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Research Article

STUDY OF PHYSIOCHEMICAL PARAMETERS AND IDENTIFICATION OF ZOOPLANKTON IN ESTUARY AND COASTAL AREA OF MELA VANJUR IN NAGAPATTINAM DISTRICT

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ABSTRACT

Assessment of estuary and marine water quality is essential to check the suitability of a water source for the designated use. Therefore, the present study focuses on preliminary aspects of Physio-chemical parameters and identification of Zooplankton in the estuary and coastal area from Mela Vanjur, Nagapattinam, District, Tamil Nadu, India for this period of January 2023. Physico-chemical parameters like Smell, Flavour, Odour, Colour, Total Dissolved Solids, Turbidity, Temperature, Electrical Conductivity, pH, Salinity, Total alkalinity, Total hardness, Nitrite, Nitrate, NH_3, Phosphate, Iron, Total Suspended Solids, COD, BOD, DO, were varied in both sample in the same month. The present study revealed that all the Physico-chemical parameters were more low, normal and high value, which may be due to the industrial effluents mixing up with the estuary. Suitable remedial measures should be taken to prevent the mixing of domestic sewage and discharge of effluent into the river to maintain the quality of the Vettar estuary. The present study revealed 15 genera of zooplankton from the estuary and marine water belonging to the four groups namely, 1. Cladocere: *Daphnia sp. Ceriodaphnia sp, Alonella sp, Diaphanosoma sp, Moina sp,* 2. Copepoda: *Cyclops sp, Tropocyclops sp, Nauplius sp, Diaptomus sp, Heliodiaptomus sp,* 3.Rotifera: *Brachionus sp, Conochilus sp, Filinia sp,* 4.Ostracoda: *Cypris sp, Stenocypris sp.* The present work provides substantial evidence that water quality analysis from Vettar estuary and marine water. From the study, it is evident that zooplankton may be a promising non-polluted depending on the ecological condition.

Keywords: Physio-chemical parameter, Vettar estuary, Marine water, Zooplankton.

INTRODUCTION

After air, soil and water is possibly the most valuable natural resource. Poor water quality is not simply a sign of environmental degradation; it is also a threat to the ecosystem. Water quality is described as the chemical, physical, and biological properties of water, typically about its suitability for a specific use. Water can be used for recreational purposes, drinking, fishing, agriculture, and industry. Each of these approved uses has its own set of chemical, physical, and biological standards that must be met to support that use. Water used for drinking or swimming, for example, has stricter regulations than water used in agriculture or industry. Water is a resource with numerous applications, including recreation, transportation, hydroelectric power, as well as home, industrial, and commercial usage. Water also supports all kinds of life and has an impact on our health, lifestyle, and financial well-being. Although water covers more than three-quarters of the earth's surface, just 2.8 percent of it is suitable for human use. Currently, nearly one-third of the world's population lives in nations with moderate to severe water stress, and global freshwater consumption increased six-fold between 1900 and 1995, more than twice the pace of population expansion. As a result of limited water supplies and a growing population, many countries of the world are experiencing water scarcity. Because water is important to life on Earth, hydrological research is critical to understanding the interaction between its various tropic levels and food webs. The composition of its biota is determined by environmental factors such as water

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circulation, salinity, oxygen, temperature, and nutrients (Karande, 1991). Estuaries are transitional zones between land and sea that are important from both an economic and ecological standpoint. Inflows of both marine and freshwater generate significant quantities of nutrients in the estuary's water column and sediment (McLusky and Elliott, 2004; Valle-Levinson, 2011). Estuaries account for less than 10% of the ocean's surface yet play an essential part in global biogeochemical cycles such as the carbon, nitrogen, and nutrient cycles (Lisitsyn, 1995; Gebhardt *et al*., 2005).Usually in the near shore waters and estuaries, they exhibit considerable seasonal variations depending on the local conditions of rainfall, tidal incursions, various abiotic and biotic processes, and the quantum of freshwater inflow affecting the nutrient cycle of different coastal environments (Choudhury and Panigraphy, 1991). Estuaries are economically important ecosystems for fisheries in tropical regions (Kawabata *et al*., 1993) and they act as a transitional zone between land and sea (Bardarudeen *et al*., 1996).

