

## EFFECT OF SEDIMENT ORGANIC CARBON CONTENT ON MICROBIAL DIVERSITY OF BHITARKANIKA MANGROVE ESTUARY

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### ABSTRACT:

Mangroves found in the intertidal zone are considered as a very productive area with high rates of organic carbon accumulation due to the presence of highly diverse marine and terrestrial flora, fauna including microbes. Organic carbon concentration and composition are closely linked to the biogeochemistry of the substrate, which occurs on the earth surface and in deep-sea sediments in various geological intervals correlating the strong interactions in between sedimentary organic matter, microorganisms, mineral phase etc. In the present study sediment samples were collected from three different localities such as Baraipur, Thakurdia and Khola of Bhitarkanika estuary. Isolation and enumeration of microbes as well as estimation of total organic carbon content of the sediment samples has been done. Total bacterial count was found to be more i.e.  $2.5 \times 10^5$  CFU/gm and least i.e.  $1.5 \times 10^4$  CFU/gm in the sediments of Khola and Thakurdia respectively. The organic carbon content was found to be least i.e. 1.7 mg/gm and more i.e. 19.20 mg/gm in Thakurdia and Khola region respectively. pH of all the three sediments was found to vary between 6.43 to 6.67 from which indicates that mangrove sediments are slightly acidic in nature. The present paper will highlight on the effect of sediment and organic carbon on microbial population, enumeration and its effect on Bhitarkanika microbial diversity.

### 1. INTRODUCTION

India has a total area of 4461 sq. km under mangroves, which represent a major environment of tropical coasts, is 0.14% of the country's total geographic area. It account for about 5% of the world's mangrove vegetation (State forest report, 2003). Nearly 57% of the mangroves of India are found along the east coast (Kathiresan, 2003). Extensive mangrove forests occur in the major river deltas such as Budhabalanga, Subernarekha, Bhitarkanika, Mahanadi and Devi river mouths of Orissa coast extending over 480 km along the Bay of Bengal. Mangroves of Bhitarkanika is the second largest viable mangrove ecosystem in India after the Sunderbans (Mishra *et al.*, 2008; Thatoi, 2004). It covers an area of 672 sq. km extending between  $86^{\circ}48'$ – $87^{\circ}03'$ E long. and  $20^{\circ}33'$ – $20^{\circ}47'$ N lat. The Government of Orissa declared this area as a sanctuary in 1975 for better protection of the habitat. Later, the core area (145 sq. km) of the sanctuary was declared as a National Park in the year 1998. Due to its rich diversity in flora and fauna, this mangrove area has been declared as a Ramsar site in 2002, being a wetland of international importance (Reddy *et al.*, 2007). Mangroves are highly productive and act both as a source and a sink of organic carbon (Marchand *et al.*, 2006). The mangrove habitat is referred to as an advancing coast, where the land advances toward the sea due to soil sedimentation (Kinjo *et al.*, 2005). The distribution of microbial activities in estuarine systems is clearly complex and variable. Much research remains to be done in order to define the distributions of microbial activities and the major factors involved in controlling these distributions in estuaries. It is interesting to note that for any given water column depth, the proportion of organic matter deposited in the sediments

which is degraded by microbial processes appears to be similar in fresh and salt waters (Wollast and Billen, 1981). Qualitative differences in the input and content of organic material between freshwater and marine sediments likely affect microbial activities in the sediments. Analysis of the composition of sediment organic matter readily reflects trends in organic carbon sources. The oxidations of deposited organic matter, regeneration of inorganic nutrients and in some cases, transformation of those organic materials, are generally attributed to the sediment microbiota (Fenchel & Blackburn, 1979). In the present investigation attempt has been made to study the effect of organic carbon content with the microbial diversity of different sampling sites of Bhitarkanika mangrove estuary.

### 2. MATERIALS AND METHODS

The study area is the Bhitarkanika mangrove (lat  $20^{\circ} 4' -20^{\circ} 8' N$ - long  $86^{\circ} 45' -87^{\circ} 50' E$ ) ecosystem of Orissa state, east coast of India, which is situated in the deltaic region of Brahmani river and Baitarani river of Orissa. The sediment samples were collected from 3 different locations of dense mangrove such as Baraipur, Thakurdia and Khola regions of the Bhitarkanika estuary (Fig.1).

#### 2.1 Estimation of Organic Carbon of Sediment

Sediments were collected from 3-4cm depth of the soil with the help of a spatula and transferred to the laboratory soon. The collected samples were first air-dried and successively oven dried at  $60-65^{\circ}C$ . The dried samples were ground by the help of a grinder till fine powder and kept in a sterile polythene zip pack. The

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laboratory apparatus were acid soaked (Chromic acid) before the analysis. After acid soaked, it is rinsed thoroughly with tap water and distilled water to ensure any traces of cleaning reagents were removed. The surface sediments were air-dried first followed by oven drying and after homogenization using pestle and mortar, it

was passed through a 2-mm mesh screen and stored in polyethylene bags for further analysis. Organic carbon content of the sediment samples were analysed followed by the methods of Walkey and Black (1934).

