ISSN 1996-0700

Asian Journal of Biotechnology

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Asian Journal of Biotechnology 1 (1): 20-28, 2009
ISSN 1996-0700

Study on the Effect of Sewage Pollutant of Bandar Imam Petrochemical Company on Benthic Macrofauna Community Mossa Creek Using Biodiversity Indices and Bioindicators

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Abstract: Macro benthoses are an important part of sea-bed fauna which include *Polycheata*, *Decapoda* and *Mollusca*. Some species of this group are considered as biological indicators for aquatic ecosystem. Macro benthos are mostly inhabitants without migration and they can be used as indexes of ecological crises related to water. In the present research, benthic community structure in Ghanam creek and region of Mossa creek, is located around BIPC sewage outlet were studied, eight station were selected and water and sediment samples were collected in two season warm (September) and cold (February). Result of research indicated that station of sewage outlet around had least species and higher organic matter, on the contrary, the station far from petrochemical industry (station located in Ghanam creek) activities had higher species diversity. Also, present study showed that Polychaetes, reference of pollution bioindicators had higher abundance. Consequently, macro benthic biodiversity relation with dissolved oxyqen and percentage of organic matter in the sediment.

Key words: Biodiversity, macrobenthos, Ghanam creek, dissolved oxygen, fauna

INTRODUCTION

Creeks usually considered as most complex and riches ecosystems in aquatic ecosystem and one of as important zones of environmental. Human activity increased in the ecosystems (example industries settlement or entrance of pollutant sewage of urban, industry or agriculture) to cause destroyed this ecosystem, because of high production of organic matter and provide a safety place for varied marines.

Mossa creek is a long canal with high depth, it is a tidal marine in Iran. The creek stretches almost 56 km along the North western of the Persian Gulf. It is connected with Mahshahr port and Shadegan watershed (largest watershed in Iran), width of creek on opening mouth is 37-40 km. Water depth on the west is 80 m and on the East decreased (5-18 m). Tidal wave in zone cause to water of creek mixed with Persian Gulf. Change of water quantity within seasons is 4 m.

It contains numerous sources of organic pollution including sewage outlet industries. The creek is of immense importance to zone for trading, commercial development and increase petrochemical industries.

However industry location in the area to cause huge volume entrance of industry and non-industry pollutans to this aqua ecosystem. In the present research, environmental condition in Ghanam creek (reference of un pollution creek) and region of Mossa creek, it is located around Bandar Iman Petrochemical Company (BIPC) sewage outlet (reference of pollution Maximum), were studied.

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Previous pollution survey in the Ghanam creek, performed by Nabavi and Savari (2002) and Mousavi *et al*. (2007) showed that, this area had moderate pollution load.

The objective of this study is to analyze the relationship between Macrobenthos with physicochemical parameter, percentage of organic matter and Grain Sediment Analyze (GSA) for determine pollution load. Bandar Imam Petrochemical Company is a very important manufacture in Iran, geographical situation and Entrance of sewage pollutant in to Mossa creek cause to increased concentration and severity. However a severity is performance for complete filtration of sewage base on environmental law. The company claimes, treatment of sewage absolutely perform. This present research were studied, is the sewage treatment or no? Is sewage effect on the environment (this research performed by using index and macro benthos)?

MATERIALS AND METHODS

Site Selection

Mossa creek is situated in North western Persian gulf (30° 21' until 30° 31', 48° 52' until 49° 15').

Bandar Iman Petrochemical located in North of Mossa creek, it is largest petrochemical company in Iran , this area is 450 ha (Kazemi, 2002). For the purpose of this study, the eight stations along Mossa creek were selected. Stations 1, 2 and 5 were situated in the earlier sewage outlet of BIPC, Stations 3 and 4 located in distance 500 m from sewage outlet and Stations 6, 7 and 8 located in Ghanam creek (Fig. 1). The creek was sampled on the 8th September 2007 and 8th February 2008.

