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ASSESSMENT OF POLLUTION STATUS THROUGH THE DIVERSITY OF INTERTIDAL MACROBENTHOS OF THE ESTUARY OF BHAYANDER AND NAIGAON, THANE, MAHARASHTRA, INDIA

Zoology

KEYWORDS: Macrobenthos, Bhayander, Naigaon, Shannon's Index, Margalef Index, Estuary.

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ABSTRACT

Benthos due to their differential tolerance has been considered as the best indicator organisms of environmental stress or aquatic pollution. The present investigation was undertaken from May 2008 to June 2009 with the objective of understanding the pollution status of Bhayander and Naigaon estuary based on the diversity of intertidal Macrobenthos. In the present study 25 species of Macrobenthos belonging to 4 Phylum's have been identified at both the Station No.1 Bhayander and Station No.2 Naigaon. The mean Shannon Wiener Diversity Index for Macrobenthos for Station No 1. Bhayander and Station No. 2 Naigaon was 3.15 ± 0.03 and 3.20 ± 0.02 respectively. The mean Margalef Species Diversity Index for Macrobenthos for Station No. 1 Bhayander and Station No. 2 Naigaon was 2.50 ± 0.03 and 2.51 ± 0.03 respectively. The present study on benthos has revealed that at both the Station No. 1 Bhayander and Station No. 2 Naigaon there is slight or moderate pollution according to Staub et. al. (1970) scale of pollution in terms of Shannon's species diversity index and Margalef species diversity index for Macrobenthos.

INTRODUCTION

The studies of benthic animals and communities have gained importance with the increasing realization of the significant role they play in the trophic cycle. (Pillai 1977) The term benthos is widely referred to flora and fauna which are intimately associated with sediments in an aquatic environment. They support a rich variety of floral and faunal assemblage of marine bottom communities, viz., bacteria to vertebrates. Their distribution in the marine environment starts from intertidal zone to deep sea. The benthos are mainly divided into 1) Macrobenthos and 2) Meiobenthos. The Macrobenthos comprises the larger, more visible, benthic organisms that are greater than 1 mm in size. While Meiobenthos comprises tiny benthic organisms that are less than 1 mm but greater than 0.1 mm in size. Benthos plays a vital role in the marine food chain and in the recycling of essential life sustaining elements like Carbon, Nitrogen and Phosphorus in the marine ecosystem. (Pillai 1977)

The benthic ecosystem of coral reefs, mangroves and intertidal mud flats serves as a good feeding, breeding, spawning and nursery grounds for many marine organisms of economical importance, variety of migratory birds, fishes, sea mammals and reptiles. Benthos due to their differential tolerance has been considered as the best indicator organisms of environmental stress or aquatic pollution. (Pillai N. K., 1990)

Benthic fauna have a great potential to indirectly control the fate and subsequent bioavailability of sedimentary contaminants in their immediate environment (Sandens et. al. 2000)

According to Duda et. al. (1982), macrobenthos play an important role in the food chain either at secondary level as feeders of detritus and plant matter or at tertiary level as food for predators like crabs and fishes. Macrobenthic fauna prey on all lower forms of life and help to process organic matter helping nutrient recycling in the energy cycle of benthic ecosystem. (Pawar et. al. 2007)

Pawar et. al. 2007 also investigated the diversity indices of selected macrobenthos of Karanja creek (District – Raigad) Maharashtra, West coast of India. They revealed that Karanja creek harbours varied forms of macrobenthic community showing no effect of human disturbance.

Since studies pertaining to assessment of pollution status through the macrobenthos diversity are not available much in India thus the present investigation was undertaken with the objective of assessing the pollution status of Bhayander and Naigaon through the same.

