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Zoobenthos distribution on biotope in the shelf zone of the Azerbaijan sector of the South Caspian

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Abstract
The present paper presented the distribution of organisms on the biotopes of macrozoobenthos in the shelf zone of the Azerbaijan sector of the South Caspian, showing the relationship of species diversity of benthic organisms on the types of soil, Comparing the species diversity of four biotopes showed that species diversity is richer than all on the shelly-silt. Only 157 species belonging to 10 taxonomic groups, among which 54 species were observed for the first time in this part of the Caspian Sea. Minimum indices of qualitative and quantitative development of macrozoobenthos were observed on the biotope of the clayey silt, on which only 33 species belonging to 6 taxonomic groups were observed.

Keywords: Caspian Sea, macrozoobenthos, bottom biotopes, shelf zone, distribution

1. Introduction

The Caspian Sea stretches in the meridional direction of 1200 km and the width from 200 to 560 km. The surface of the sea is about 422 000 m^2km and the volume is about 77 000 m^3 with an average depth of 184 m. The Caspian Sea is divided into three parts - the northern, very shallow (no more than 10-12 m), middle with depths up to 770 m and south, and a deeper one (1000 m) [1]. Middle and South Caspian are divided into shallow water in the latitude of the Absheron Peninsula. The area of the three parts of the sea is almost equal to one another, but they vary greatly in volume: the northern part is less than 0.01, the middle part is about one-third and the south is about two-thirds [2]. The distribution and abundance of species in bottom life, including macrozoobenthic animals, is due to the nature of ground. It should be noted that the depth of the Caspian Sea (100m deep) is mainly occupied by silt. High capacity deposits of soft silt-rich detritus are formed on the Caspian Sea shallow waters, frequently on the very coast, particularly in the northern part, at the expense of rich vegetation and abundant offsets flowing into the Caspian Rivers, first of all into the Volga, and then in the southern part into the Kura [3]. Vast areas occupied by sands and vast placers of sea shell bat with admixture of silt sometimes stretch between shallow and deep zone. The distribution of soil in its turn is associated with the system of marine currents. As a whole the Caspian Sea covers a large cyclonic (anti-clockwise) course being divided into several smaller cyclonic zones -two in the South Caspian, one large in the middle and two in the North [3]. The South Caspian Sea is of great importance in the production of all sea fish stocks. The main supply areas of commercial and semi-anadromous fish, including the most valuable, wintering in the Southern Caspian sturgeon can be found in some waters of the South Caspian Sea [4].

The maximum depth in the Southern Caspian is 1025 m, and the average is 345 m. However, the largest part of the South Caspian (62.2%) occupies the depth of 100 m and the depth of more than 900 m occupies only 1.0% of the sea area. The shelf of the western part of the South Caspian ground is occupied by shelly silt and sand. The deep zone (more than 200 m) of the South Caspian is dominated mostly by sludgy, silty-sand, shelly silt and clayey silt [5].

In recent years the change in the Caspian Sea level and intensive oil production greatly influence on its ecological condition. Therefore, carrying out research on zoobenthos distribution of biotopes in the new changing environmental conditions of the Caspian Sea is of great scientific and practical significance, since, macrozoobenthos organisms form the food base of many commercial fish. In this context, the aim of this investigation was to study the distribution patterns of zoobenthos on biotopes in the waters of the Azerbaijan sector of the South Caspian.

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2. Material and Method

The material for this investigation was collected in different seasons during the period of 2010-2014 in various deep horizons of the Azerbaijan sector of the South Caspian. Bottom samples were collected at three sections with 24 biological stations (Western part of South Caspian) (Fig.1).

Fig 1: Sample points of the macrozoobenthos on the Southern Caspian**.**

The samples were taken by bottom grab type of the "Van Veen" with an area of 0,1m^2. At each station three samples were taken, then they were combined and processed as 1 total from every point of sample collection. In all 360 samples of macrozoobenthos were collected and processed. Collecting and processing benthic samples were carried out by the usual method [6, 7]. During the collection of macrozoobenthos samples parameters of the main abiotic factors (water temperature, salinity, oxygen, pH and transparency) were investigated in parallel.