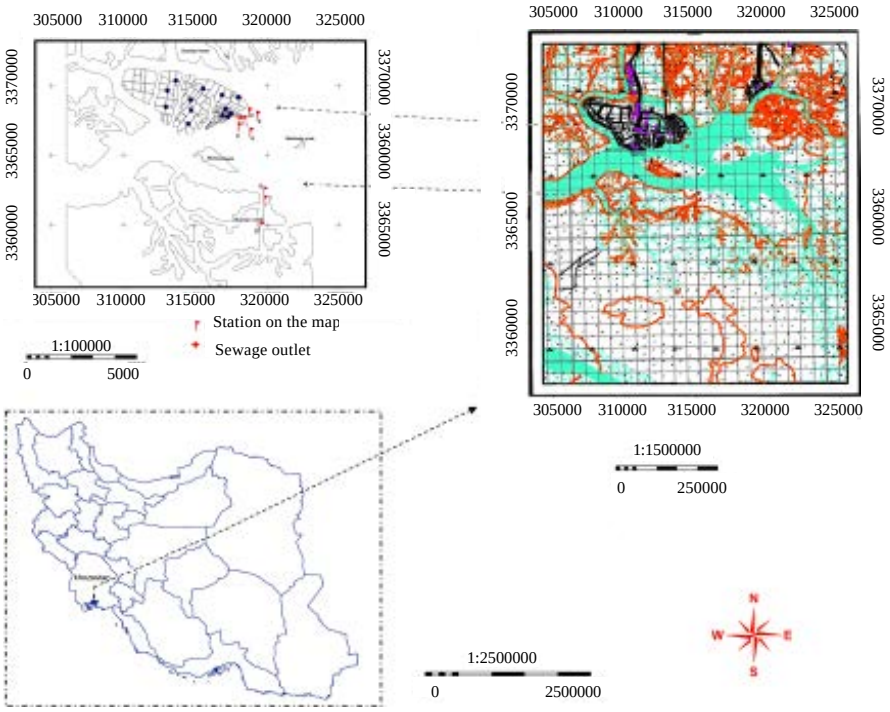

Fig. 1: Location of the Mossa creek and BIPC. The sampling stations are indicated

Water Sampling

Water samples were taken in 3 bottles from each station. Point samples in each station were determined with GPS. Samples were taken from water near the bottom of the creek with Nansen. The Dissolved Oxygen (DO) and temperature were measured inside by portable do-meter. pH and salinity were measured in laboratory.

Macrobenthos Sampling

Four grab samples were collected at eight stations with Van Veen grab of 0.025 m^2. Three of the samples were allocated to study the macrobenthic and fourth was used for sediment analysis. Samples for macro benthos were processed through a sieve with a mesh size of 0.5 mm and the retained fraction was fixed 5% formalin stained with Rose Bengal. Granulometry of the sediment was determined using Buchanan and Kain's (1984) method. The organic content was analyzed using Elwakeel Riley method.

Statistical Analysis

The total number of species, the Shannon- Weaver diversity index was calculated for each station by using MVSP software (Shannon and Weaver, 1963). Differences between stations were tested with one-way ANOVA and differences between seasons were tested with t-test after verifying normality using the Kolmogorov-Smirnov test (Zar, 1999). Correlation between diversity index and physicochemical parameters were calculated by Pearson test. Comparison between stations, season was performed by Duncan's post hoc test. The affinities among stations, based on the macro fauna species, were established trough cluster analysis, using UPGMA (un weighted pair group method using arithmetic averages), (Estacio *et al*., 1997; Guerra-Garcia and Garcia-Gomer, 2005).

RESULTS AND DISCUSSION

Physicochemical Parameters

Results of ANOVA showed that no difference between stations for purpose of temperature ($p = 0.985$), pH ($p = 0.425$) and percentage of organic mater ($p = 0.16$), also t-test analysis showed that no difference between seasons based on DO ($p = 0.435$) and percentage of organic matter variables ($p = 0.378$). The statistical analysis indicate that the oxygen dissolved and salinity was different between station ($p \leq 0.05$).The different between pH, temperature and salinity was significant ($p \leq 0.05$). All stations for cold and warm season were dominated by silty-clay (Fig. 2, 3). The cluster

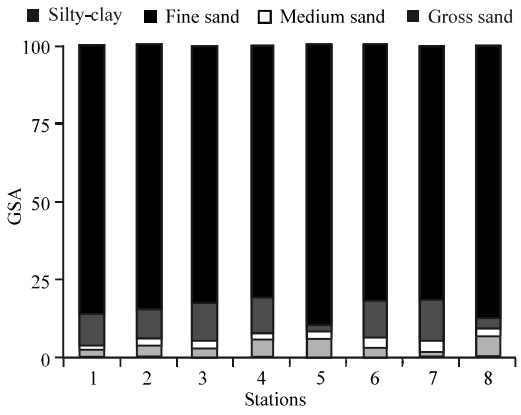

Fig. 2: Sediment granulometry measured in the eight station sampled in the warm season

