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Temporal and Spatial Variation of Macrozoobenthos in the Chamkhale Estuary (South Caspian Sea)

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Abstract: The study has done on the joint month of the rivers, shalman rood and, Langrood khan, in the area of Chamkhaleh, Langrood in Gilan province (North of Iran). The study tried to find dispersion and determination of biomass macrozoobenthose though comparing them in different months and fresh water stations, at the month and sea stations. Ekman in six stations did sampling and the amount of organic deposition was examined. The results showed that biotaxa bentic groups are in this estuary including Lumbriculidae, Naididae, Gammaridae, Tubificide, Chironomidae, Ampharetidae, Enchytraeidae, Psudocumidae, Neroidae, Simulidae and Xanthidae. The dominant group in the Chamkhaleh estuary was Oligchaeta that is seen throughout the year and has the most abundance, Gammaridae, Ampharetidae families have the most abundance after oligochaete. The average concentration of biomass each year was 8.91 g/m^2, Lumbriculide was the most dominant biomass in winter with the average of 0.09±0.144 g/m^2, the smallest amount of it was in summer with the average of 0.053±079 g/m^2 and the smallest amount was in summer with the average of 0.013021 g /m^2. Gammaridae in summer was the greatest amount with the average of 0.053±0.086 g/m^2 and the smallest in winter with average of 0.049±0.041 g/m^2. Naididae was the largest amount in winter with average of 0.045±0.006 g/m^2 and the smallest amount of biomass in summer with the average of 0.099±0.008 g/m^2. Tubificidae was the largest amount in the winter with the average of 0.019±0.016 g/m^2 and the smallest amount in summer with the average of 0.005±0.002 g/m^2. Chironomidae was the largest amount of biomass in winter with average of 0.02±0.03 g/m^2 and the smallest amount in summer with the average of 0.004±0.003 g/m^2. From station (one) to the station (six) an increasing biological groups like Gammaridae, Pseudocumidae Nereidae are seen. Station (one) with total amount of 2.78 g/m^2 has the most biomass and station (three) with total amount of 1.25 g/m^2 has the least biomass. Kroscalvalice test showed that there is a meaningful different among the average biomass of oligochaeta group in different months and seasons. Total Percentage of organic matters (T.O.M) in different seasons has obvious changes, so that its average was 6.39% and the maximum of it is varied from 8.84% in winter to 4.70% in full. Based on the information it seemed that feeding if fish, the type of seabed, the amount of organic matters (T.O.M), water temperature pollution are of the most important factors about population and biomass of aqueous Invertebrates in the stations and different seasons.

Key words: Estuary · Benthos · Caspian Sea · Temporal · Spatial variation

INTRODUCTION

The analysis of macrofauna community structure has been an important tool in environmental monitoring programs [1-3]. However, the lack of knowledge about temporal variability of macrofauna is the major methodological limitation for environmental diagnose, which makes it difficult to distinguish between natural variability and eventual macrofauna response to human produced impacts [2,4]. This problem is aggravated in estuarine-lagoons systems, which are considered naturally stressed environments [5,6] due to their high variability and low previsibility of environmental conditions. Benthic organisms are the most common

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targets in biological assessments of environmental quality, because they are an important ecosystem component that provide a primary food source for many fish, birds, a mammals and affect sediment stability and geochemistry.

Estuaries are important marine ecosystems by maintaining the coastal biota, being one of the highly productive systems and serving as breeding and nursery grounds for a diverse array of organism [7,8]. In the estuaries, earlier studies have shown that the distributional patterns of macrobenthos are closely linked to environmental factors [4,9]. Macrozoobenthic communities are key components in the functioning of estuarine systems. Benthic organisms produce considerable changes in physical and chemical conditions of the sediment, especially in the water-sediment interface. They also promote the decomposition of organic matter, the nutrient recycling and the energy transfer to other links within the food web [10].