Being washed on a vessel, the samples were fixed in 4% formalin solution with added eosin dye for aquatic organisms. The benthic fauna was selected under laboratory conditions. Then the selected organisms were dried up lightly by filter paper and weighed on the electronic scale accurately within 0.1 mg. Then the fixed organisms were identified to the species level. Modern identification key on invertebrate fauna of the Caspian Sea [8, 9] were used for taxonomic designation of macrozoobenthic organisms.

The Bray-Curtis cluster analysis was used to compare the macrozoobenthos species richness on different biotopes.

3. Results and Discussions

In addition to the depth, one of the main factors of the abiotic environment is the character of bottom type, determining the species diversity and quantitative development of certain groups of benthic animals [10].

However, it should be noted that the number of faunistic studies of special operations depending on the distribution of benthic biotopes of the Caspian Sea was very few for more than 30 years [11-13].

During present investigation of zoobenthos in the Azerbaijan sector of the South Caspian mainly 4 types of bottom were observed: shelly silt, silty-sand, silty, clayey-silt.

The results showed that these biotopes vary greatly from each other both in species richness of community and quantitative parameters of macrozoobenthos.

During the research, in all 159 species of macrozoobenthos organisms belonging to 10 taxonomic groups were observed (Table 1). Of the four main types of biotopes in the shelf zone of the Azerbaijan sector of the South Caspian, shelly silt biotope is the richest in species and quantitative development of macrozoobenthos, in which totally 136 species belonging to 10 taxonomic groups were observed (Table 1).

Table 1: Species composition and distribution macrozoobenthos four biotopes in the shelf area of the South Caspian (2010 – 2014).

Species composition	Biotopes			
	silty-shelly	silty-sand	silty	clayey silt.
1	2	3	4	5
Polychaeta				
Nereis diversicolor Müller,1776	+	+	+	+
N. succinea (Leuckart,1847)	+	+	+	-
Hypania invalida (Grube,1860)	+	+	+	+
*Hypaniola kowalewskii (*Grimm in Anninkova,1927)	+	+	-	+
Parhypanis brevispinis Grube,1860) *	+	+	-	+
Manayunkia caspica Annikova,1929	+	+	-	+
Fabriciasabella caspica Zenkewitch,1922	+	+	-	-
*Ficopomatus enigmatica (*Fauvel.,1923)	+	+	-	-
Oligochaeta				
Psammoryctides deserticola Grimm,1877	+	+	+	+
Tubifex tubifex Müller,1774*	+	+	-	-
T. acapillatus Finogenova, 1972*	+	-	+	-
Stylodrilus parvus (Hr. et Cern.,1927) *	+	+	-	-
S.cernosvitovi Hrabe,1950*	+	+	-	+
Isochaetides michaelseni (Last.,1937) *	+	+	-	+
Aktedrilus svetovi Finogenova, 1972*	+	+	-	+
Marionina aberrans Finogenova,1973*	+	-	-	+
Peloscolex debilis (Hatton.,1902) *	+	-	-	+
Trichodrillis pauper Finogenova,1973*	+	+	-	-
Potamothrix caspicus Last,1937*	-	+	-	-
P. grimmi (Hrab.,1950) *	+	+	-	-
P. cekanovskajae Finogenov,1972	+	+	-	-
Mollusca				
Mytilaster lineatus (Gmelin,1791)	+	+	+	+
D. profundicola Logv.et Star.,1966*	+	+	-	-
D. parallella Bogachev,1932*	+	+	-	+
Hipania caspia filatovae Logv. et Star.,1876	+	+	-	-
H. albida Logv.et Star.,1967	+	+	-	-
Dreissena rostriformis grimmi Andr.,1890	+	+	+	-
D. polymorpha (Pall.,1771)	+	+	+	-
D. rostriformis distincta (Andr.,1897)	+	+	-	-
*D. rostriformis pontocaspica (*Andr.,1897)	+	+	-	-
D. elata (Andr.,1897)	-	+	+	-
D. caspia Eichw.,1855	+	+	-	-
D. polymorpha (Pall.,1771)	+	+	-	-
Caspiohydrobia curta (Logv. et Star.,1968)	+	+	+	-
C. gemmata (Kolesnikov, 1947)	+	+	+	-
C. convexa Logv. et Star.,1966	+	+	-	-
Cerastoderma rhomboides (Lamarck,1812)	+	+	-	-
C. isthmicum (Issel.,1869)	+	+	-	-
Turricaspia dagestanica Log. et Star.,1968	+	-	+	-
T. dimidiata (Eichwald,1841) *	-	+	+	-
T. pseudobacuana Log. et Star.,1947	-	+	+	-
T. laticarinata Logv. et Star.,1947	+	+	-	-
T. spasskii Logv. et Star., 1966*	+	-	-	-
T. variabilis (Eich.,1924)	-	+	-	-
*T. cincata (*Abich.,1947)	+	-	-	-
T. eulimellula (Dub. et Gr.,1915) *	+	+	-	-
*T.turricula (*Cless. et Dyb.,1947) *	+	+	-	-
T.fedorovi Logv. et Star.,1966*	-	+	+	-
T.elegantula (Cless. et Dyb.,1888) *	-	-	+	-
T.similis Logvinenko et Starobogatov,1966*	-	-	+	-
T.grimmi (Cless. et Dyb.,1888)*	-	+	+	-
T.nossovi (Kolecnikov,1947) *	-	+	+	-
*T.kowalewskii (*Cless. et Dyb.,1888) *	-	+	-	-
T.pseudodimidiata Logv.et Star.,1966*	+	+	-	-
T.turkmenica Logv. et Star.,1966	+	-	-	-
T.caspia (Eichw.,1838) *	+	+	-	-
T.simplex Logv. et Star.,1966*	+	+	+	+
T.curta (Nalikin,1915) *	+	+	+	+
T.lirata (Dub. et Gr.,1917) *	-	+	-	-
T.kolesnikoviana Logv. et Star.,1966	+	-	+	-
T.abichi Logv. et Star.,1947*	-	+	+	-
T.eburnea Logv. et Star.,1947*	+	+	+	-