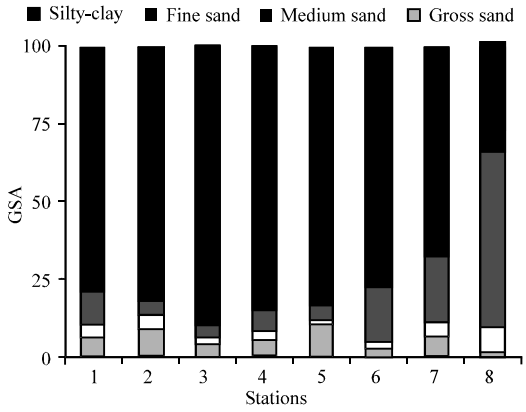

Fig. 3: Sediment granulometry measured in the eight station sampled in the cold season

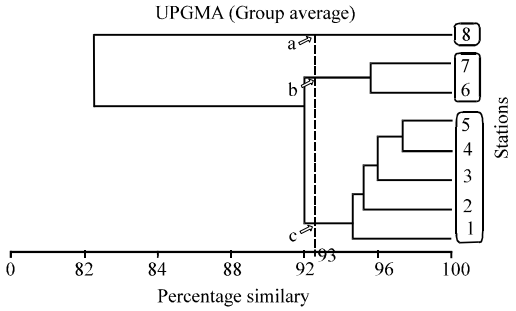

Fig. 4: Cluster analysis elaborated using the value of the physicochemical parameters measured in station

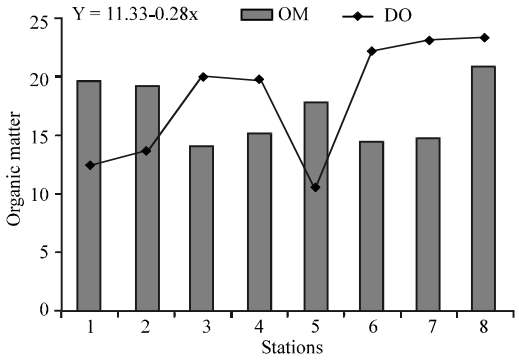

Fig. 5: Comparison between the dissolved oxygen (mg L^{-1}) and total Organic Matter (OM) in sediment (%) measured in stations, in the warm season

analysis approach between stations indicates that the physicochemical variables were different near and far from sewage outlet (Fig. 4).

Spearman analysis gives a correlation of -0.50 between oxygen concentration and organic matter (Fig. 5, 6). Also the correlation of 0.55 between changes in the total organic matter and percentages of silty-clay (Fig. 7, 8).

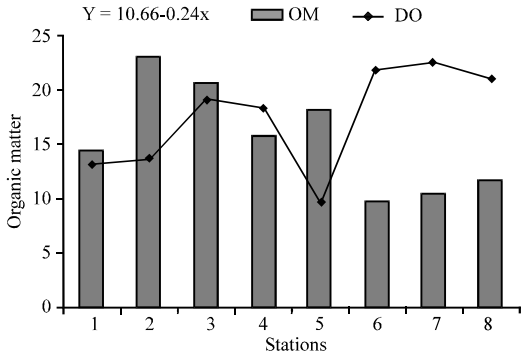

Fig. 6: Comparison between the dissolved oxygen (mg L^{-1}) and total Organic Matter (OM) in sediment (%) measured in stations, in the cold season

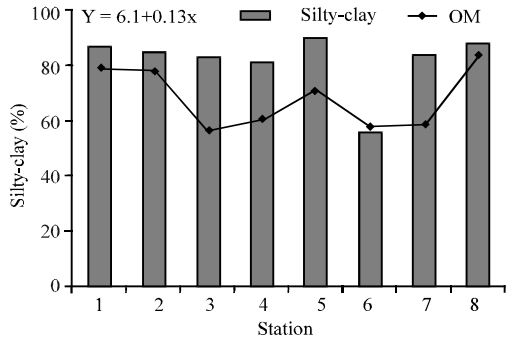

Fig. 7: Comparison between the total Organic Matter (OM) in sediment (%) and silty-clay grains (%) measured in the stations for warm season

