wilbert, 1989*	+		+	+
142.	*P.striatus* Cohn, 1856	+	+	+	+
Fam. Prorodontidae Kent, 1881					
143.	*Rhagadostomacompletum* Kahl, 1926	+		+	
144.	*R.nudicaudatum* Kahl, 1926		+		
145.	*Pseudoprorodonhalophilus* Kahl, 1930	+		+	+
146.	*P. incisus* Bock, 1952*			+	
Fam. Urotrichidae Small and Lynn, 1985					
147.	*Urotrichasphaerica* Groliere, 1977	+			+
148.	*U.armata* Kahl, 1927	+			+
149.	*U.discolor* Kahl, 1931	+			

Table 1 (continued)

150.	*U.baltica* Czapik and Jordan, 1977	+		+	+
151.	*U.turanica* Alekperov, 1977	+			+
Fam. Colepidae Ehrenberg, 1838					
152.	*Colepshirtus* (Müller, 1786)		+		
153.	*C.remanei* Kahl, 1933			+	+
154.	*C.similis* Kahl, 1933		+		
155.	*C.tesselatus* Kahl, 1930		+		
Fam. Plagiopylidae Schewiakoff, 1896					
156.	*Plagiopylastenostoma* Alekperov and Asadullayeva, 1996				+
157.	*P.nasuta* Stein, 1860		+		
158.	*P.ovata* Kahl, 1930		+	+	
Fam. Parameciidae Dujardin, 1840					
159.	*Paramecium caudatum* Ehrenberg, 1838		+	+	
160.	*P.woodruffii* Wenrich, 1928		+	+	
161.	*P.calkinsi* Woodruff, 1921		+	+	
Fam. Uronematidae Thompson, 1964					
162.	*Uronemamarinum* Dujardin, 1841	+	+	+	
163.	*U.nigricans* (Müller, 1786)		+	+	
Fam. Cyclidiidae Ehrenberg, 1838					
164.	*Cristigerasetosa* Kahl, 1928	+		+	+
165.	*C.sulcata* Kahl, 1928		+		
166.	*C.media* Kahl, 1928*	+		+	+
167.	*C.penardi* Kahl, 1935	+			+
168.	*Cyclidium glaucoma* Müller, 1786	+	+	+	+
Total:		**104**	**62**	**86**	**96**

Analysis of data on distribution of ciliate indicators of various saprobity zones revealed significant differences between the sites of the Sumgayit coast of the Caspian. We can see from Fig. 2.1 that the coast zone of the Haji Zeynalabdin Tagiyev is characterized with mesosaprobic zone of pollution. It should be noted that representatives of betasaprobic zone made up 38% here which is rather big portion. Representatives of the betameso-alfamesosaprobic zone made up absolute majority (50%) and the portion of indicators of alphamesosaprobic zone in this site was 12% of total number of all indicator species.

We can see from Fig. 2.2 that in this site for the first time were noted representatives of alphameso-polysaprobic zone rather high portion of which (20%) indicate significant pollution. The portion of alphamesosaprobes rather big as well (35%). The portion of the indicators of more moderate pollution, betameso-alphamesosaprobes was 30% and of betamesosaprobes - 15%.

The ratio of indicator species significantly varied in different points of collection along the industrial zone of the Sumgayit coast.

The ratio of the ciliate species indicators of saprobity in the collection points along the Sumgait City coast indicates that this site is significantly purer than the previous one. It is indicated by rather high portion of the representatives of the betamesosapobic zone (45%) and betameso-alphamesosaprobic zone (35%). Yet, presence of representatives of alphamesosaprobic zone (13%) and even indicator species of alphamesosaprobic zone (though they made up only 7%) in this site should also be noted.Their presence indicates that there is local organic pollution in this site. It is not by chance that the most of indicator species of alpha- and alphameso-polysaprobic zone we noted next to the Sumgayit water treatment plant.

The data obtained indicated that the site of the Sumgayit coast at the Novhany settlement should be regarded the most ecologically clean one.

We can see from Fig. 2.4 that in this site for the first appeared ciliate indicators of oligo-betamesosaprobic zone that made up 15%. Relative purity of this site is also indicated by the highest portion of indicator species of betamesosaprobic zone (57%).

The portion of indicator species of betameso-alphamesosaprobic zone made up 25% in this site and the portion of representatives of alphamesosaprobic zone – 3%.It can be seen from the obtained results that the portions of ciliate species indicators of various saprobity zones indicate purer states of sites 1 and 4 of the Sumgayit coast, i.e., in the zones of Novhany and Haji Zeynalabdin Tagiyev settlements.

Ecological analysis revealed that the most polluted site of the Sumgayit coast is the site of the industrial zone and the site at the Sumgayit City is somewhat purer.