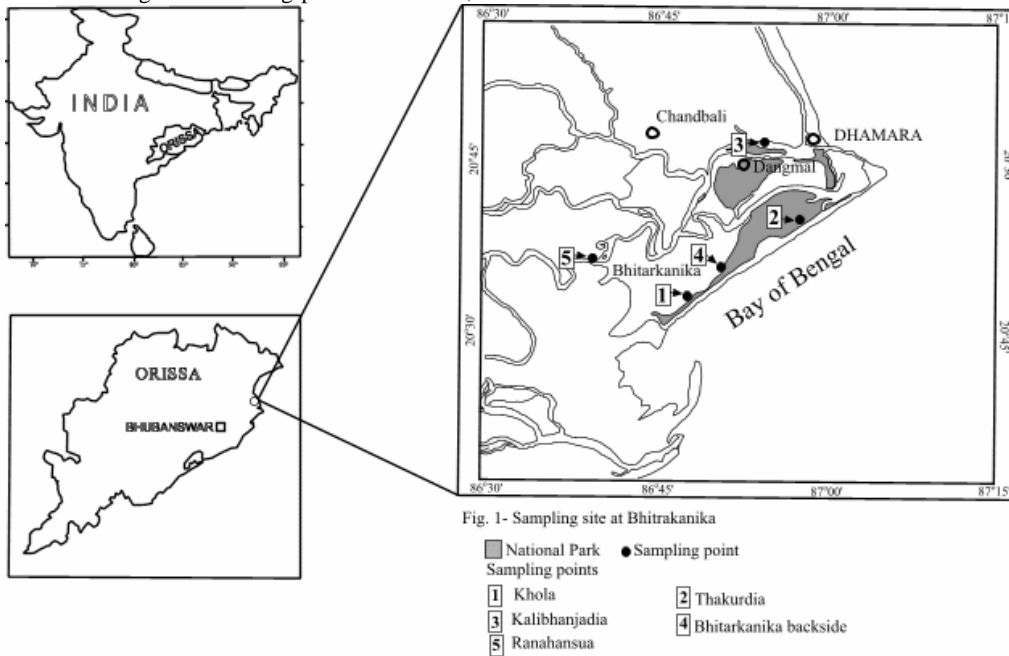


Figure 1. Map Showing Sampling Sites of Bhitarkanika

### 2.2 Isolation of Bacteria and Fungi

Sediment samples were stored at 4<sup>0</sup>C immediately after collection and transported to the laboratory, for analysis with adequate care. The sediments were air dried aseptically. Isolation of bacteria and fungi from mangrove sediments was carried out by spread plate method. The samples were plated on different solid medium such as Nutrient Agar and Potato Dextrose agar for the isolation of total bacteria and fungi respectively and kept in incubator for growth. Bacterial colonies growth was observed in NA plate after 24 hrs and fungal colonies growth was observed in PDA plate after 36-48 hrs. Enumeration of the bacterial and fungal colonies was done and isolated colonies were maintained in pure culture forms in slants.

### 3. RESULTS

The organic carbon content in the sediment samples was found to be 1.7mg/gm, 10.16mg/gm and 19.20 mg/gm in Thakurdia, Baraipur and Khola regions respectively (Fig. 2). The total bacterial and fungal count, estimated by colony counting method was found to be more in Khola where as less in Thakurdia region of Bhitarkanika. The total microbial count was found to be higher i.e.  $2.5 \times 10^5$  CFU/gm whereas less i.e.  $1.5 \times 10^4$  CFU/gm in Khola and Thakurdia respectively (Table 1). The microbial load increases with the increase in organic carbon content of sediments of different localities (Fig.3) The sediment pH of Khola was found to be least i.e. 6.43 where as Thakurdia was slightly more that is 6.67.

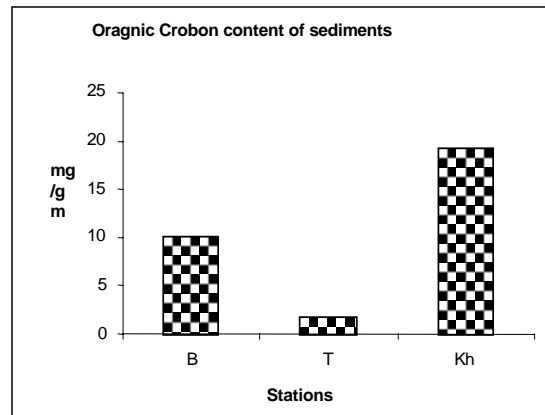


Figure 2. Organic Carbon Content in Different Sampling Areas of Bhitarkanika

Sl No.	Sampling Areas	Bacterial Count/gm	Fungal Count/gm	Total Microbial Count/gm
1	Baraipur	$1.7 \times 10^5$	$1.7 \times 10^3$	$1.7 \times 10^5$
2	Thakurdia	$9.5 \times 10^3$	$6.0 \times 10^3$	$1.5 \times 10^4$
3	Khola	$2.5 \times 10^5$	$2.0 \times 10^3$	$2.5 \times 10^5$

