*Baku State University Journal of Life Sciences & Biology **2025**, v.2 (1), p.50-56*

journal homepage: http://bsuj.bsu.edu.az/en

SPECIES COMPOSITION OF THE MACROZOOBENTHOS OF DAVACHY PORT OF THE CASPIAN SEA, ITS DEVELOPMENT BY THE QUANTITY AND DISTRIBUTION FOR THE BIOCENOSES

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Received 10 april 2025; accepted 17 april 2025

Abstract

The Davachy Port extends 11.2 km along the western coast of the Middle Caspian Sea, serving as a vital freshwater reservoir. This study focuses on the composition of species, biomass, and seasonal distribution of macrozoobenthos in the port, considering historical and recent research findings. Over the study period from 2018 to 2019, 50 species of invertebrates were identified, with chironomid larvae dominating in both abundance and biomass. Seasonal variations significantly influenced species diversity, with the highest diversity observed in spring and the lowest in winter. The study highlights long-term changes in the harbor's fauna, the impact of environmental factors on macrozoobenthos, and the ecological significance of the port as a habitat for various aquatic organisms. The findings contribute to understanding biodiversity shifts and provide a foundation for future conservation efforts.

***Keywords**: Species compositio; macrozoobenthos; biomass; fauna; biocenosis*

1. Introduction

The Caspian Sea, the world's largest enclosed inland water body, is home to a diverse range of aquatic organisms, with its coastal areas providing critical habitats for various species. The Davachy Port, located in the northeastern region of Azerbaijan, is a unique ecosystem characterized by its dynamic hydrobiological conditions. As an important spawning and feeding ground, it plays a crucial role in sustaining the biodiversity of the Caspian macrozoobenthos.

Hydrobiological studies of the Davachy Port date back to the mid-20th century, with early research focusing on its food resources and macrozoobenthic composition. Since then, significant shifts in species composition have been observed due to natural and anthropogenic influences, including climate variations, water salinity fluctuations, and habitat modifications. This study aims to assess the current state of macrozoobenthos in the port, analyze seasonal dynamics, and compare findings with historical data to evaluate biodiversity trends and ecosystem stability.

The water level in the port fluctuates depending on factors such as river inflow, lock operation, evaporation, and other environmental conditions. During the summer months, river flow decreases significantly, sometimes drying up completely, which gradually disrupts the overall water and gas balance in the port. While the concentration of biogenic elements in the water is low, the mineral content is relatively high [10, 11]. Currently, the water salinity ranges from 3.5 to 4.2 ppm, with a hardness of 7.9–8.3 mg/eq. The oxygen content varies between 0.5 and 8.4 mg/L.

Main outcomes of earlier hydrobiological studies of the Davachy Port

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The first hydrobiological studies of the Davachy Port were conducted in the 1950s and 1960s, primarily aimed at assessing the port's food resources. These studies recorded the presence of 10 to 12 groups of invertebrates, with total raw biomass fluctuating between 0.60 and 9.18 g/m². A significant presence of chironomid larvae and mollusks was observed in the benthic zone. Consequently, the 1960s and 1970s marked the beginning of comprehensive and in-depth hydrobiological research in the port. During the 1960s up to 1980s, various researchers conducted detailed studies on its ciliate fauna, primitive crustaceans, mollusks, and macrobenthos [2, 3, 4, 5].

Further studies on macrozoobenthos were carried out by Z. Abdurrahmanova [6, 7]. Research conducted throughout the 20th century identified 77 species of planktonic invertebrates in the harbor's zooplankton, 130 species of benthic invertebrates in the zoobenthos, and 121 species of ciliates among unicellular organisms. During this period, insects were found to dominate macrozoobenthos in terms of species diversity, with 30 recorded species, followed by macroinvertebrates, which comprised up to 26 species [1, 8].

The study of macrozoobenthos in the port area during 2018-2019

After more than half a century since the first hydrobiological studies of the Davachy Port and over 35 years since the initial fundamental research on its macrozoobenthos, we started a new study in the region aimed aims to assess the changes that have occurred in the harbor and its fauna over this period, identify the factors driving these changes, and provide a scientific rationale for them. The study of the port's macrozoobenthos was conducted seasonally from 2018 to 2019.