A large number of studies on the structure and dynamics of estuarine and coastal benthic assemblages have been conducted worldwide [11]. Benthic invertebrates are also commonly used in monitoring studies, since this group reflects anthropogenic impacts [12]. However, it is often difficult to distinguish between natural and anthropogenic changes. Benthic communities vary considerably according to environmental conditions and the majority of the species have highly aggregated small-scale distribution patterns induced especially by substrate type, sediment composition, salinity, food availability and predation [13]. Benthic macroinvertebrates play a crucial role in the functioning of estuarine ecosystems. For example, they are a major component of estuarine food webs and play an important role in nutrient cycling through their burrowing and feeding activities, i.e. bioturbation [14]. The enclosed Caspian Sea is the world's largest brackish water body, comprising nearly 40% of the earth's continental surface water [15,16]. One of the remarkable aspects of its fauna is the high level of endemism [16].

Among the 950 extant aquatic metazoan species recorded, 424 taxa are endemic or shared partly with the Black-Azov and Aral Seas [15, 17].

The Chamkhale estuary is one of the most important habitat in the south of Caspian Sea and it is home of several Strogen and bony fishes. In contrast to coastal and marine benthic habitats, information about temporal and spatial variability of macrofauna in shallow water area and estuaries of southern of Caspian Sea is scarce. Thus, in this work the temporal and spatial distribution pattern of macrofauna and its relation with variability of water and sediment characteristics were studied in shallow estuary of Caspian Sea.

MATERIAL AND METHODS

Study Area: Chamkhale estuary (Figure 1) at the mouth of the Chamkhale River is a shallow and tide less estuary on the southwest coast of Caspian Sea in the North of Iran. The estuary is characterized by a salinity gradient, which is caused by the dominance of freshwater riverine run-off. For sampling, six stations were selected from the offshore station about 2 km away from the shore with a depth of about 10 m and other 4 up to about 7 km upstream. Sampling was done monthly throughout the year (November 2005 to October 2006) at three substations.

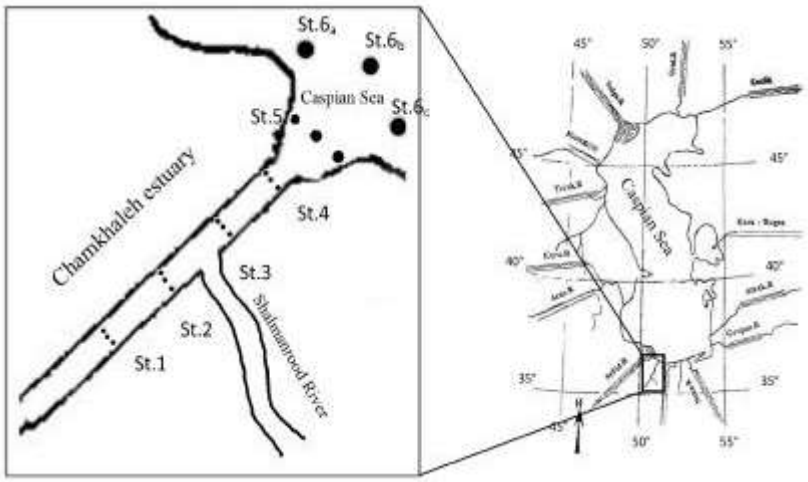

Fig 1: Sampling stations in the Chamkhaleh River estuary

At each sampling site, three replicates were collected with an Ekman grab (0.3 m^2), two for the benthic macrofaunal analysis and one for sediment characterization. In order to characterize the macrofaunal assemblages, sediment samples were sieved through a 500 µm mesh sieve and the individuals retained in the sieve preserved in 4% buffered formaldehyde. Macrobenthos were identified to the lowest possible taxonomic level, counted and wet weighed [16,18,19].

Dry sieving using the detailed description given by Gaudêncio *et al.*[20] performed the granulometric analysis. The sediment was classified according to the Wentworth scale (Buchanan, 1984) and characterized by its percentage of silt and clay (<63 lm), very fine sand (63-125 lm), fine sand (125-250 lm), medium sand (250-500 lm), coarse sand (500-1,000 lm), very coarse sand (1,000-2,000 lm), gravel (>2,000 lm) and by the median of grain size diameter. Total organic matter of the sediment was obtained by loss on ignition [21].