MATERIAL AND METHODS

The collection of macrobenthos was done on monthly basis from 10cm depth surface soil using a 10cm x 10cm metal scoop corer. 5 scoops were randomly collected and were pooled together. 15 ml of 10% MgCl2 was used to narcotize the macrofaunal organism in the soil sample and to prevent their fragmentation while sieving. The sediment collected was drained through a sieve of mesh size 0.425mm then the fauna collected on the sieve was preserved in 10% formalin which was prepared in the filtered estuarine water. The individuals were identified to the lowest possible taxon and then the dominant taxa was determined. (Ansari Z. A. and M. V. Gauns, 1996)

In the present study the Macrobenthos monthly density variation in the soil samples of Station No. 1 Bhayander and Station No. 2 Naigaon were being analyzed and then the Shannon-Wiener Diversity Index, H, is calculated using the equation $H = -\sum Pi\ (\ln Pi)$ where Pi is the proportion of each species in the sample. Also the Species Diversity is calculated using the Margalef method where D is calculated as D = (S – 1) / Loge N, where S = number of species, N = total number of individuals.

Staub et. al. (1970) has proposed a scale of pollution in terms of Shannon's species diversity Index that is being used to determine the water pollution status of the overall estuarine area of Bhayander and Naigaon.

Shannon's Index	Water Quality
Shannon's Index 3.0 to 4.5	Slight Pollution.
Shannon's Index 2.0 to 3.0	Light Pollution.
Shannon's Index 1.0 to 2.0	Moderate Pollution.
Shannon's Index 0.0 to 1.0	Heavy Pollution.

Also the Margalef biodiversity index is used to assess the water quality. The Margalef biodiversity index is widely used in evaluating the water pollution. It can more objectively reflect the degree of water pollution and its trends. The following table gives the relationship between the Margalef index and water quality. (You Jia et. al. 2007)

Margalef Index (D)	Water Quality
0 – 1	More Serious Pollution.
1 – 2	Serious Pollution.
2 – 4	Moderate Pollution.
4 – 6	Light Pollution.
> 6	Clean water

Study Area

The present study was carried out at two stations Bhayander and

Naigaon respectively.

Station 1: The first station at Bhayander is located 190 19' N and 720 51' E. (Google Earth 2008) The Bhayander is geographically surrounded by sea from the West side, by the estuary from the north side and by open and occupied land from the south and east side. The estuarine water is mainly from the buffering of Ulhas River with the Arabian sea which amalgamates its water in the Thane creek and Vasai creek.

Station 2: The second station Naigaon is located 190 20' N and 720 51' E. (Google Earth 2008) Naigaon is a small town in the Thane District of the Maharashtra state and situated diagonally opposite to Bhayander on the another side of the estuary. The approximate distance between Bhayander and Naigaon is about 5 Km.

RESULTS

Table No. 1: The Shannon - Wiener Diversity Index and Margalef Species Diversity Index for the Macrobenthos of the Station No.1 Bhayander from June 2008 to May 2009.

Month	Shannon - Wiener Diversity Index (H)	Margalef Species Diversity Index (D)
June 2008	3.09	2.54
July 2008	3.10	2.49
August 2008	3.14	2.47
September 2008	3.16	2.45
October 2008	3.14	2.46
November 2008	3.13	2.49
December 2008	3.14	2.51
January 2009	3.14	2.51
February 2009	3.15	2.52
March 2009	3.19	2.52
April 2009	3.18	2.53
May 2009	3.21	2.53
Maximum	3.21	2.54
Minimum	3.09	2.45
Mean	3.15	2.50
Standard deviation	0.03	0.03

Table No. 2: The Shannon - Wiener Diversity Index and Margalef Species Diversity Index for the Macrobenthos of the Station No.2 Naigaon from June 2008 to May 2009.

Month	Shannon - Wiener Diversity Index (H)	Margalef Species Diversity Index (D)
June 2008	3.16	2.54
July 2008	3.17	2.52
August 2008	3.19	2.50
September 2008	**3.21**	**2.48**
October 2008	**3.20**	**2.47**
November 2008	**3.21**	**2.47**
December 2008	**3.18**	**2.50**
January 2009	**3.19**	**2.50**
February 2009	**3.21**	**2.52**
March 2009	**3.21**	**2.54**
April 2009	**3.22**	**2.53**
May 2009	**3.23**	**2.54**
Maximum	**3.23**	**2.54**
Minimum	**3.16**	**2.47**
Mean	**3.20**	**2.51**
Standard deviation	**0.02**	**0.03**

Table No. 3: Pollution Analysis of Station No.1 Bhayander and Station No.2 Naigaon based on the Staub et. al. scale of pollution in terms of species diversity index for Macrobenthos.