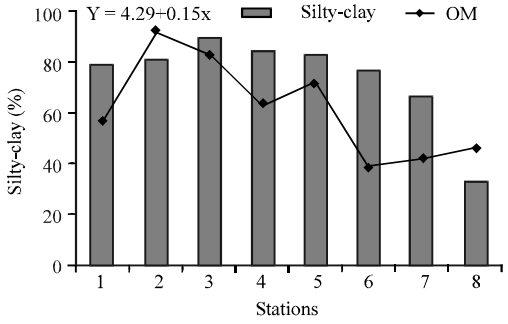

Fig. 8: Comparison between the total Organic Matter (OM) in sediment (%) and silty-clay grains (%) measured in the stations for cold season

Macro Benthos

Figure 9 shows condition of Shannon's index between stations. According to statistical analysis, difference between stations was significant ($p \leq 0.05$). Cluster analysis based on Shannon's index were able to discriminate between stations of near and far from sewage outlet (Fig. 10). The Polychaetes community was discriminating in the particular conditions (Fig. 11, 12).

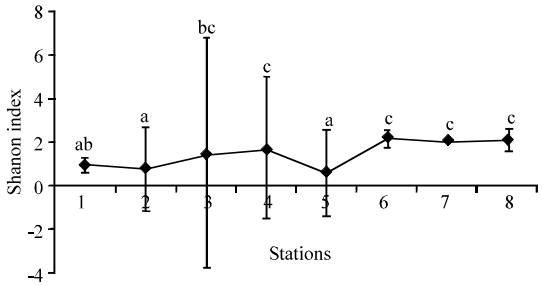

Fig. 9: Average of Shanon index condition in the station

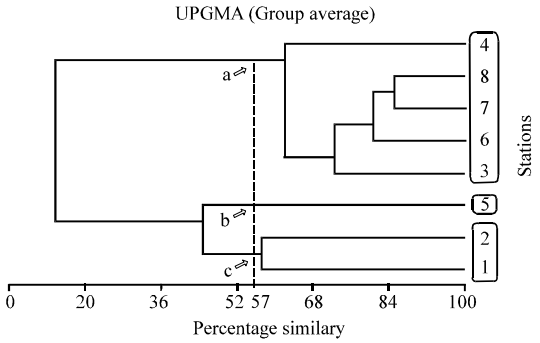

Fig. 10: Cluster analysis using the Shanon index in each station

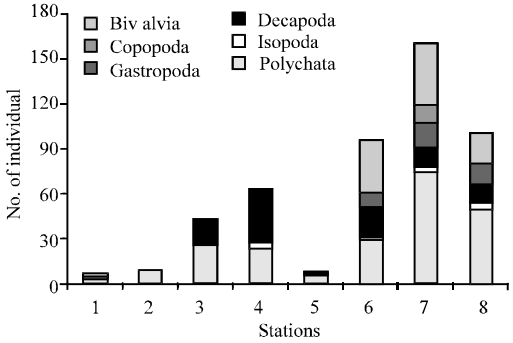

Fig. 11: No. of individuals in all stations for warm season

A Pearson analysis gives a correlation of 0.93 between of Shannon's index and combination DO (Fig. 13, 14).

BIPC located near the Mossa creek and entrance sewage outlet in to this aqua ecosystem. Sewage outlet to cause decrease dissolved oxygen, species diversity and increase percentage of organic matter in the neighboring stations of sewage outlet. Also according to Welch index, near stations sewage outlet to settle in class of high load pollution (Table 1, 2).

The results of this study show that organic pollution value increase in fine grain of sediment. Present results seem to support the review by Susana *et al.* (2006) (Fig. 2, 3). In the Mossa creek, Polychaetes turned out to be the best group to discriminate between all station. In most of the