T.conus (Eichw.,1888) *	+	+	-	-
T.marginata (Westirlinq,1962) *	+	-	+	-
T.derbentina Logv. et Star.,1966	+	+	+	-
T.dubia Logv. et Star.,1966*	+	+	-	-
T.trivialis Logv. et Star.,1947*	-	+	+	-
T.baerii Cless. et Dyb.,1888) *	-	+	+	-
.*T.pallasii* (Cless. et W.Dyb.,1888)	+	+	+	-
T.gmelinii (Cless. et W.Dyb.,1888)*	+	+	+	-
T.schorygini Logv. et Star.,1966*	+	+	-	-
T.nana Logv. et Star.,1966*	+	-	+	-
T.ulskii (Cless. et Wyb.,1888)*	-	+	+	-
T.behningi Logv. et Star.,1966	-	+	+	-
T.pulla (Dyb. et Gr.,1917)	-	+	+	-
T.derzhavini Logv. et Star.,1966	+	-	+	-
T.andrusovi (Dyb. et Gr.,1915*	+	-	+	-
Pseudamnicolabrus inianus (Cless. et Dyb.,1888)*	+	-	+	-
Horatia marina Logv. et Star.,1966*	+	-	+	-
Anisus eichwaldi (Cless. et Dyb.,1888)	+	+	+	-
A.colesnikovi Logv. et Star.,1966*	+	-	+	-
Cirripedia				
Balanus improvisus Darwin,1854	+	+	-	-
B.eburneus Gould*., 1841*	+	+	-	-
Mysidacea				
Mysis caspia Sars,1927	+	-	+	-
M.amblyops Sars,1907	+	+	-	+
M.macrolepis Sars,1907	+	-	+	-
M.microphtalma Sars,1885*	+	+	-	+
Paramysis kessleri (Grimm,1885)	+	-	+	-
P.eurylepis Sars,1907*	+	+	-	-
P.grimmi Sars,1895	+	+	+	-
*P.inflata (*Sars,1907) *	+	+	+	-
P.loxolepis Sars,1895	+	+	-	-
P.incerta (Sars,1895) *	+	+	+	-
Cumacea				
Schizorynchus bilamellatus (Sars,1894)	+	+	-	-
S..eudorelloides Sars,1894	+	+	+	+
Pterocuma rostrata (Sars,1894)	+	+	+	+
P.sowinskyi (Sars,1894)	+	+	+	-
P.pectinata (Sowinsky,1893)	+	+	+	+
Pseudocuma cercaroides Sars,1894	+	-	+	-
Stenocuma diastyloides Sars,1897	+	-	+	+
S.tenuicauda (Sars,1894)	+	-	+	+
S.gracilis Sars,1894	+	-	+	-
Pterocuma grandis Sars,1914*	+	+	-	+
Caspiocuma campylaspoides (Sars,1897) *	+	-	+	-
Volgocuma telmatophora Derzh.,1912*	+	-	+	-
Amphipoda				
Pseudalibrotus caspius Sars,1896	+	+	-	+
P.platyceras Sars, 1896*	+	+	-	+
Axelboeckia spinosa (Sars,1894) *	+	-	+	+
Gammaracanthus loricatus caspius (Sabine,1824)	+	-	+	+
Amathillina maximovitschi Sars,1896	+	-	+	-
A.cristata Grimm in Sars,1894	+	+	-	-
A.spinoza (Grimm,1896)	-	+	-	-
A.pusilla Sars,1896	+	-	-	-
A.affinis Sars,1894	+	+	-	-
Dikerogammarus oskari Birst,1945	+	+	-	+
*D.haemobaphes (*Eichwald,1841)	+	+	-	-
D.macrocephalus Sars,1896	+	+	+	-
D.aralichensis (Birstein, 1932)	+	-	-	-
Niphargoides corpulentus Sars, 1895	+	-	+	-
N.compactus Sars, 1895	+	-	+	-
N.corpulentus Sars, 1895	-	-	+	+
N.spinocaudatus Car.,1943	+	+	-	-
N.grimmi Sars,1896	-	-	+	+
N.robustoides (Grimm,1894)	+	+	-	-
N.abbreviatus (Sars,1894)	+	+	-	-
N.subnudus (Sars,1896)	+	+	-	-
N.obesus (Sars,1899)	+	+	-	-

