Research Journal of Environmental Sciences

ISSN 1819-3412

Academic
Journals Inc.

www.academicjournals.com

Research Journal of Environmental Sciences 3 (5): 599-603, 2009
ISSN 1819-3412

Benthic Fauna and Water Quality in Southern Caspian Sea Estuary: A Case Study on Gorganrood River

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Abstract: The present research is a study on water quality and benthic macro invertebrate in Gorganrood River, a South Eastern Caspian Sea. The research was carried out at six sampling sites and the abundance and diversity of benthos were monitored along the length of river from 2007 to 2008. Fourteen families included under different groups such as Annelida, Mollusca and Insecta were recorded in the present investigation. The greatest number of species were recorded at 1st station and the least number was at 6th station. Low macro invertebrate abundance was observed during spring as a result of heavy rainfall and flood and generally in all lowest section because of high value of nitrogen and other nutrients. Water physicochemical parameters such as Phosphate, Nitrate, TPS and others were measured and water quality were studied through different indices such as saprobic system, Helsinhoff (FBI), BMWP and the results were compared and evaluated by physical and chemical parameters. The result indicated that the water quality in the up stream and the middle were good to fair, but the down stream qualities were poor at all sites.

Key words: Abundance, diversity, benthos, physicochemical parameters, Caspian Sea, coastal

INTRODUCTION

Gorganrood River is one of the most important river in the south east of Caspian sea. The River basin covers an area of 1019700 ha. About 41% of this area is covered by forests and 39% belongs to agriculture. One of the greatest environmental issues in this area is usage of pesticides and chemical fertilizer. Another important point of this area is existence of two dams along this river named Golestan and voshmgir. Several communities including people in urban and suburban are using water from the river not only for municipal usage but also for agricultural purposes. Thus, the present water qualities are getting lower than the acceptable levels. The problem might have been resulted from several factors, however, among other things, the pumping of untreated waste water from the urban community seems to be a primary source. The secondary source would be the untreated waste water from agricultural lands (High amount of pesticides and chemical fertilizer). Therefore, these problems cause direct effect to both water quality and aquatic ecology. The study of water quality of the river has been done by employing the abundance and diversity of benthic organisms as a mean. Due to the fact that, among the living fauna, benthos would be the least and slowest organisms (Covich and Palmer, 1999; Edgar *et al*., 1994) in addition, the quantity and type of benthos will differ from one site to the other depends on the quality of water of such site.

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Thus, the information obtained from this study can be used for planning not only in fishery activity but also in water resource management at present as well as in the future. Therefore, the objective of the present study consists several purposes, these include:

- Study the type and quality of the benthic fauna in Gorganrood River
- Compare the type and quantity of the benthic fauna among 6 sampling sites
- Study the indices of benthic fauna including saprobic system; Helsinhoff (FBI) and BMWP could be used as a tool for water quality indication

MATERIALS AND METHODS

Duration of Samples

This study carried out during April 2007 to March 2008. Sampling has been done in four different seasons.

Samples Collection

Ekman Grab and surber were used for benthos samples collection. The samples were passed through 500 mesh screen then kept the benthos in 70% ethylic Alcohol solution for identification by employing the procedure of Eleftheriou and Mclntyre (2005).

Bentic Indices: Saprobic System, Helsinhoff (FBI), BMWP

Saprobic Index was calculated from:

$$\int = \frac{\Sigma(s.h)}{\Sigma(h)}$$

Where:
$\int$ = Saprobic value of an area
s = Saprobic value of each specie
h = The abundance of each specie

Helsihoff (FBI) index was calculated from:

$$FBI = \frac{\Sigma[(TV_i)(n_i)]}{N}$$

Where:
Tv_i = Tolerance value for each specie
n_i = The number of each specie
N = Total number of specie (animal)

BMWP method was calculated through following codes:

Code	No. of each specie
1	Less than 2
2	3-10
3	11-100
4	More than 100

Water Samples Collection Analysis

- Water samples were collected from the middle depth of the river
- Measurement of water temperatures, pH, DO, salinity and transparency were evaluated immediately at each sites

Sampling Sites

Six sites in the Gorganrood river have been sampled, these include (1) Crenal, (2) Before dam, (3) After dam, (4) Gonbad, (5) Agh ghal and (6) Khajeh nafasx.

RESULTS AND DISCUSSION

Types and Quantities of Benthic Fauna

Three benthos phyla namely Annelida, Mollusc, Insecta were found and they were identified into 14 families.