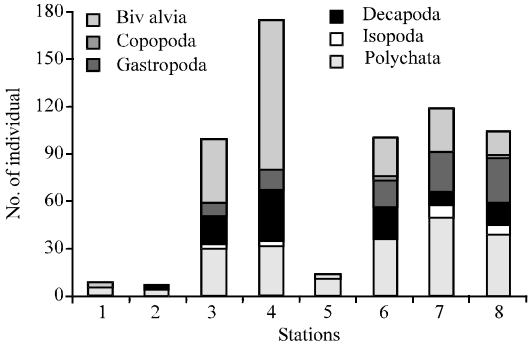

Fig. 12: No. of individuals in all station for cold season

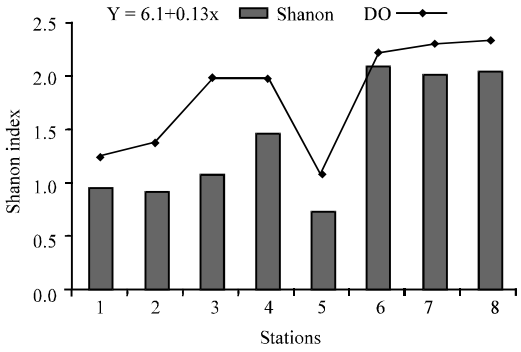

Fig. 13: Relation between the Shanon index and DO (mg L^{-1}) showed in the warm season

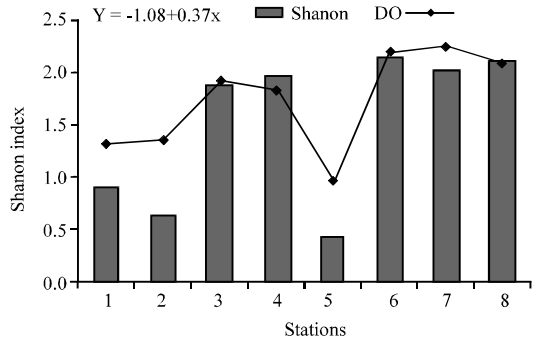

Fig. 14: Relation between the Shanon index and DO (mg $^{-1}$) showed in the cold season

studies, the Polychates were referee to marine pollution, especially to the lack of oxygen and usually discriminate among station better than other groups of Macro benthos (Susana *et al*., 2006, Guerra-Gareua and Garcia-Gomez, 2005). The results of this research indicated that macrobenthos diversity relate with dissolved oxygen end percentage of organic matter, the present study highlighted zones of high and low pollution impact on the macro benthic fauna. Generally, Macrobenthos assemblage decrease from the near sewage outlet, with the opposite pattern for dissolved oxygen, which has led to an increase of macrobenthos in the Ghanam creek.

Table 1: Welch index (1992)

Class of water quality	Welch index
High pollution	3-5
Moderate pollution	1-3
Unpollution water	<1

Table 2: Condition of stations according to Welch index

Class of water quality	Stations
High pollution	1,2 and 5
Moderate pollution	3, 4, 6, 7 and 8

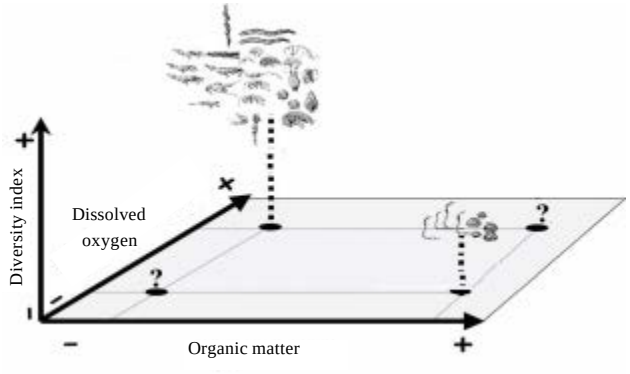

Fig. 15: Schematic model indicating the diversity index under different level of organic matter and dissolved oxygen

Abu-Hilal (1994), Hassan *et al*. (1995) and EL-Sammak (2001) established that high level of organic pollution in Dubai creek to cause decrease dissolved oxygen and macro benthos diversity. Johansson (1997), Flemer (1999) and Wu (2002) to explained that, in response to decreasing oxygen concentration, species richness and diversity both decrease and the species composition is largely determined by the tolerance to oxygen deficiency. The adverse biological effects on soft bottom communities are mainly due to reduced oxygen content of the water (Saiz-Salinaz, 1997). However, the interpretation of stress due to low dissolved oxygen is difficult because there is a lack of information about oxygen tolerances for most macro benthic species (Dauer *et al*., 1993). Consequently, the importance of oxygen in water column and percentage of organic matter in sediment as key factors for macro faunal assemblage in sediment is well known. Figure 15 summarizes possible outcomes under different levels of organic matter and dissolved oxygen.

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