N.maeoticus (Sow.,1894)	+	+	-	-
N.carausui (Derzh. et Pjat.,1962)	+	+	-	-
N.compressus (Sars,1894)	+	+	-	-
N.macrurus (Sars,1894)	+	+	-	-
N.similis (Sars,1894)	+	+	+	-
N.derzhavini Pjat.,1962	+	+	+	-
N.quadrimanus Sars,1895	-	-	+	+
N.boltovskoi Derzhavin et Pjat.,1962*	+	+	-	-
N.caspius (Grimm,1880)	+	+	-	-
N.grimmi Sars,1896	+	+	-	+
N.similis (Sars,1894)	-	+	+	-
N.quadrimanus Sars,1895	+	+	-	-
N.crassus (Grimm,1894)	+	+	-	+
N.deminutus (Steb.,1906)	+	-	+	-
Iphigenella andrussovi (Sars,1896)	+	-	+	-
I.acanthopoda Grimm in Sars,1896	+	+	-	-
Pandorites podoceroides (Grimm,1880)	+	+	-	-
Gmelinopsis aurita Sars,1896	+	-	-	-
Gammarus placidus Grimm,1896	+	+	-	-
G.ischnus Steb.,1898	+	-	+	-
G.pauxillus Grimm,1856	+	+	-	-
Pontoporeia affinis microphthalma Grimm,1880	+	+	-	-
Corophium chelicorne Sars,1895	+	+	-	-
C.spinulosum Sars,1896	+	+	+	-
C.nobile Sars,1895	+	+	-	-
Isopoda				
Saduria entomon caspia Sars,1897	+	+	+	-
Jaera sarsi caspica Kessler,1938	+	+	+	-
Decapoda				
Palaemon elegans Rathke, 1884	+	+	+	-
P.adspersus Rathke, 1884	+	+	+	-
Rhitropanopeus harrisii tridentatus (Could,1898)	+	+	+	-
Insecta				
Chironomus albidus Konst., 1956	+	+	+	-
Clunio marinus Hal.,1944	+	+	+	-
Total:	**136**	**119**	**79**	**33**

Note: * - Species, observed in this part of the Caspian Sea for the first time.

According to the species richness the second place is occupied by the biotope of silt-sand bottom- in which 119 species of macrozoobenthos were observed. The next one was the biotope of sludgy bottom where found 79 species. Finally, the minimum species richness was observed in the biotope of the clayey-silt, where found only 33 macrozoobenthos. Pairwise comparison of macrozoobenthos species similarity of different types of biotopes showed that the greatest similarity was observed for biotopes shelly-silt and silty-sand bottoms, and it was 78.7%. The similarity between silty-shell and silty biotopes was 54% and the similarity of silty-sand and silty bottom was 46%. The similarity of species richness of silty-shell and clayey silt biotope was 36%, and the minimum value of the species similarity index was observed while comparing the silty-sand and sludgy biotopes with clayey-silt bottom (respectively 30.2% and 31.5%).