The highest density or numbers of benthos belong to Diptera (chironomidae), oligocheata (tubificidae), Mollusca and Ephemeroptera. Highest densities of Ephemeroptera were observed in sites No. 1, 2, 3 and the others in site 4, 5, 6 (Table 2).

The lowest density or number of benthos were found, at site No. 5 in spring which were 28 per square meter and included under only one family (Table 1). This might be related to the fact that there was poor organic matter in the soil and the type is mainly sand which is not quite suitable for the growth of benthos (Rader and Belish, 1999).

The highest number of benthos were found at site No. 4 in summer which were 195 per square meter (Table 3).

The percentage of benthic fauna in different seasons and stations have been shown in Table 1 and 2.

The 1st station has the greatest number of species. In this station not only there aren't any pollutants, but also the river bed is stone which the best type for growth of benthos.

Another reason of high diversity and abundance of species in upper station is low depth and velocity of water (Cusson and Bourget, 2005; Mistri, 2002).

The species of Chironomidae were found in all stations during the year, because these species have high tolerance and found in all water from clean to highly polluted (Fore *et al*., 1996; Cognetti and Maltagliati, 2000).

Table 1: The percentage of benthic in length of year

Genus	Spring	Summer	Fall	Winter
	(%)			
Mullusca (Physidae, Planorbidae)	25	9	11	24
Diptera (Chironomidae)	35	23	50	35
Ephemeroptera (Baetidae, Heptagenidae)	16	22	28	21
Oligocheata (Tubificidae)	17	39	6	11
Others	11	7	5	9

Table 2: The percentage of dominating benthic in stations

Genus	ST.1	ST.2	ST.3	ST.4	ST.5	ST.6
	(%)					
Mullusca (Physidae)	42					
Diptera (Chironomidae)	5	8	21	32	83	48
Ephemeroptera (Baetidae, Heptagenidae)	43	92	59			
Amphipoda (Gammaridae)	5					
Crustacea (Mysidae)			20			
Mullusca (Planorbidae)				45		
Oligocheata (Tubificidae, Lumbricidae)				17	17	52
Others	5			6		

Table 3: Saprobic, FBI, BMWP index in different seasons and stations

Season and station	SAPROBIC	FBI	8MWP
Spring			
Carenal	1.63	3.71	51
Befor dam	1.70	4.18	20
After dam	1.90	4.44	20
Gonbad	2.57	5.18	25
Agh ghola	2.80	6.00	6
Khaje nafas	3.20	8.15	9
Summer			
Carenal	1.72	4.15	54
Befor dam	1.40	4.04	54
After dam	1.90	4.60	34
Gonbad	2.90	6.41	11
Agh ghola	3.10	7.20	10
Khaje nafas	3.30	8.30	10
Fall			
Carenal	1.43	3.72	54
Befor dam	1.40	4.23	37
After dam	1.75	4.16	14
Gonbad	2.25	5.45	27
Agh ghola	2.90	6.38	12
Khaje nafas	3.02	6.24	8
Winter			
Carenal	1.58	3.83	45
Befor dam	1.63	4.42	39
After dam	1.85	4.47	24
Gonbad	2.51	5.68	27
Agh ghola	2.80	6.00	6
Khaje nafas	3.20	7.00	9

In polluted water the number of species is very low, but these species often have high abundance, which is exactly observed in this research (Lillebo *et al*., 1999).

BMWP Saprobic System, FBI (Helssinhoff)

The result from saprobic system represents 1st, 2nd and 3rd station have good quality but the 4th, 5th and 6th stations are polluted. The same results have obtained through FBI methods (Table 3).

The most polluted site according to BMWP scoring system was site No. 5 in winter that was 6 and the highest score belongs to site No. 1 in summer and fall (Table 3).

Helsinhoff index shows that the best quality belongs to site No. 1 with the number of. And the most polluted site was site No. 6 in summer (with the number 8.3).

The same results were shown by saprobic index which means site No. 6 in summer had poor quality (s = 3.3).

That might be related to high amount of usage of pesticides and chemical fertilizers in agricultural lands along the river.

Water Quality

The results have shown water quality in upstream and middle stream were higher than water quality standard value (Nazarova and Semenov, 2004). They were very good to fair from site No. 1 to site No. 3. But the down stream quality was poor in all seasons (Site 4 to 6).

There are several reasons for low water quality in some sites. But pumping of untreated wastewater from urban community seems to be a primary source. And the secondary source would be the untreated waste water from agricultural lands (high amounts of pesticides and chemical fertilizer) the highest pollution was observed in summer when the velocity of river due to agriculture usage was at minimum level. Therefore, these problems cause direct effect on both water quality and benthic fauna.

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