The marine environment plays a very important role in economic and social development. With its wealth, it currently occupies an important place in the national economy. Moreover, this sector constitutes a reservoir of food resources contributing significantly to the increase in the rate of national self-sufficiency. However, this strategic ecosystem has become the privileged receptacle of pollution because of anthropogenic development which discharges wastewater at many points of marine coasts. Such a situation requires the establishment of a sustainable strategy for monitoring and protecting the environment. Indeed, preserving the environment and its resources is considered one of the priorities of scientists and managers of the marine environment. For this, several approaches are currently used, including the use of conventional physic-chemical methods. This physic-chemical approach, essential for the qualitative and quantitative assessment of pollutants in the various compartments of the environment (water, sediment and organisms), was used in this study to contribute to the assessment of the health status of the marine ecosystem of the Mela vanjur region. Planktons play an important role in the ecosystem. As producers, they account for half of the total oxygen produced during photosynthesis. Fisheries are dependent on plankton for fish food. Phytoplankton is used as a source of food in space travel and also for carbon dioxide fixation. *Chlorella* is used as a protein supplement. They play an important role in nutrient recycling. Dead and decaying organic matter can be transformed into inorganic nutrients for plants some of the species can fix nitrogen of dissolved air to ammonia and nitrates, which are useful for the growth of phytoplankton. Phytoplankton and Zooplankton are essential for regulating the carbon dioxide and oxygen equilibrium.CO_2 uptake in an ocean can be increased by phytoplanktonic growth. Phytoplankton initiates the marine food chain by feeding primary consumers such as zooplankton, shellfish, and finfish (Sridhar *et al*., 2006; Mathivanan *et al*., 2007; Tas and Gonulol, 2007; Saravanakumar *et al*., 2008). Biomass and productivity of phytoplankton in different size ranges are important factors regulating the productivity of higher tropic-level organisms. The pelagic algal communities make important contributions to the smooth functioning of an estuarine ecosystem (Kawabata *et al*., 1993).

MATERIALS AND METHODS

Studied and sampling sites

The river, Mela Vanjur is situated near Nagapattinam town on the east (Coromandel) coast of India. The Mela Vanjur Vettar estuary and Marine water have a year-round connection with the sea and are subjected to semi-diurnal tides with maximum tidal amplitude of about 1m. It flows (from the western part of Tamil Nadu) for a distance of 380 km through the area of red sandy leached and lateralised black soil in loamy red soil and eventually joins the Bay of Bengal. The width of the estuary at the mouth is about 85 m and the tidal flushing extends to a distance of about 10 km. For the present study, two sampling sites were chosen.

Collection of samples

Marine water was sampled month of January 2023. The estuary water sample was collected from the open field of Mela Vanjur, Vettar River, Nagapattinan Districts, Tamil Nadu, India. Marine water collected from the coastal area of Mela Vanjur Harbour Beach at Nagapattinam District, Tamilnadu, India.

Parameter analysis of study samples

Physical Parameter

1.Smell by organoleptik 2. Flavour by organoleptic 3. Odour in the Physiological sense. 4. Colour by Visual/ Colour Kit 5. Total Dissolved Solids (TDS) by Gravimetric 6. Turbidity by Turbidity meter 7. Temperature by Thermometer. 8. Electrical Conductivity by Conductivity meter.

Chemical parameter

The Mela VanjurVettar estuary and marine water samples were analysed for the following selected aspects. 1. pH 2. Salinity (ppt) 3. Total alkalinity (mg/l) 4. Total hardness (mg/l) 5. Nitrite (ppm) 6. Nitrate (ppm) 7.NH3 (ppm) 8. Phosphate (ppm) 9. Iron (ppm) 10.TDS (ppm) 11.TSS (mgl) 12.COD (mgl) 13.BOD (mgl) 14.DO (mgl).