The results on comparing the species richness of macrozoobenthos organisms of different biotopes of cluster analysis are presented in Fig. 2.

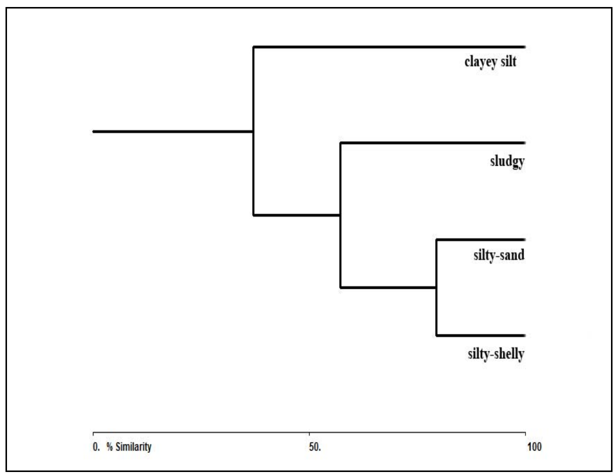

Fig 2: The similarity of macrozoobenthos species richness on four biotope of the South Caspian.

The greatest similarity of the species richness was observed between shelly-silt and silty-sand biotopes being more than 75% (Fig. 2) The similarity of species richness of macrozoobenthos organisms of these two biotopes in its turn is closest to the biotope of sludgy bottom (over 50%), and the lowest species richness was observed between the clayey silt biotope among all the others, forming not more than 30%. This distribution pattern of macrozoobenthos organisms is due to environmental features of each biotope, including granulometric characteristics of the bottom. The resulting reduction of species richness dependence almost correlates with a decrease in the size of the soil particles, which successively decrease from silty to clayey and shell biotopes. Naturally, for a sufficient large macrobenthic animals need to be corresponded to their size cavity in the ground. Furthermore, the smaller the bottom particles, the denser they are and it leads to deterioration of the gas mode and the amount of food.

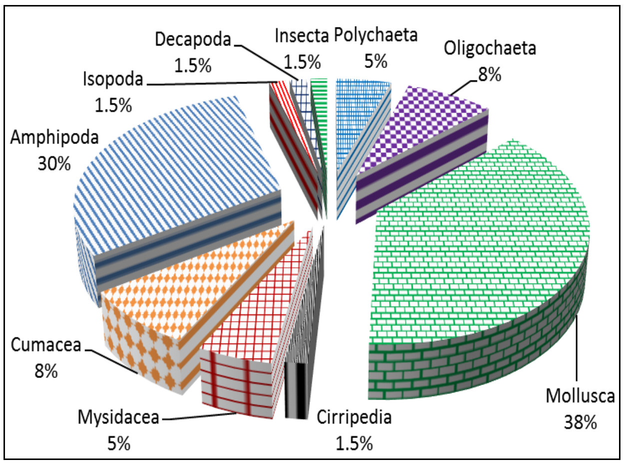

Fig 3: The overall ratio of macrozoobenthos taxonomic groups of South Caspian biotopes

Fig. 3 presents total ratio of taxonomic groups of macrozoobenthic organisms of four type bottom biotopes in the South Caspian zone. As it is seen from the figure, the dominant in the species richness groups were *Mollusca* (38%) and *Amphipoda* (30%). The share of other taxonomic groups was considerably less, including *Oligochaeta* and *Cumacea* accounted for 8%, and *Polychaeta* and *Mysidacea* each 5%, and the remaining group *Decapoda, Isopoda, Cirripedia* and *Insecta*, each made up only 1.5%.

