Research Paper

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Study of Pollution Index in A Stretch of Estuarine Area of Bhayander and Naigaon, Thane, Maharashtra, India

Zoology

KEYWORDS : Phytoplankton, Shannon's Index, Cyclotella, Ditylum, Gyrosigma, Navicula.

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ABSTRACT

The present study revealed the species diversity of phytoplankton and pollution status in the estuarine waters along the area of Bhayander and Naigaon. In the present investigation, total 42 species of Phytoplankton belonging to 5 families were observed at Station No.1 Bhayander and Station No.2 Naigaon. The mean Shannon Wiener diversity index for Phytoplankton at Station No.1 Bhayander and Station No.2 Naigaon were 3.50 ± 0.13 and 3.53 ± 0.15 respectively. Whereas the Margalef Species Diversity Index for Station No.1 Bhayander and Station No.2 Naigaon were 3.15 ± 0.11 and 3.12 ± 0.16 respectively. The Staub et.al. scale of pollution in terms of species diversity index for Phytoplankton revealed slight pollution for both the Stations under study.

INTRODUCTION

Estuaries are tidally influenced ecological systems where rivers meet the sea and freshwater mixes with seawater. Estuaries also form crucial transition zones between land and water that provide unique biological and geological functions like, they provide habitat to varieties of micro and macro organisms; nurseries to many marine organisms including commercially valuable fish species; filtration of nutrition and sediments from upland, flood control, etc. (Sreedharan T. P. 2002).

Inshore waters of Mumbai and region around, particularly Versova creek, Mahim creek, Ulhas estuary, Thane creek and Patalganga estuary are the examples of highly degraded environment because of anthropogenic perturbations. Several other inshore waters also reveal varying degrees of ecological deterioration and have drastically reduced the population of plankton and fishes. It has also caused considerable ecological imbalance and resulted in large-scale disappearance of their flora and fauna. Further, introduction of untreated municipal waste-water and industrial effluents into these water bodies leads to serious water pollution including heavy metal pollution, which gets biomagnified and reaches man through food-chain implications. (S. Baskara Sanjeevi et. al. 2004)

The Phytoplankton has great significance in the biology of the estuary as they provide the principal source of primary nourishment. The Phytoplankton constitute 95% of the total marine production, so they form a vital source of energy of the first tropical tier and also serve as a direct source of food to several aquatic animals. They form an important link between the abiotic factors and the biota in the aquatic ecosystem. (Saha, 2000) In India, studies on marine Phytoplankton systematics, species composition, distribution and productivity in relation to environmental parameters were carried out by Gopinathan in 1975 from both the east and west coast.

Throughout the history of mankind estuaries have been the sources of food and depository of waste materials. Information on the nature and diversity of primary producers and their influence on production potential are of great importance in view of the urgent need to assess the impact of anthropogenic activities on the estuarine ecosystems. Several phytoplankton species have served as bioindicators and it is a well suited tool for understanding water pollution studies. If the phytoplankton population of the estuarine ecosystem is harmed because of any anthropogenic activity then directly the zooplankton population of the same estuarine ecosystem will also be at risk because the phytoplankton are a source of food for the zooplankton. (Ritakumari S. D. et. al., 2007) Phytoplankton of coastal water bodies have been studied by various workers like Santhanam et. al. (1975), Mani (1992), De et. al. (1994), Ramaiah and Ramaiah (1998).

The present study revealed the species diversity of phytoplankton and pollution status in the estuarine waters along the area of Bhayander and Naigaon.

MATERIAL AND METHODS

In the present study Phytoplankton monthly density variation in the water samples of Station No. 1 Bhayander and Station No. 2 Naigaon is being analyzed between (June 2008 to May 2009) and then the Shannon-Wiener Diversity Index, H, is calculated using the equation $H = -\sum P_i (\ln P_i)$ 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) proposed a different scale of pollution in terms of species diversity index that is being used to determine the pollution status of the overall estuarine area of Bhayander and Naigaon.

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.

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 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 1 The Shannon - Wiener Diversity Index and Margalef Species Diversity Index for the Phytoplankton 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	3.36	3.13
July 2008	3.37	3.07
August 2008	3.27	2.86
September 2008	3.30	3.10
October 2008	3.54	3.27
November 2008	3.57	3.28
December 2008	3.61	3.26
January 2009	3.61	3.24
February 2009	3.58	3.21
March 2009	3.60	3.17
April 2009	3.62	3.15
May 2009	3.61	3.12
Maximum	3.62	3.28
Minimum	3.27	2.86
Mean	3.50	3.15
Standard deviation	0.13	0.11

Table 2 The Shannon - Wiener Diversity Index and Margalef Species Diversity Index for the Zooplankton 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	3.37	3.23
July 2008	3.36	2.93
August 2008	3.22	2.69
September 2008	3.40	3.17
October 2008	3.52	3.24
November 2008	3.63	3.27
December 2008	3.66	3.24
January 2009	3.66	3.22
February 2009	3.65	3.18
March 2009	3.65	3.15
April 2009	3.65	3.12
May 2009	3.65	3.10
Maximum	3.66	3.27
Minimum	3.22	2.69
Mean	3.53	3.12
Standard deviation	0.15	0.16

Various species of Phytoplankton such as *Bacillaria paradoxa, Odontella sp., Chaetoceros sp., Coscinodiscus sp., Cyclotella striata, Ditylum brightwellii, Gyrosigma balticum, Navicula henneydii, Netrium digitus, Planktoniella sol, Pleurosigma sp., Rhizosolenia sp., Skeletonema costatum, etc* were observed at both the stations.

Table 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 Phytoplankton.

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.	**3.50**	**Slight Pollution**	**3.53**	**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.					

(Margalef R. 1958), (Shannon C. E. et. al., 1963) (Staub R. et. al., 1970)

CONCLUSION AND DISCUSSION

In the present study, total 42 species of Phytoplankton belonging to 5 families were observed at Station No.1 Bhayander and Station No.2 Naigaon. The family Bacillariophyceae being the dominant of all the families. The Phytoplankton population was abundant during the Premonsoon season, lowest during the monsoon and a gradual increase was seen during the Postmonsoon season at both the Stations. The mean Shannon Wiener diversity index for Phytoplankton at Station No.1 Bhayander and Station No.2 Naigaon were 3.50 ± 0.13 and 3.53 ± 0.15 respectively. Whereas the Margalef Species Diversity Index for Station No.1 Bhayander and Station No.2 Naigaon were 3.15 ± 0.11 and 3.12 ± 0.16 respectively. By comparing mean of the Shannon Wiener diversity index and Margalef Species Diversity Index the scale of Staub et.al. was applied to determine the pollution status of estuarine study area. The Staub et.al. scale of pollution in terms of species diversity index for Phytoplankton revealed slight pollution for both the Stations under study.

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