Methods of analysis

The quality of Mela VanjurVettar estuary water and Marine water was evaluated by the determination of the following physicochemical parameters:

Identification of Zooplanktons

Method

The most Probable Number method (MPN) was used to identify plankton which was present in the study area.

Figure 1. Sample collection site of Mela Vanjur harbouring Vettar estuary area.

Figure 2. Site of sample collection in Mela vanjur coastal area.

Table 1. Methods of analysis of physicochemical parameters.

Parameter	Methods of analysis	Parameter	Methods of analysis
1.Temperature	Thermometer	9.Phosphate	Spectrophotometer method
2.Ph	Digital pH meter	10.Iron	AAS
3.Salinity	Salinity meter	11. Total dissolved solids (TDS)	Gravimetric
4.Total alkalinity	Titration methods	12.Total suspended solids (TSS)	Gravimetric
5.Total hardness	EDTA Titration	13.Chemical oxygen demand (COD)	Titration with Ferrous ammonium sulphate
6. Nitrite	Colorimeter	14.Biological oxygen demand (BOD)	BOD incubator
7. Nitrate (as NO3-)	Spectrophotometer	15.Dissolved oxygen (DO)	Winkler's method
8.NH3	Spectrophotometer	16.Plankton	MPN

Samplings were made to record the physicochemical, phytoplankton and zooplankton characteristics.

RESULTS AND DISCUSSION

The total life of the world depends on water and hence the hydrological study is very much essential to understand the relationship between its different tropic levels and food webs. The environmental conditions such as water movement, salinity, oxygen, temperature and nutrients are determining the composition of its biota. The nature and distribution of flora and fauna in the aquatic system are primarily determined by oscillations in the physical and chemical properties of the water body. Nagapattinam is a coastal district of Tamil Nadu situated on the southeast coast of India, In the presence study the temperature in the upper reaches was varied from 30.2 to 36.6ºC. The minimum range was recorded during the study period (January). The ranges were varied in lower reaches from 35.6 to 39.2º C. The pH of the sample (Estuary water) showed a variation from 7.93 to 7.95. The normal pH of estuary water is 7.5 but, in our study, the hydrogen ion concentration of the sample was slightly increased due to ecological changes the pH of the sample: 2 (Marine water) was noted as 8.29. The salinity of study samples was shown in different ranges due to the occurrence of freshwater plumes and mass movement in the estuary. The salinity of seawater with river water interfacing in the estuary can cause a mix of the different types of fluids into brackish water. During the study period, salinity was shown in different ranges from 33 to 40ppt. Sample 1 (Estuary water) has the range of 5.0ppt, but sample 2 (Marine water) showed 28ppt this slightly increased saline level was due to various ecological changes.

The Total alkalinity of the sample (Estuary water) varied reaches from 180 to 200mg/l. Normally Total alkalinity of the estuary water is 370mg/l, whereas in our study the acidification concentration of the sample was

slightly decreased due to ecological changes, the alkalinity of the sample:2 (Marine water) was noted as 220mg/l. The Total Hardness of the studied sample (Estuary water) varied reaches from 1000 to 15,000 mg/l. normally, the Total hardness of the estuary water is 1800mg/l, but in our study, the sample has a higher mineral concentration than the normal value of total hardness. These increases were due to the changes acquired at the ecological level. The alkalinity of sample 2 (Marine water) was noted as 11,000mg/l this was lower than that of sample 1. At the same time, both samples showed higher mineral concentrations than the normal ones. The nitrite level of seawater is different from 0.4 to 0.5 ppm. In our study sample 1 (Estuary water) was noted in the range of 0.2ppm, but in sample 2 (Marine water) was shown in the range of 0.2ppm. So, based on our analysis both sample 1 and 2 has some range in between the normal nitrite level. The nitrate in the upper reaches was varied from 0.5 to 1ppm. The sample: 1 (Estuary water) showed the range of 0.1ppm, whereas sample: 2 (Marine water) was noted as 0.2ppm. The marine water has a higher nitrate concentration than the estuary water sample. The concentration of ammonia in the upper region varied from 0.1 to 3.0 ppm. The sample (Estuary water) was noted in the range of 0.1 ppm. The normal concentration of ammonia in the estuary water is 0.1ppm, but our studied sample showed a slightly increased level of ammonium concentration this was due to ecological changes acquired in marine water sources. The range of ammonia in sample 2 (Marine water) was noted as 0. 2ppm. our observation showed an increased ammonia level in sample 2 than in sample 1.