2. Materials and Methods

The study was conducted seasonally from 2018 to 2019, following standard hydrobiological research methods [9]. Sampling was performed in different biotopes, including silt and aquatic vegetation zones, to ensure a comprehensive assessment of macrozoobenthos diversity. Specimens were collected using a grab sampler and hand nets, preserved in 4% formaldehyde solution, and analyzed in the laboratory. Species identification was carried out using taxonomic keys, and biomass was measured to determine the abundance of dominant species. Environmental parameters such as water temperature, oxygen levels, and salinity were also recorded to assess their influence on species distribution.

3. Results and discussion

Analysis of materials collected from various parts of the harbor and different biotopes (silt and aquatic vegetation) revealed 50 species and forms of invertebrates in the macrozoobenthos (Figure 1, Table 1). Chironomid larvae were the most dominant group by the number of species in the macrozoobenthos, comprising 11 species. They were followed by dragonfly larvae with 8 species, oligochaete worms with 5 species, and mollusks with 4 species. In terms of frequency of occurrence (f.o.) within the macrozoobenthos, the following species were identified: earthworms - *T.tubifex* (f.o. 70%), *O.serpentina* (f.o. 65%), leeches - *H.m.orientalis* (f.o. 40%) mollusks - *P.planorbis* (f.o. 45%), dragonfly larvae - *C.scitulum* (f.o. 75%), *S.metallica* (f.o. 75%), mayfly larvae - *O.macrura* (f.o. 70%), Hemiptera - *C.dentipes* (f.o. 70%), *C.affines* (f.o. 65%), Chironomid larvae - *C.conjugens* (f.o. 65%), *Ch.plumosus* (f.o. 75%), *P.ferrugineus* (f.o. 70%), *CH.thummi* (f.o. 45%), *Culicoides sp.* (f.o. 70%).

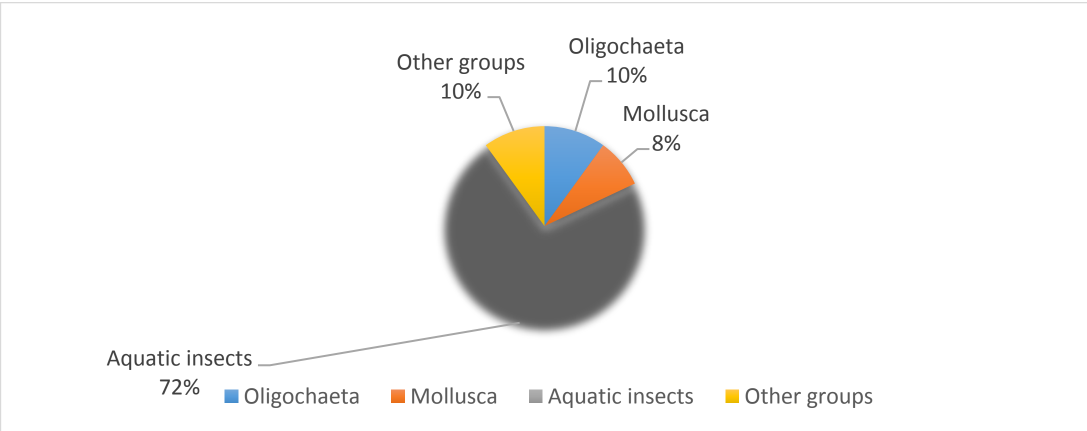

Fig. 1. Species composition of the macrozoobenthos in the Davachy Port

The species composition of the macrozoobenthos remained relatively stable over the study period, with 49 species identified in 2018 and 50 species in 2019. However, species diversity varied by season. The highest number of species (44) was recorded in spring, while the lowest (30) was observed in winter. The 14-species decline in winter is likely due to the limited amount of material collected during this season. In summer and autumn, 41 and 39 species were recorded, respectively.

Table 1. Species composition of the macrozoobenthos in the Davachy Port of the Caspian Sea during 2018-2019