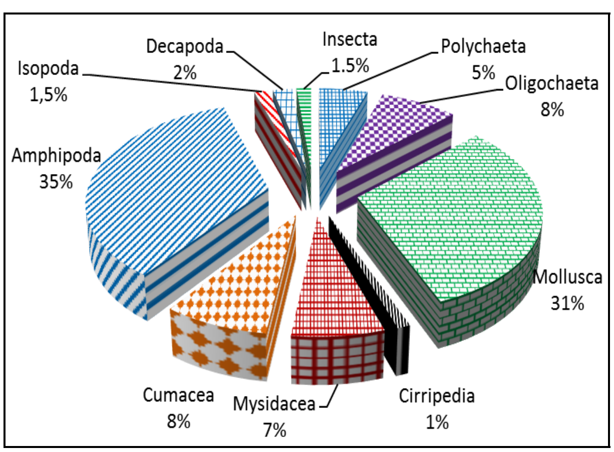

Fig 4: The ratio of taxonomic groups of macrozoobenthos on silty-shelly biotope.

Analysis of the data obtained by the ratio of species richness taxonomic groups of macrozoobenthos on various bottom showed that depending on the biotopes occur as the common patterns, as well as some differences. As it is seen from Fig. 4, the dominant species richness groups were *Amphipoda* and *Mollusca* forming respectively 35% and 31% in sludgy and shelly biotopes. According to the species richness, the next ones are *Oligochaeta* and *Cumacea,* forming (8%) and then *Mysidacea* (7%) and *Polychaeta* (5%). Other groups of macrozoobenthos were a little percentage of the total species richness of silty-shell biotopes,
including Decapoda (2%), and *Isopoda, Cirripedia* and *Insecta* 1%.

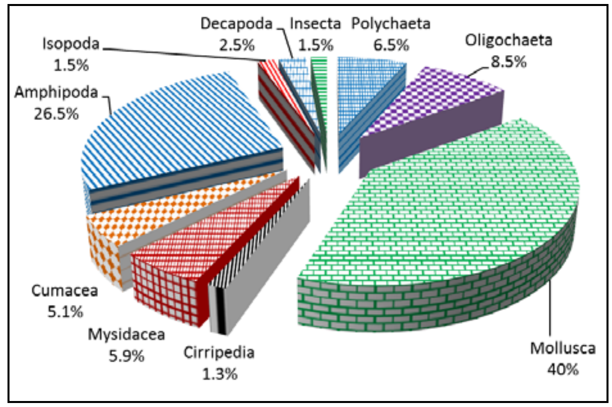

Fig 5: The ratio of taxonomic groups of macrozoobenthos on silty-sand biotope.

As it is seen from Fig. 5, the dominant groups on species richness were also *Mollusca* (40%) and *Amphipoda* in the silty-sand bottom (26.5%), forming more than 65% of this biotope. The ratio of other groups of macrozoobenthos is more equal than in the previous biotope. For example, *Oligochaeta* were 8.5% and *Cumacea, Mysidacea* and *Polychaeta* were respectively 5.1-5.9 and 6.5%. Other groups *Cirripedia, Isopoda, Insecta* and *Decapoda* were respectively 1.3% -1.5% -1.5% -2.5%.

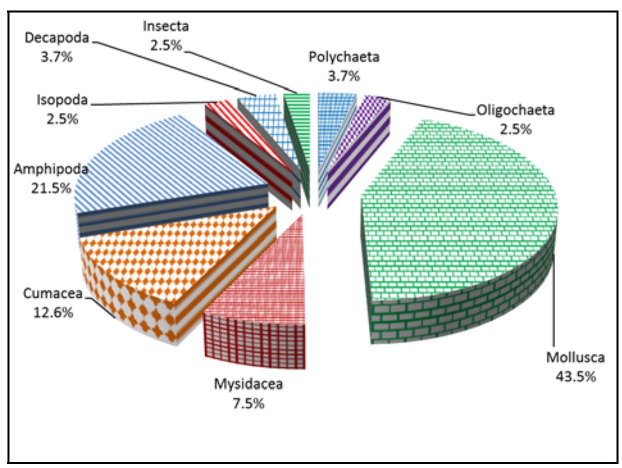

Fig 6: The ratio of taxonomic groups of macrozoobenthos on silty biotope.

Being presented in Fig. 6, the data on the ratio of taxonomic groups of macrozoobenthos of sludgy biotopes showed that in this case the dominant groups were *Mollusca* and *Amphipoda* (respectively 43.5% and 21.5%). Characteristic of silt is formed by higher species richness of *Cumacea* group

(12.6%), *Mysidacea* were 7.5% on sludgy soil and *Polychaeta* of species richness decreased to 3.7%. *Decapoda* group also was with the same percentage. The decline of species richness was observed on the sludgy bottom for *Oligochaeta*, forming the same way as the rest of the small group (*Isopoda* and *Insecta*) of 2.5%.

