

Pollution Status Study Based on Zooplankton Diversity of the Estuarine Area of Bhayander And Naigaon, Thane, Maharashtra, India



Zoology

KEYWORDS : Zooplankton, Estuary, Shannon-Wiener Diversity Index, Margalef Species Diversity Index.

Dr. Devdatta Lad

Department of Zoology Wilson College Chowpatty, Mumbai - 400 007

Dr. Shashikant Patil

Department of Zoology Mithibai College of Arts, Chauhan Institute of Science,

ABSTRACT

The present study aims to analyze the species diversity of zooplankton and to determine the pollution status in the estuarine waters along the area of Bhayander and Naigaon. A total of 38 species of Zooplankton belonging to 9 classes have been recorded from both the Stations during the research study. The class Maxillopoda being dominant of all the classes. The mean Shannon Wiener diversity index for Zooplankton at Station No.1 Bhayander and Station No.2 Naigaon were 3.35 ± 0.20 and 3.41 ± 0.15 respectively. Whereas Margalef Species Diversity Index for Station No.1 Bhayander and Station No.2 Naigaon were 4.12 ± 0.26 and 4.20 ± 0.21 respectively. The Staub et. al. scale of pollution in terms of species diversity index for Zooplankton revealed slight pollution at both the Stations Bhayander and Naigaon.

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 bio-magnified and reaches man through food-chain implications. (S. Baskara Sanjeevi et. al. 2004)

Plankton as a term was first used by Victor Hensen for the aquatic communities of floating and drifting organisms which are carried primarily by movement of water current rather by their own swimming ability. A few of them are capable of slow movement but cannot progress against the prevailing current or flow of the water. The name plankton comes from the Greek word planktos meaning wanderers. There are two types of plankton - phytoplankton, and zooplankton. Phytoplanktons are plant plankton. Zooplanktons are animal plankton. (Pillai N. K. 1990)

Zooplanktons are small heterotrophic animals inhabiting almost every type of aquatic environment. According to Nair et. al. (1999), the zooplankton community comprises of herbivores, omnivores and carnivores of which generally herbivores form a major fraction. Zooplanktons are primary consumers form a major link in food chain. They constitute a major item for crustaceans, mollusks and fishes. Thus the abundance of zooplankton practically acts as an index to assess the fertility of water mass.

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. (Ritaku-mari S. D. et. al., 2007)

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

MATERIAL AND METHODS

In the present study Zooplankton 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 $D = (S - 1) / \text{Loge } N$, 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° 19' N and 72° 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° 20' N and 72° 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 Zooplankton of the Station No.1 Bhayander.

Month	Shannon - Wiener Diversity Index (H)	Margalef Species Diversity Index (D)
June 2008	3.38	4.37
July 2008	3.21	4.03
August 2008	3.06	3.73
September 2008	3.07	4.15
October 2008	3.09	4.55
November 2008	3.27	4.40
December 2008	3.50	4.33
January 2009	3.53	4.22
February 2009	3.53	4.15
March 2009	3.52	3.90
April 2009	3.54	3.86
May 2009	3.56	3.80
Maximum	3.56	4.55
Minimum	3.06	3.72
Mean	3.35	4.12
Standard deviation	0.20	0.26

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	3.41	4.35
July 2008	3.34	4.30
August 2008	3.23	4.15
September 2008	3.15	4.51
October 2008	3.20	4.46
November 2008	3.40	4.35
December 2008	3.51	4.30
January 2009	3.54	4.21
February 2009	3.54	4.06
March 2009	3.56	4.00
April 2009	3.57	3.93
May 2009	3.58	3.82
Maximum	3.58	4.51
Minimum	3.15	3.82
Mean	3.41	4.20
Standard deviation	0.15	0.21

Various species of zooplankton such as *Acartia plumose*, *Acartia southwelli*, *Cypris larvae*, *Euterpina acutifrons*, *Fish eggs*, *Acetes sibogae*, *Lucifer hanseni*, *Zoea larvae*, *Nauplius larvae*, *Megalopa*

larvae, *Sagitta elegans*, *Sagitta bedoti*, *Oikopleura dioica*, 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 Zooplankton.

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.	3.35	Slight Pollution	3.41	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)

CONCLUSION AND DISCUSSION

In the present investigation, total 38 species of Zooplankton belonging to 9 classes were observed from both the Stations Bhayander and Naigaon. The population of Zooplankton was low in the Monsoon season with gradual increase in Postmonsoon season and highest in the Premonsoon season. The mean Shannon Wiener diversity index for Zooplankton at Station No.1 Bhayander and Station No.2 Naigaon were 3.35 ± 0.20 and 3.41 ± 0.15 respectively. Whereas Margalef Species Diversity Index for Station No.1 Bhayander and Station No.2 Naigaon were 4.12 ± 0.26 and 4.20 ± 0.21 respectively. The Staub et.al. scale of pollution in terms of species diversity index for Zooplankton revealed slight pollution for both the Stations Bhayander and Naigaon. The zooplankton studies in Indian waters are mainly reported by Madhupratap (1987), Lodh N. M. (1990), L. R. Tiwari et. al. (2002) and Heiner et. al. (2005)

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