№	**Species**	**Frequency of occurrence**	**Seasons**			
			Spring	**Summer**	**Autumn**	**Winter**
1	**2**	**3**	**4**	**5**	**6**	**7**
	Coelenterata					
1	*Hydra circumcieneta* Schulz, 1776	**30**	**2**	**2**	**2**	**-**
	Oligochaeta					
2	*Dero dorsalis* Ferroniere, 1899	**35**	**1,2**	**1,2**	**1,2**	**1,2**
3	*Ophidonais serpentina* (Müller, 1773)	**65**	**1,2**	**1,2**	**1,2**	**1,2**
4	*Limnodrilus udekemianus* Claparede, 1862	**35**	**2**	**2**	**2**	**-**
5	*Tubifex tubifex* (Müller, 1774)	70	1,2	1,2	1,2	1,2
6	*Eisenia rosea* (Savigny, 1826)	25	1	-	-	1
	Hirudinea					
7	*Piscicola geometra* (Linneaeus,1761)	35	1,2	1,2	1	2
8	*Hirudo medicinalis (orientalis)* (Utersky et Tronteli, 2005)	40	1,2	1,2	1,2	-
	Mollusca					
9	*Lymnaea auricularia* (Linnaeus, 1758)	30	1,2	1,2	1,2	1,2
10	*Acroloxus lacustris* (Linnaeus, 1758)	30	-	2	-	-
11	*Planorbis planorbis* (Linnaeus, 1758)	45	1,2	1,2	1,2	1,2
12	*Theodoxus danubialis* (C.Pfeiffer,1828)	35	1	1	-	-
	Isopoda					
13	*Asellus aquaticus* (Linnaeus, 1758)	35	1,2	1,2	1	-
	Odonata					
14	*Coenagrion scitulum* Rambur, 1842	75	1,2	1,2	1,2	1,2
15	*C.pulchellum* Vandre-Linden,1823	30	1,2	1,2	1,2	1,2
16	*Aeschna affinis* Vandre-Linden,1823	30	1,2	1	1,2	-
17	*A. grandis* Linnaeus, 1758	25	1	1		1
18	*Somatochlora metallica* Vandre-Linden, 1823	75	1	1	1	1
19	*Libelulla depressa* Linnaeus, 1758	30	1,2	1,2	1	2
20	*Sympetrum danae.* Selys, 1841	35	1	-	-	-
21	*S.vulgatum* Linnaeus, 1758	25	1	1	1	-
22	*S.flaveolum* Selys, 1841	34	1	1	1	1
23	*S.striolatum charp,* Charpentier, 1840	30	1	1	1	2
24	*S.meridıonale* Selys, 1841	32	2	1	-	2
	Ephemeroptera					
25	*Ephemera vulgata* Linnaeus, 1758	25	1,2	1	2	1
26	*Siphlonurus linneanus* Eaton, 1871	35	2	2	-	-
27	*Cloeon dipterum* (Linnaeus, 1758).	40	2	2	-	-
28	*Ordella macrura* Stephens, 1835	70	1,2	1,2	1,2	1
	Trichoptera					
29	*Ecnemus tenellus* Rambur, 1842	35	2	2	-	-
	Hemiptera					

30	*Corixa dentipes* (Thomson, 1869)	70	1,2	1,2	1,2	1
31	*C.affinis* Leach, 1817	65	1,2	1,2	1	1,2
32	*Notonecta glauca* Linnaeus, 1758	35	1	1	1	-
33	*N.lutea* Müller, 1776	35	1,2	1,2	1	1
34	*Hydrometra stagnorum* (Linnaeus, 1758)	40	2	-	1,2	-
	Coleoptera					
35	*Hydroporus planus* (Fabricius,1781)	35	1	1	2	1
36	*H.palustris* (Linnaeus, 1758)	30	1,2	1,2	1	-
	Diptera					
37	*Dixa dilatata* Stroff, 1900	*35*	*1*	*1,2*	*1,2*	-
38	*Chaoborus crystallinus* De Geer,1776	*30*	*1*	*2*	-	-
	Chironomidae				-	-
39	*Tanytarsus gregarius* Kieffer, 1918	*35*	*1*	*2*		
40	*T.lauterborni* Kieffer, 1919	*30*	*1*	*1*	*1*	*1*
41	*Cryptochironomus conjugens* Kieffer, 1918	*65*	*2*	*2*	*1*	*1*
42	*C.defectus* Kieffer, 1919	*30*	*1*	*1*	*1*	*1,2*
43	*Chironomus plumosus* Linnaeus, 1758	*75*	*1,2*	*1,2*	*1,2*	-
44	*Ch.thummi* Kieffer, 1918	*45*	*1,2*	*1,2*	*1,2*	*1,2*
45	*Limnochiromomus nervosus* Staeger, 1839	*35*	*1,2*	*2*	*1*	*2*
46	*Polypedilum nubeculosum* Meigen, 1818	*35*	*1,2*	*1,2*	*1,2*	-
47	*Pelopia villipennis* Kieffer, 1918	*35*	*2*	-	*1*	*2*
48	*Procladius ferrugineus* Kieffer, 1918	*70*	*1,2*	*1,2*	*1,2*	*1,2*
49	*Ablabesmyia lentiginosa* Fries, 1823	*30*	*2*	*2*	-	-
	Cerotopogonidae					
50	*Culicoides so. Nubeculosum* Meigen, 1818	*30*	*1,2*	*1,2*	*1,2*	*1,2*
	Total		*50*	*48*	*36*	*30*

