Asian Fisheries Science **22** (2009): 21-26
ISSN: 0116-6514
E-ISSN: 2073-3720
https://doi.org/10.33997/j.afs.2009.22.1.003

Asian Fisheries Society, Manila, Philippines

Studies on the bottom faunal diversity of Ganga River system in relation to water quality adjacent to Serampore area, West Bengal

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Abstract

Physico-chemical and biological characteristics of river Ganga have been studied in the area of Serampore (station I) and Barrackpore (station II), West Bengal, India with a view to assess the condition of the river Ganga. Water samples, benthic fauna were collected from the two stations. Less number of Tubificid were recorded in station II than in station I whereas chironomid larvae were found maximum in station I. The study indicates that station I is more polluted than station II.

Introduction

Studies on benthic organism in natural waters are of fundamental importance as they form the basic food for many fish species and invertebrate bottom dwellers of economic significance. Benthos have been employed to assess the reflect past and present environmental condition of an ecosystem more efficiently than physical and chemical indices of water and soil (Hofmann, 1978) and are sedentary, sessile, long lived and easily collectable (Petersen 1913). The Ganga River or the Hooghly river (the name of the Ganga river in the studied area) in the studied area is affected due to abstraction of large amount of water for industrial uses. Sewer outlets and drainages, which open into the rivers directly, cause resource deterioration. The present study is mainly concerned with the population dynamics of macro benthos as related to certain hydrological condition of the studied portion of the river particularly in view of its organic and industrial pollution. The main objectives of this study are to highlight the ecological status in the studied area of Ganga, to study the macrozoobenthic community of the studied stations, to find out the influence of abiotic factors on the macro fauna of the studied regions using statistical methods and to assess the different population attributes with special reference to community diversity. In this context, an attempt was made to study the above factors in the Ganga Rivers in the areas of Serampore, West Bengal from January 2007 to November 2007.

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Materials and Methods

Two different stations were selected for study in the Ganga river around Serampore area (Dist. Hooghly, West Bengal) (latitude 22.04^0 (N); longitude (88.23^0(E). These are

i) Station I: 3.5 kms upstream from the college area (motorized boats are moving across Serampore launch ghat and Dhobi ghat).

i) Station II: Opposite to Serampore launch ghat (it is under Barrackpore and it is on the eastern side of the river).

a) Physico-chemical parameters viz. water pH, soil pH, and water temp. (^{0}C), dissolved oxygen (DO), dissolved carbon-di-oxide (DCO_2), water hardness, Total alkalinity, BOD, Soil phosphate, soil organic carbon were determined following standard methods (APHA, 1995).

b) Macrozoobenthos: An Ekman dredge of 22 cm^2 was used for the collection of macrozoobenthos samples. Six samples were collected at random from the study area. All the samples collected were sieved through a standard sieve no. (256 mesh / cm^2). The samples were preserved in 70% alcohol for laboratory analysis. Different mollusks, annelids were identified.

Density and percentage frequency of benthos were calculated. To measure the diversity of species, different biological indices (Shannon Weiner index, Evenness index) were also calculated.

Results

Results of the sediment quality in the studied areas are given in the table 1. The pH of the sediment was alkaline in both the stations. In station I both benthic organisms and humus causes the decrease of pH of the sediment. The temperature of the sediment mainly ranges between 23^{o}c-26^{0}c at station I and 23^0 C- 27^{0}c at station II. At station –II the temperature of the sediment is slightly higher than station I

Table 1. Station wise variation in sediment quality in the studied stations

Parameters	Station-I	Station-II
pH	7.4-8.4	7.65-8.9
Temparature(^{o}c)	23 - 26	23 -27
Phosphate(mg/l)	3.9 - 4.5	3.5 -4.1
Organic carbon(%)	0.70 -0.89	0.73 -0.82

The phosphate content of the sediment varied from 3.9-4.5 mg/lit in Station-I and 3.5-4.1 mg/lit in station II. In the present study the percentage of organic carbon (%) varied from 0.70-0.89 at station I to 0.73-0.82 in station II. Temperature of the water was fluctuated from 19 to 29.75 (^{0}C) at Station I & 19 to 30(^{0}C)At Station II (table 2). The mean value of temperature is slightly higher in Station II.pH of the water ranged between 7.31-8.45 at station 7.36-8.83 & I at station II. Alkaline nature of Ganga water at station I and station II indicates photosynthetic activity& regular entry of cloth washing wastes in both the areas. Klein (1972) has pointed out that the pH value between 6.7 and 8.4 are suitable. In the present study, the decomposition of organic matter received by the river either as human waste or as sewage input have not suppressed the pH level.Total alkalinity was higher at station I than at station II (table 2). The presence of bicarbonate increases the total alkalinity of the water in stations I.Dissolved CO_2 value at station I was fluctuated from 0.96 to 2.83 mg/l whereas at station II it ranged from 0.43 to 2.36 mg/l. The minimum value was observed in May. The average value of CO_2 was higher at station I than at station II.The DO value ranged from 5.03 to 7.10 mg/l at station I and 5.13 to 7.0 mg/l at station II. The average value is slightly higher at station I. The average value of water hardness is much higher at station I than at station II (Table 2).