RESULTS

Water temperature showed a clear seasonal pattern (Figure 2) with the highest values registered in summer (June-August) and the lowest in winter (January to March). Water salinity had a less marked temporal pattern, with mean values ranging from 0.5 to 13ppt (Figure 3). The sediment was mainly composed by poorly sorted fine sand with fine fractions (i.e. silt + clay) ranging from 6 to 14% (Figure 4). However, an increase of fines fractions and, consequently a decrease in both, mean grain size and sorting of sediment during winter months (June to September) were observed (Figure 5). Sediment organic matter content ranged from 0.09 to 3.15% with the highest values registered in summer (Figure 6 & 7).

Biomass of the macrozoobenthos in the estuary shown in the figure 4. There are clear spatial patterns from station 1 to station 6 and higher macrofauna biomass were determined in the station 1.

In the present study, 12 taxa were indentified figure 5, Lumbriculidae, Nematoda, Gammaridae and Nereidae, were the main groups, Lumbriculidae is more than 59% of the species richness density and biomass. All dominant species showed a clear special and temporal variation during the period sampling.

Table 1: Means of number and biomass macrozoobenthos in the season and month in the Chamkhale estuary

Season	Mean N/m^2	Mean Biomass g/m^2	Month	N/m^2	Biomass g/m^2
Spring	351	2.14	April	362	1.034
			May	222	0.693
			Jun	468	4.711
Summer	150	0.37	July	355	0.818
			August	79	0.257
			September	14	0.044
Full	122	0.45	October	98	0.501
			November	148	0.436
			December	120	0.43
Winter	489	1.66	January	708	2.411
			February	489	1.582
			March	269	0.998

