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Assessment of Pollution Status Through the Diversity of Intertidal Meiobenthos of the Estuary of Bhayander and Naigaon, Thane, Maharashtra, India

Zoology

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

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ABSTRACT

The diversity of intertidal Meiobenthos from estuary of Bhayander and Naigaon of Thane district were studied from May 2008 to June 2009. In the present investigation, total twenty three species belonging to 8 Phylum were observed at Station No. 1 Bhayander and Station No. 2 Naigaon. The mean Shannon Wiener Diversity Index for Meiobenthos for Station No. 1 Bhayander and Station No. 2 Naigaon was 3.02 ± 0.04 and 3.03 ± 0.05 respectively. The mean Margalef Species Diversity Index for Meiobenthos for Station No. 1 Bhayander and Station No. 2 Naigaon was 2.05 ± 0.06 and 2.06 ± 0.07 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. scale of pollution in terms of Shannon's species diversity index and Margalef species diversity index for Meiobenthos.

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)

Estuarine intertidal habitat harbour rich meiofaunal communities which in turn serve as live food for higher trophic levels. (Ingole et. al., 1998) Meiobenthos are known to be sensitive indicators of environmental perturbation. Because of their large numbers, relatively stationary life habits, short generation times and intimate association with sediments they are known to accumulate various contaminants. (Wells et. al., 1981)

Diversity studies on meiofauna indicated occurrence of 40,000 species. (Giere Olav, 2009) Based on the nature of sand and other physicochemical factors (Gray, 2002) variations are observed in the meiofaunal composition in different beaches. (Rodriguez et. al., 2003) In India, published reports on Meiobenthos diversity are limited and available studies are either from west coast (Ingole et. al., 1990, Ansari and Gauns, 1996) Lakshadweep islands (Rao and Misra, 1983), Andaman and Nicodar. (Rao, 1993) Such studies on the east coast of India are comparatively less.

Since such studies are not available in India, the present investigation was undertaken with the objective of assessing the pollution status of Bhayander and Naigaon estuary through the diversity of intertidal Meiobenthos.

MATERIAL AND METHODS

Surface soil samples (10cm depth) was collected every month from below the mangrove tree at High Level Water mark (HLWM) using a metal scoop (10cm x 10cm) corer and was fixed in 1:500 Rose Bengal formalin and was preserved in a plastic container. The sample was passed through two sieves, first through 0.5mm followed by 62 micrometer sieve so as to separate the macrobenthos and then to collect the meiobenthos. The meiobenthos collected was preserved in 10% formalin and was observed under microscope and then the groupwise sorting and counting of meiofauna was done. (Giere Olav 2009), (Higgins R. P. and Thiel H., 1988)

In the present study the Meiobenthos 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 $H = -\Sigma P_i (\ln P_i)$ where P_i is the proportion of each species in the sample. Also the Species Diversity is calculated using the Margalef method where D is calculated as $D = (S - 1) / \text{Log}_e N$, 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. (Staub et. al., 1970)

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 19^0 19′ N and 72^0 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

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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 19^0 20′ N and 72^0 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 Meiobenthos 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	2.98	2.09
July 2008	2.96	1.95
August 2008	2.96	2.00
September 2008	3.00	2.19
October 2008	2.99	2.03
November 2008	3.02	2.09
December 2008	3.06	2.06
January 2009	3.06	2.06
February 2009	3.06	2.03
March 2009	3.05	2.02
April 2009	3.05	2.02
May 2009	3.06	2.01
Maximum	3.06	2.19
Minimum	2.96	1.95
Mean	3.02	2.05
Standard deviation	0.04	0.06

Table No. 2: The Shannon - Wiener Diversity Index and Margalef Species Diversity Index for the Meiobenthos 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	3.03	2.07
July 2008	3.02	2.03
August 2008	2.96	1.99
September 2008	2.90	2.13
October 2008	3.00	2.20
November 2008	3.04	2.13
December 2008	3.06	2.09
January 2009	3.07	2.06
February 2009	3.06	2.03
March 2009	3.07	2.01
April 2009	3.06	2.00
May 2009	3.05	1.99
Maximum	3.07	2.20
Minimum	2.9	1.99
Mean	3.03	2.06
Standard deviation	0.05	0.07

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 Meiobenthos.

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.	**3.02**	**Slight Pollution**	**3.03**	**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 Meiobenthos.

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.	**2.05**	**Moderate Pollution**	**2.06**	**Moderate Pollution**	**Moderate Pollution**
1 – 2	Serious Pollution.					
2 – 4	Moderate Pollution.					
4 – 6	Light Pollution.					
> 6	Clean water					

DISCUSSION

In the present study total 23 species of Meiobenthos belonging to 8 Phylum were observed from both the Station No. 1 Bhayander and Station No. 2 Naigaon. The mean Shannon Wiener Diversity Index for Meiobenthos for Station No. 1 Bhayander and Station No.2 Naigaon was 3.02 ± 0.04 and 3.03 ± 0.05 respectively. (Table 1 and 2) The mean Margalef Species Diversity Index for Meiobenthos for Station No. 1 Bhayander and Station No. 2 Naigaon was 2.05 ± 0.06 and 2.06 ± 0.07 respectively. (Table 1 and 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 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 Meiobenthos. In these perspectives, it is also noted that well planned programmes like the mass awareness programmes such as total ban on plastic and reclamation of land on eco – development and campaigns for protection of these benthos are needed for their conservation.

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