Note: *The figure 1 in the Table indicates the species found in 2018, while the figure 2 shows the species found in 2019*

The following species are found in the macrozoobenthos of Davachy Harbour in almost all seasons. These include species such as *D.dorsalis, O.serpentina, T.tubifex, H.m.orientalis R.auricularia, P.planorbis, C.scitulum, C.pulchellum, A.grandis, S.metallica, L.depressa, E.vulgata, O.macrura, C.dentipes, C.affinis, N.lutea, H.fuscipes, P.lauterborni, C.conjugens, Ch.plumosus, Ch.thummi, P.nubeculosum, Procladius ferrugineus, Culicoides* sp.

Among the found species throughout the year, certain species such as *T.tubifex, H.m.orientalis, P.planorbis, C.affinis, N.lutea, C.conjugens, Ch plumosus, Ch.Thummi, P.nubeculosum, Pr.ferrugineus* are found more frequently and in greater numbers across the harbor. These species can also be called dominant or background species.

In the Davachy Port, the macrozoobenthos primarily develops in two biotopes: silt and aquatic vegetation. The silt biotope is dominated by oligochaete worms and several chironomid larvae species, including *C. conjugens, Ch. plumosus, Ch. thummi, P. ferrugineus*, and *Ablabesmyia* sp., as well as heleids such as *Culicoides* sp. The remaining species belong to the plant biotope (phytophilic biocenosis) and are found in small numbers throughout the port. However, in areas with high concentrations of hydrogen sulfide (H_2S), benthic organisms are either absent or extremely rare.

The total average annual biomass of macrozoobenthos in the port ranged from 0.650 to 1.28 g/m² in 2018-2019. In both years, invertebrates from eight major groups dominated the benthic community. The plant biotope stood out for its high density and diversity of benthic organisms.

Table 2. Seasonal dynamics of development of the main groups of macrozoobenthos in the port of Davachy in 2018-2019 (difference/g x m^2)

№	Seasons / Group	Spring	Summer	Autumn	Winter	Average
1	*Oligochaeta*	25 0,07	15/ 0,04	34/ 0,08	-	18/ 0,04

2	*Mollusca*	18 0,26	17 0,24	4 0,04	5 0,04	11 0,14
3	*Isopoda*	107 0,20	4 0,01	3 0,01	--	28 0,04
4	*Odonata*	16 0,08	16 0,06	-	36 0,12	17 0,05
5	*Ephemeroptera*	18 0,06	5 0,01	31 0,06	17 0,03	20 0,04
6	*Hemiptera*	21 0,05	18 0,04	12 0,03	2 0,01	13 0,06
7	*Chironomidae*	178 0,54	101 0,06	247 0,71	84 0,16	42 0,10
8	*Ceratopogonidae*	12 0,04	17 0,06	33 0,10	45 0,14	27 0,05
	Total:	395 1,28	197 0,52	364 1,03	189 0,50	176 0,48

Among the bottom fauna of the port, chironomid larvae were the most dominant, both in terms of average density (725 individuals per m² in 2018 and 49% of the total in 2019) and biomass (51% in 2018 and 37% in 2019). They were followed by dragonfly larvae (16–36 individuals), oligochaete worms (15–34 individuals), flat-cheeked crabs (3–107 individuals), and mayfly larvae (17–36 individuals). Mollusks contributed significantly to biomass, ranging from 0.104 to 0.24 g. The highest macrozoobenthos density was observed in the autumn-winter period of 2018 and the spring-autumn period of 2019, while the highest biomass was recorded in spring and winter of both years. This pattern aligns with the life cycles of key animal groups that form the foundation of the macrozoobenthos. During these seasons, chironomid larvae continue to dominate both in terms of abundance and biomass (Table 2). Overall, a clear trend has been observed in the seasonal dynamics of chironomid larvae, with their occurrence in the benthos gradually decreasing from winter to summer. This decline is linked to the developmental cycle of chironomids, which exhibit two distinct lifestyle strategies.

The saprobic organisms of the water of the Davachi port are variable. The main place is occupied by oligosaprobic organisms (Fig. 2).