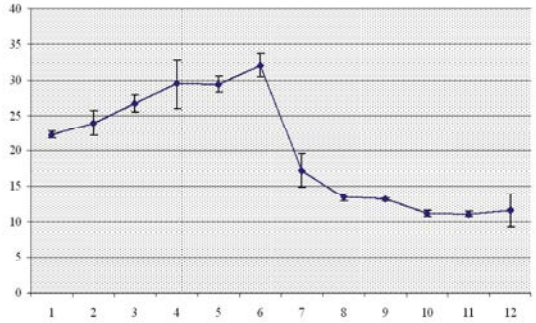

Fig. 2: Water temperature in the during one year in the Chamkhale estuary

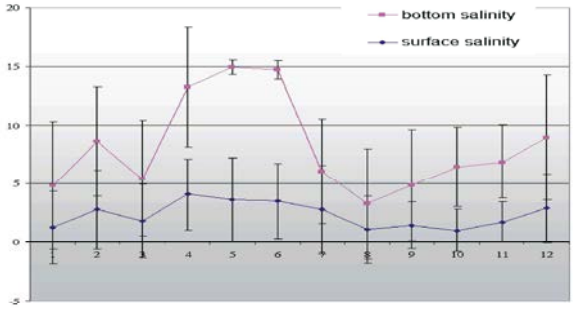

Fig. 3: Bottom and surface salinity during one year in Chamkhaleh estuary

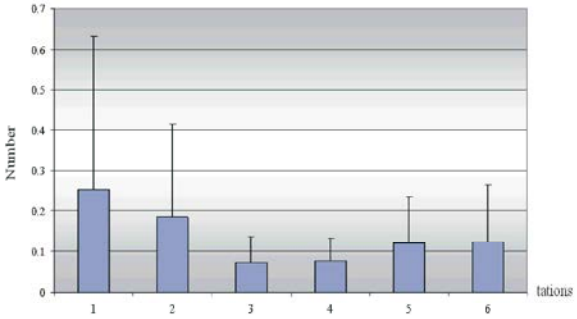

Fig. 4: Biomass of benthos (g/m^2) in the six stations in Chamkhaleh estuary

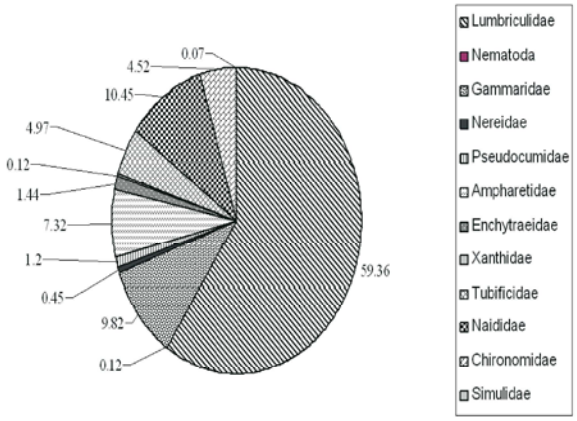

Fig. 5: Percentage of groups of benthos in the Chamkhale estuary

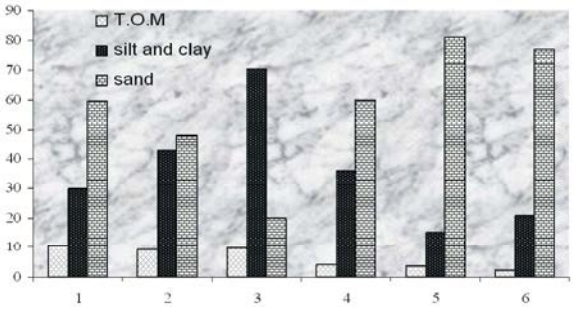

Fig. 6: percentage of T.O.M. silt, clay and sand in the 6 stations of Chamkhaleh estuary

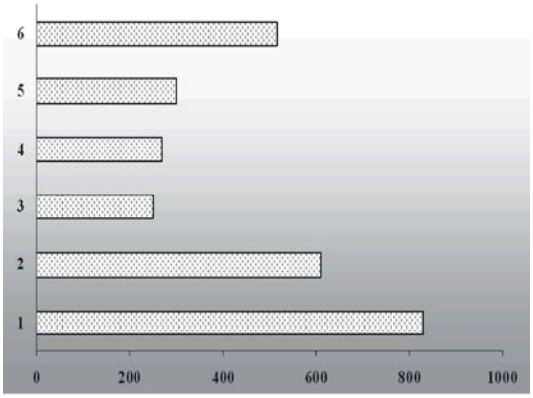

Fig. 7: Number of benthos in the 6 stations of Chamkhaleh estuary(ind/m2)

DISCUSSION

Both, water column and sediment proprieties showed clear seasonal patterns, characteristic of subtropical region. In Chamkhale, summer months with higher temperatures and lower precipitation rates favor marine water intrusion into the estuarine region resulting in higher salinity values, as observed in this study. In contrast, high precipitation during winter months increase runoff and lower salinity values are observed.

Climatic perturbations such as cold fronts are also frequently observed in the region during winter. During these situations, the increase of wind intensity changes the local hydrodynamics favoring the resuspension, transport and deposition of sediment in the completely estuarine. The Chamkhale estuary is about 5km from month to Freshwater, other estuary in the south of Caspian sea like Sefidrood estuary are non tidal estuary and its length is about 7 km [22].

Estuarine macrofauna also showed a clear seasonal pattern; strongly correlated with the temporal variability of both, water column and sediment characteristics. The higher macrobenthic densities observed in summer are related to recruitment processes, which in turn is influenced by the increase of temperature and salinity [23,24]. Sedimentary changes resultant of such climatic disturbances could have significant effects on macrofauna, especially on sedentary and superficial burrowing organisms [25,26].

This temporal pattern had already been registered for Patos Lagoon [23,24] as well as for other estuaries in south Atlantic (e.g. Mar Chiquita Estuary and Samborombon Bay [27]. Studies on temporal variability of this polychaete had shown the presence of juveniles along the entire year, suggesting the absence of a seasonal recruitment pattern [27].Additionally, the low frequency of H. similis individuals in the stomach content of the zoobenthophagic predators [28].

Estuarine macrofauna showed a marked seasonal pattern, strongly correlated to temporal change of water column and sedimentary proprieties. The highest predation effect during summer along with the absence of effective recruitment in warm months resulted in the low macrofauna densities observed during winter. Furthermore, sedimentary proprieties changes due to natural climatic disturbances might also be an important controlling factor of the estuarine macrofauna of the Chamkhaleh by increasing mortality rates.

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