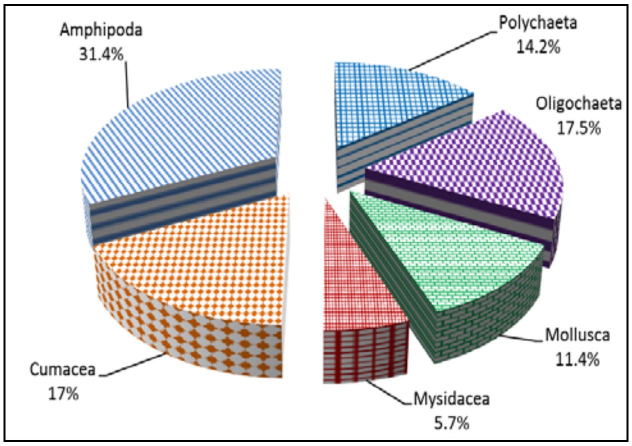

Fig 7: The ratio of taxonomic groups of macrozoobenthos on clayey silt biotope.

The most considerable differences in the ratio of benthic animal groups were observed on clayey silt biotope (Fig.7). Here domination of *Amphipoda* retains and even it increases to 31.4%. According to species richness the second one was *Oligochaeta* group (17.5%) and *Cumacea* (17%). This is followed by a group of *Polychaeta* (14.2%) and only then the dominant of all other biotopes group was *Mollusca*, being only 11.4%. Among the other groups of animals only *Mysidacea* (5.7%) was observed on clayey biotopes.

4. Conclusion

In total 157 species of macrozoobenthos were observed in the South Caspian. As a total species diversity, among the four biotopes typical for the South Caspian was dominated by sludgy-shell soils. The greatest species richness of all the macrozoobenthos in the South Caspian was observed in this biotope, being 10 taxonomic groups of organisms, including 136 species. The next species richness was a silty-sand biotope, where 119 species belonging to 10 taxonomic groups were observed. 79 species belonging to 9 taxonomic groups were observed on the sludgy silt and here *Cirripedia* group already was missing. The lowest species richness-33 species belonging to 6 taxonomic groups were observed in the biotope of the clayey silt. Here 4 taxonomic groups as *Cyrripedia*, *Mysidacea*, *Decapoda*, and *Insecta* were missing in macrozoobenthos community. This distribution pattern of macrozoobenthos organisms is possibly due to environmental peculiarities of each biotope, including the particle size characteristics of the soil. The observed reduce in the dependence of species richness almost correlates with a decrease in the size of the soil particles, which are also successively decreased from silt to clayey-shell biotope. Naturally, macrobenthic animals need to be corresponded to their size cavity in the soil. Moreover, the smaller the particles of soil the denser they are, and it leads to deterioration of the gas primer mode and causes fewer food items. On species diversity of taxonomic groups, the richest ones were *Mollusca* -38% and *Amphipoda*-30%. These groups of animals dominated in almost all bottom type and *Mollusca* sharply reduced to 11.4% only in biotope of clayey silt of species richness. Besides, as already mentioned above, only four of ten taxonomic groups- *Cyrripedia, Mysidacea, Decapoda,* and *Insecta* fall out on the clayey silt of macrozoobenthos communities.

Prior to our research, the Caspian Sea macrozoobenthos species diversity mainly studied at relatively shallow depths up to 100-150 m. According Birstein and Ryabchikov 1935 (10) in the Caspian Sea deep horizons were noted mainly species - arctic invaders. Up to 50 m in biomass is dominated by molluscs, crustaceans and deeper below the worms. It should be noted, before our studies (11) the macrozoobenthos of the South Caspian maximum depths was not investigated. Beginning at a depth of 300-400 m, and up to maximum of 900-1000 m of the Caspian Sea, the species diversity of macrozoobenthos drops sharply and consistently decreases, reaching a minimum at depths of 900-1000 m-6 species (3 species of worms, 2 mysid and 1 insect).

Thus, the most biologically productive biotopes are silty-shell and silty-sand soils, and in relation to the optimum depth horizons are up to 100m for the main taxonomic groups of macrozoobenthos living conditions [11].

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