The saprobic zones of macrozoobenthos in the Davachy were identified. Among the species found in the study area, Shamkirchay, 7 (7.8%) are α-mesosaprobic, 31 (34.07%) are β-mesosaprobic, 10 (11%) are x-xenosaprobic, and 43 (47%) are oligosaprobic organisms (Fig. 2).

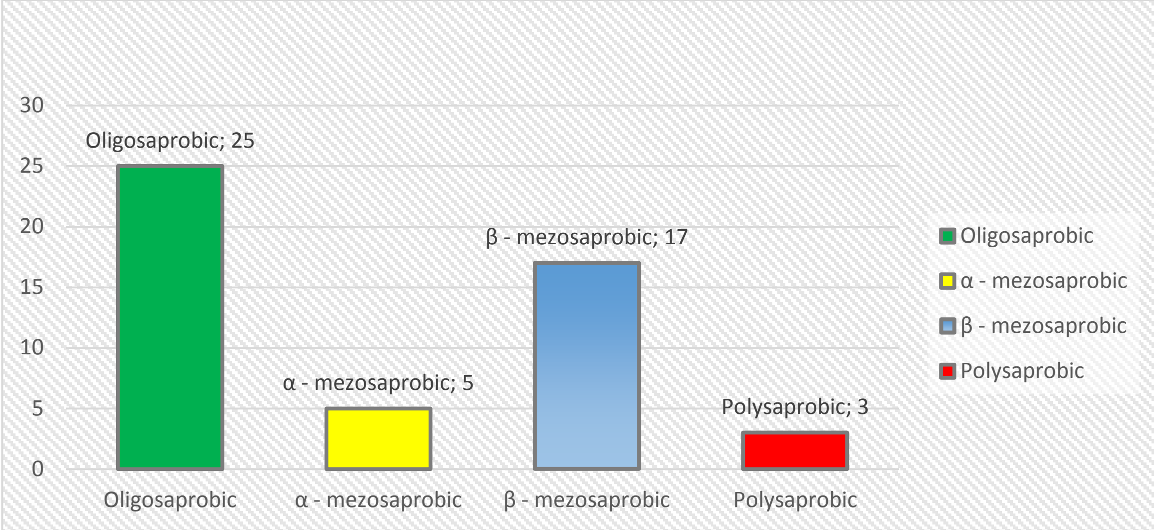

Fig. 2. Percentage ratio of saprobity of the organisms in the territory of Davacy Port

The chemical indicators of the studied rivers are provided in Table 3.

Table 3. Chemical indicators of the water of the studied rivers in 2019-2020

Rivers	**Indicators**					
	pH	**O_2**	**Cl**	**NO_2**	**NO_3**	**SO_4**
Station 1	7,9	8,1	78,2	0,02	3,5	119
Station 2	7,2	8,6	82,3	0,03	4,3	127
Station 3	7,8	9,02	89,7	0,02	3,8	133
Station 4	8,1	7,4	79,2	0,02	3,1	129
Station 5	7,2	7,9	84,4	0,01	2,9	127
Station 6	6,9	8,9	90,3	0,02	3,9	139
Station 7	8,2	8,6	67,5	0,02	4,2	131
Station 8	6,6	7,9	81,6	0,01	4,1	134
Station 9	7,1	8,1	78,7	0,01	3,91	132
Station 10	6,8	7,5	77,8	0,04	4,2	126

Certain species from various groups dominantly contribute to the formation of quantitiative indicators of macrozoobenthos in Davachy port, including: earthworms - *T.tubifex*, leeches - *H.medisinalis orientalis*, mollusks - *P.planorbis and Radix dympala auricularia*, flat-cheeked crabs - *A.aquaticus*, dragonfly larvae - *C.scitulum*, *S.metallica*, mayfly larvae - *O.macrura*, Hemptera - *C.dentipes*, *C.affini*, chironomid larvae *Ch.plumosus*, *Ch.thummi*, *P.nubeculosum*, *P.ferrugineus* etc.

4. Conclusion

The Davachy Port remains a significant habitat for macrozoobenthos, supporting a diverse array of invertebrate species. Seasonal and environmental factors continue to shape the composition and abundance of macrozoobenthos, with chironomid larvae playing a dominant role in the ecosystem. The findings contribute valuable insights into the ecological dynamics of the port, emphasizing the need for continued monitoring and conservation initiatives to sustain biodiversity in this critical aquatic environment.

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