Table 2. Physico-chemical parameters (Sample site: 1) of Mela Vanjur, Vettar estuary during January 2023.

Parameters	Value of analysed sample
Temperature	30.2 to 36.6ºC
pH	7.93
Salinity (ppt)	5.0
Total Alkalinity (mg/l)	370
Total Hardness (mg/l)	1800
Nitrite (ppm)	0.2
Nitrate (ppm)	1.0
NH3(ppm)	0.1
Phosphate (ppm)	<0.1
Iron (ppm)	<0.1
TDS (ppm)	2630
TSS (ppm)	5.88
COD (mg/l)	3.14
BOD (mg/l)	14.4
DO	5.8

Table 3. Physico-chemical parameters (Sample site: 2) of Mela Vanjur Marine water during January 2023.

Parameters	Value of analysed sample
Temperature	30.2 to 36.6ºC
pH	8.29
Salinity (ppt)	28
Total Alkalinity (mg/l)	220
Total Hardness (mg/l)	11000
Nitrite (ppm)	0.2
Nitrate (ppm)	0.5
NH3(ppm)	0.2
Phosphate (ppm)	<0.1
Iron (ppm)	<0.1
TDS (ppm)	17150
TSS (ppm)	4.76
COD (mg/l)	2.86
BOD (mg/l)	7.5
DO	4.6

When we lookout the total phosphate level in the upper reaches was minimum (1.00ppm) in January. The phosphate of the sample (Estuary water) showed the range of <0.1 ppm. The sample:2 (Marine water) phosphate level was noted as <0.1. According to our analysis, the amount of phosphate was the same in both samples. Normally the concentration of iron in seawater is very low (0.01ppm). Sample 1 (Estuary water) has the range <0.1ppm and sample 2 (Marine water) also showed the same range was <0.1. The total dissolved solids (TDS) in the upper reaches were varied from 2000 to 25,000ppm. In our analysis the total dissolved solids of the sample. (Estuary water) was noted as 2630ppm.Whereas the sample (Marine water) was noted as 17,150ppm. On this basis, the marine water sample has a high amount of total dissolved solids. If we take the total suspended solids in the seawater upper reaches were varied from 4.0 to 7.0 mg/l. Our studied sample: 1(Estuary water) was 5.88mg/l, but in sample: 2(Marine water) was noted as 4.76mg/l. The COD in the upper reaches varied from 2.00 to 5.00 mg/l. Our studied sample: 1 (Estuary water) and sample: 2 (Marine water) showed the range was 3.14mg/l and 2.86mg/l respectively. Marine water has more amounts of COD than that of estuary water. BOD is a measure of the amount of oxygen required to waste organic matter from water in the process of decomposition by aerobic bacteria. The BOD in the higher reaches ranged from 5.5 to 15.5 mg/l. Sample 1 (Estuary water) showed a value of 14.4 mg/l. The sample:2 (Marine water) has a slightly decreased amount of BOD due to some ecological changes the range of value was 7.5mg/l. Dissolved oxygen (DO) is a measure of how much oxygen exists in water. Dissolved oxygen in the upper region was varied from 3.0 to 7.8 mg/L. The DO of the sample (Estuary water) was noted as 5.8mg/l. Sample 2 (Marine water) was noted as 4.6mg/l in this observation showing a slight difference between samples: 1 and 2.