Shannon's Index	Pollution Level	Mean Shannon index of Station No. 1 Bhayander	Pollution level of Station No.1 Bhayander	Mean Shannon index of Station No. 2 Naigaon	Pollution level of Station No. 2 Naigaon	Pollution level of Overall Estuarine area of Bhayander and Naigaon
Shannon's Index 3.0 to 4.5	Slight Pollution.	3.15	Slight Pollution	3.20	Slight Pollution	Slight Pollution
Shannon's Index 2.0 to 3.0	Light Pollution.					
Shannon's Index 1.0 to 2.0	Moderate Pollution.					
Shannon's Index 0.0 to 1.0	Heavy Pollution.					

Table No. 4: Water Quality Analysis of Station No.1 Bhayander and Station No.2 Naigaon based on the Margalef species diversity index for Macrobenthos.

Margalef species diversity index	Water Quality	Mean Margalef index of Station No. 1 Bhayander	Water Quality of Station No.1 Bhayander	Mean Margalef index of Station No. 2 Naigaon	Water Quality of Station No. 2 Naigaon	Water Quality of Overall Estuarine area of Bhayander and Naigaon
0 – 1	More Serious Pollution.	2.50	Moderate Pollution	2.51	Moderate Pollution	Moderate Pollution
1 – 2	Serious Pollution.					
2 – 4	Moderate Pollution.					

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4 – 6	Light Polluti on.					
> 6	Clean water					

DISCUSSION

The sediments at both the stations Bhayander and Naigaon were clayey – slit type rich in organic Carbon that exceeded the limits of unpolluted sediments. Bi Hongsheng and Feng Wei (1996) revealed that the diversity in sediment slit – clay is higher than the homogenous sediment of silt. Samidurai K. et. al. (2012) deals with the spatial distribution and diversity of macrobenthos in different mangrove habitats of Tamil Nadu, India during different seasons in 2008. They recorded 31 species including 16 species of polychaets, 6 species of bivalve, 7 species of gastropods and 2 species of crustaceans.

Thilagavathi B. et. al. (2013) deals with spatial distribution and diversity of macrobenthos in different mangrove habitats of Tamil Nadu, India during different seasons of the year 2011. The macrobenthos in Bhayander and Naigaon estuary comprised of 25 species belonging to 4 phylum's. The Population and Biomass of Macrobenthos were highest during the Postmonsoon season with a gradual decrease in the Premonsoon and Monsoon season were seen at both the Station No.1 Bhayander and Station No.2 Naigaon.

Dahanayaka D and Wijeyaratne M. (2010) recorded 76 species of benthic invertebrates belonging to 41 families at Negombo estuary, Sri Lanka. They have also revealed that gastropods were the most abundant apart from the polychaetes and amphipods. Similar type was observed at Bhayander and Naigaon estuary of Thane, although the number of species was much less.

Pawar P. R. and Kulkarni B. G. (2007) revealed that various diversity indices like Shannon's index of general diversity and Margalef's richness index did not vary significantly in Karanja creek of district Raigad.

Thilagavathi, B. et. al. (2013) revealed that in different mangrove ecosystems of Tamil Nadu coast, India, the benthic faunal assemblages, macrofauna density, richness, eveness and Shannon – Wiener index were the highest.

The mean Shannon Wiener Diversity Index for Macrobenthos for Station No 1. Bhayander and Station No. 2 Naigaon was 3.15 ± 0.03 and 3.20 ± 0.02 respectively. (Table 1 & 2) The mean Margalef Species Diversity Index for Macrobenthos for Station No.1 Bhayander and Station No.2 Naigaon was 2.50 ± 0.03 and 2.51 ± 0.03 respectively. (Table 1 & 2) The present study on benthos has revealed that at both the Station No. 1 Bhayander and Station No. 2 Naigaon there is slight or moderate pollution (Table 1, 2, 3 and 4) according to Staub et. al. (1970) scale of pollution in terms of Shannon's species diversity index and Margalef species diversity index for Macrobenthos.

Although at present Bhayander and Naigaon estuary harbours varied forms of macrobenthic community with no effect of human disturbance. But in future, measures must be taken for the protection and conservation of macrobenthic community of the estuary.

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