Table-2. Water quality at station I and station II

Parameters	Range of Variation	
	Station I	Station II
pH	7.31 - 8.45	7.36 - 8.83
Temperature (0^0c)	19-29.75	19-30
Dissolved O_2 (mg/l)	5.03-7.10	5.13-7.0
Free Co_2 (mg/l)	0.96-2.83	0.43-2.36
Total alkalinity (mg/l)	170-225	161.0-195
Water hardness (mg/l)	90-149	87-139.10215
BOD (mg/l)	3.3-20.1	2.6-16.9

During the course of survey work some species of annelids, mollusks; arthropods, which are macrobenthic, have been encountered in the study area. Among annelids, tubificids and *Nereis* are noticed. Among mollusks *Thiara lineata, T. scabra* have been found. Some crabs were also collected (Table 3,4,5).

Table 3. Percentage of Annelids in studied stations

	Station I	Station II
Percentage of Tubificida	100	47.7
Percentage of Nereis	0	9.2

Table 4. Average no.(per m2) of annelids, crustaceans in the studied stations

	Station I	Station II
Annelids	153	37
Crustaceans	41	78

Table 5. Average no.(per m^2) of annelids, crustaceans in the studied stations

	Station I	Station II
Thiara lineata	7998-22300/m^2	4061-10690/ m^2
Thiara scabra	733-4174/ m^2	130-6450/ m^2

Discussion

Concept of species diversity index is based on the theory that in aquatic biotic community living in sewage pollution free environment is characterized by the presence of a wide variety of species but only a moderate number of each species. A change in the biotic community structure resulting in less species but greater abundance to select to learn once reflects the aberrant condition of environmental stress.

In this present study Shannon Weiner Index (H) value is higher in Station -II (1.2614) than Station-I (0.6644) which indicates station - I is more polluted than station II (Table 6).

Table 6. Different indices in Station I and Station II

Biological indices	Station-I	Station-II
Shannon Weiner index (H)	0.6644	1.2614
Evenness Index (J)	0.2452	0.4190

Here Mollusk is the largest group of macro fauna in both the stations. *T.lineata and T.scabra*, the most dominant species may be regarded as a higher tolerant species fairing well under stressed condition prevailing in Station I. In Station I pollution indicator worm *Limnodrilu* was found abundantly. According to Szczesny (1991) if a river is more polluted with organic compound, there is greater number of oligochaetes, Carr and Hiltune (1965) classified polluted water bodies into different categories according to density of oligochaetes as follows: 100-999 individuals/m^2 indicates polluted water, 1000-5000 individuals/ m^2 indicates moderate pollution and 5000 individuals / m^2 and above indicates heavily polluted condition. According to this classification station I is more polluted than station II.

Goodnight and Whitly (1960) suggested that a bottom invertebrate community containing 80% or more of the tubificid worms indicate a high degree of organic enrichment. Tubificidae were recorded more at Station-I, which was enriched with organic matter receiving the sewage from different sources. However, it harbored Chironomid larvae less in number. Station-II receiving very little sewage harbored in higher density of chironomid larvae. The presence of higher densities of tubificidae and lower density of chironomid larvae may indicate the pollution level at Station-I than at Station-II.

At the point of discharge of pollutant, the clean water fauna is eliminated being unable to tolerate low oxygen tension and the tolerant fauna such as tubificids, may be present below the discharge. As the water body gradually reoxygenates, the clean water fauna increases in number and density.

The damage to an aquatic ecosystem is caused by different kinds of pollutants. The organisms through their presence, number and behavior can integrate the whole effect and tend to preserve the past effect of a waste discharge or any ecological perturbation, even if stressed, species sensitive to that particular stress will be eliminated, thus reducing the richness of the community and certain species may be favored so that they become abundant compared to the other members of the community.

However dissolved oxygen content is susceptible to slight environment changes. In high community oxygen depletion occurs due to higher respiration. For this reason dissolved oxygen has been extensively used as parameters delineating water quality. In this the dissolved oxygen value at Station-I was seen to fell as 7.8mg/l - 4.1mg/l. Lower value of oxygen (4.1mg/l) coupled with higher value free CO_2 (14.7mg/l) and alkalinity (205mg/l) indicated a stressed condition and higher pollution compared to other stations.

So, the variation in the abundance of bottom fauna is mainly influenced by a number of biotic factors such as temperature, dissolved oxygen, nutrients, composition of sediment and its organic carbon content. The study of community structure also provide a clear concept on the polluted condition of the Station I as it harbored the pollution indicator Tubificid- *Limnodrilus* in huge number (100% of total Annelids) but had the lowest diversity of the species.

Conclusion

1) Concept of species diversity index is based on the theory that in aquatic biotic community living in sewage pollution free environment is characterized by the presence of a wide variety of species but only a moderate number of each species. A change in the biotic community structure resulting in less species but greater abundance to select to learn once reflects the aberrant condition of environmental stress.

2) Shannon Weiner index value of station I is less than station II, which indicates that station-I is more polluted than station-II.

3) Mollusk is the largest group of macro fauna in both the studied stations. *Thiara lineata*, *Thiara scabra* is most dominant species and may be regarded as a higher tolerant species.

5) The study of community structure also provide a clear concept on the polluted condition of the Station I as it harbored the pollution indicator Tubificid- *Limnodrilus* in huge number (100% of total Annelids) but had the lowest diversity of the species.

Acknowledgement

Authors are grateful to UGC for providing fund in the scheme of Minor Research Project (Sanction No. F. PSW - 55/06-07(ERO))

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Received: 30 December 2007; Accepted: 09 November 2008