Table 1: Total Microbial Colony Count from the Sediments of Different Sampling Areas:

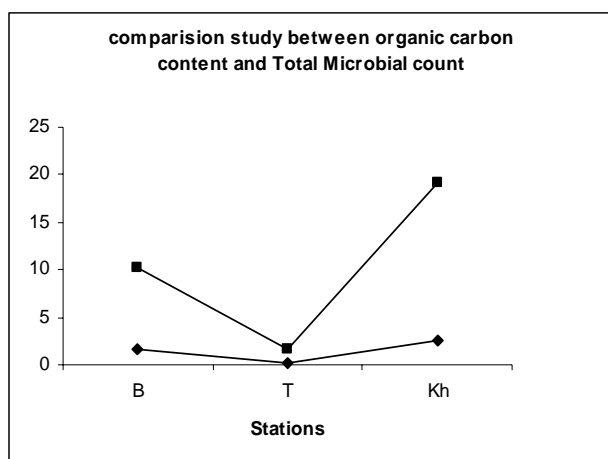


Figure 3. A Comparison Study Between Organic Carbon Content and Total Microbial Load in Different Stations of Bhitarkanika (B-Baraipur, T-Thakurdia & Kh-Khola)

#### 4. DISCUSSIONS

Estimation of organic carbon can serve as an important tool in determining the status of food available to benthic fauna and indicates the extent to which the bottom is fertile for the sustenance of microbes. The Thakurdia sediment is somehow sandy whereas the sediment of Khola is clayey. The total microbial count was found to be higher in sediments of Khola and lower in Thakurdia sediment may be due to depletion of organic carbon in these stations. OC is present as the carbon in extractable organic matter (EOM). Organic carbon represents the organic matter in the sediments and this is of potential significance for aquatic productivity. The range of variation in organic carbon content may be due to soil texture, sediment quality, nature of vegetation, rate of accumulation of dead and decayed part and animal materials. The microbial load was found to be higher when the organic carbon in the sediments was higher. The fluctuation in pH values may be due to sewage deposition, pollution etc.

#### CONCLUSION

Mangrove habitat are cooler, having low pH, organic carbon 19.20 mg/gm much. The distribution of organic carbon in sediment and total microbial population was found to be directly proportional with each other. Hence from the present study a positive correlation between distribution of organic carbon and

microbial population was observed which indicates microbial population will be more if organic carbon of sediment increases.

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#### REFERENCES

- Fenchel, T., & Blackburn, T.H., 1979. Bacteria and Mineral Cycling. Academic.
- Kathiresan, K., 2003. Conservation strategies for mangroves in India. *Botanica*, **53**, 61–75.
- Kinjo, Kitou, M. & Shimo, M., 2005. Characteristics of Surface Sediments along a Creek in a Mangrove Forest, *Soil Science & Plant Nutrition*, **51** (6) 809–817.
- Marchand, C., Alberic, P., Lallier-Verges, E. & Baltzer, F., 2006. Distribution and characteristics of dissolved organic matter in mangrove sediment pore waters along the coastline of French Guiana, *Biogeochemistry* **81**(1): 59–75.
- Mishra, R.R., Rath, B. & Thatoi, H., 2008. Water Quality Assessment of Aquaculture Ponds Located in Bhitarkanika Mangrove Ecosystem, Orissa, India *Turkish Journal of Fisheries and Aquatic Sciences* **8**: 71–77.
- State of Forest Report 2003, Forest Survey of India, Ministry of Environment and Forests, Government of India, New Delhi, 2003, pp. 21–22.
- Thatoi, H.N., 2004. Study on vegetation in mangrove Forests of Bhitarkanika Wildlife Sanctuary. Project. Report submitted to Forest Department (Mangrove Forest Division, Rajnagar) Government of Orissa, 23–26.
- Walkey, A. & Black, I.A., 1934. An Examination of The Degtjareff Method for determining Organic Carbon in Soil: Effect of variations in Digestion conditions and of inorganic soil constituent. *Soil Sci.* **63**: 251–262.
- Wollast, R., & Billen, G., 1981. The fate of terrestrial organic Carbon. In the flux of carbon from the rivers to the ocean. U.S. DOE CONF 8009/40/US.