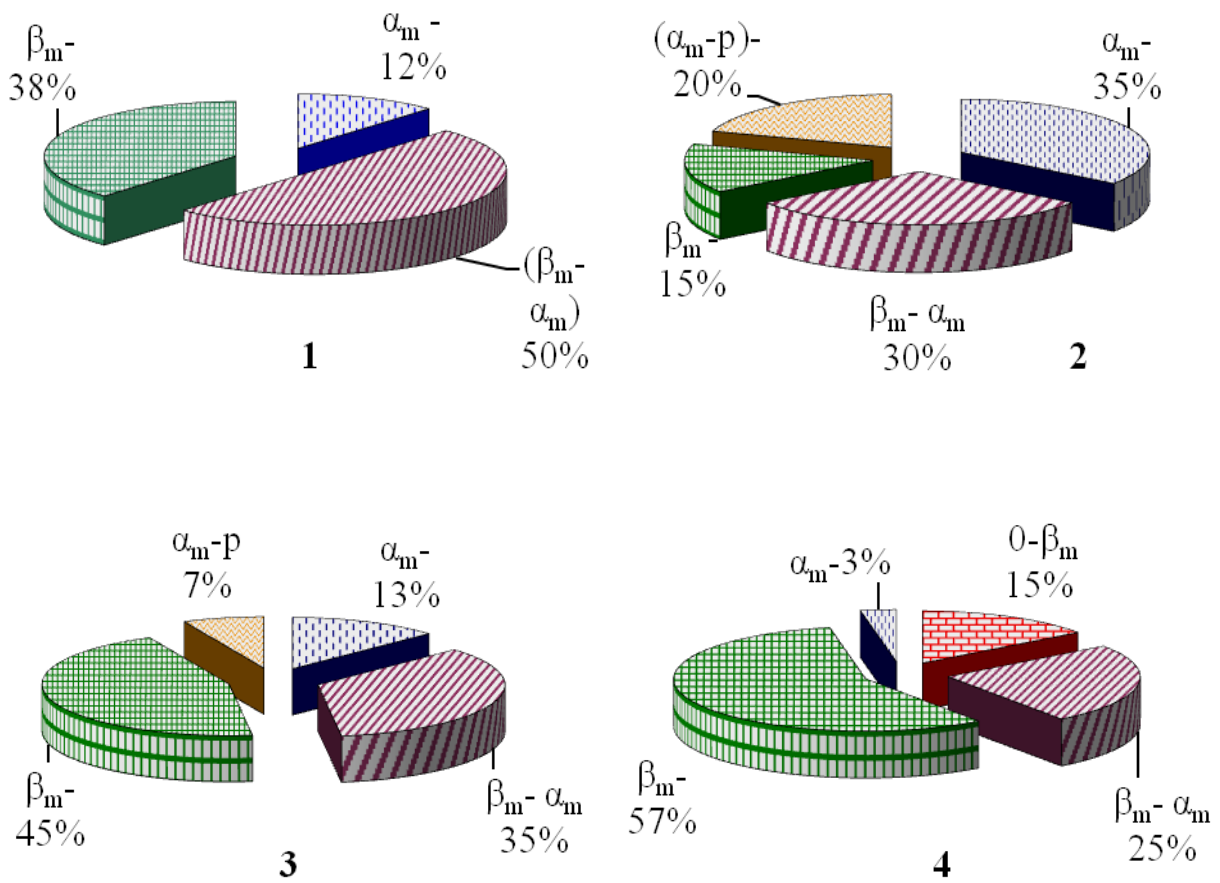

Fig. 2. Distribution of ciliate indicators of various saprobity zones (%) between the sites of Sumgayit coast of the Caspian Sea.

The communities of freeliving benthic ciliates significantly change seasonally during a year which manifests in regular shifts of dominating complexes. Early in spring reproduction of small eurytop species occurs which feed mainly on bacteria, zoo- and phytomastigina and also small diatom algae.

These are typical pioneer species which are resistant to fluctuations of climatic and hydrochemical factors and characterized with high reproductive potential. Somewhat later, in the next stage the leadership proceeds to larger forms in diet of which significant part is played by the small pioneer species. In the second half of summer large interstitial species dominate which possess high regulation ability and fine food specialization that give them advantage in the conditions of variable environment and food deficiency.

When cold weather having established the total ciliate density reduces by about 10-20 times and sometimes only single specimens of a few species are noted. In the end of winter small bacterio- and histotrophic species dominate which live during this period mainly by feeding on detritus and organic substances dissolved in the water.

Thus in communities of benthic ciliates during the year real cyclic succession occurs with replacement of a few relatively steady species complexes. It is known that the scale of the 'biological time' reflects specific responsiveness of population to ecological conditions and can be estimated by the value of the interval between generations. For organisms, e.g., ciliates the life span of which is measured in hours and dosens of hours calendar year is the time period sufficient for occuring succession. Any microscale changes in the protozoan vital activity (e.g., formation of temporary congestions, vertical migrations, etc.) are connected with reproduction cycles [4].

Findings. The data show the relationship between the species composition, structure of the ciliates benthic communities and contamination degree of the different part of the coastline. In our opinion for more correct results in the future probably need to conduct parallel similar studies in other benthic animal groups.

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