Identification of Plankton

The present study revealed 15 genera of Zooplankton from the estuary water and marine water belonging to the four groups namely Cladocera, Rotifera, Copepoda and Ostracoda. Among all four groups maximum abundance of Cladocerans (34%) was observed. Five species of Cladocerans, five species of Copepods, three species of Rotifers and two species of ostracods were observed. CLADOCERA: *Daphnia sp. Ceriodaphnia sp, Alonella sp, Diaphanosoma sp, Moina sp,* COPEPODA: *Cyclops sp, Tropocyclops sp, Nauplius sp, Diaptomus sp, Heliodiaptomus sp,* ROTIFERA: *Brachionus sp, Conochilus sp, Filinia sp,* OSTRACODA: *Cypris sp, Stenocypris sp.*

Other Zooplankton

Fish egg, Larvay, *Ceratium, Cephalodella sp. Lecane sp. Asplanchna sp. Courella obtuse, Philodinavus paradoxus, Philodina roseola, Keratella sp. Mytilina sp. Brachionusnilsoni, Cladocera, Chydorus sp. Daphnia longispina, Diaphanosomaexisum, Ceriodaphnia sp. Tropocyclopspracinus, Cyclops vicinus, Osciliotoria.* The temperature variation is one of the factors in the coastal and estuarine systems, which may influence the physico-chemical characteristics and also influence the distribution and abundance of flora and fauna. In the present study, it has been observed that high temperature was noticed in January 2023. (Sample-I) of Mela VanjurVettar Estuary, and Sample-II at Mela Vanjur Marine Water during January 2023. Lower temperatures in January were due to cloudy skies and rainfall brought down the temperature to the minimum (Kannan and Kannan, 1996). It has been stated that the higher value of pH during summer was due to the uptake of CO2 by photosynthesizing organisms. The low pH observed during January may be due to the influence of freshwater influx, dilution of seawater, low temperature and organic matter decomposition as suggested by Ganesan (1992). A similar trend of pH in Vanjur Vettar estuarine system was reported by Thangaraj (1984), in the present study, it has been observed in lower reaches (Sample-II) that the pH showed greater variation due to irregular treatment of the industrial effluents and subsequently released into the estuary.

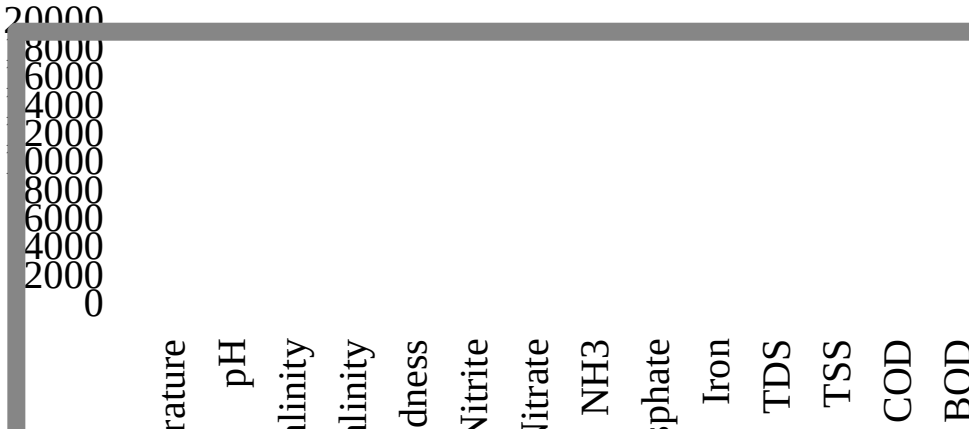

Figure 3. Shows the parameter analysis of Estuary and Marine water samples.

Salinity is the total amount of dissolved salts in water as parts per thousand (ppt) marine water has 11 major constituents. The normal range of ocean salinity ranges between 33-40 grams for litter, but as in weather, where there are areas of high and low pressure, and salinity, ocean water enters the estuary and the salinity increases hence more freshwater enters the estuary and salinity decreases. Salinity is one of the important factors which profoundly influence the abundance and distribution of the animals in an estuarine environment. Our studied sites have a lower level of salinity than normal values, hence nearly 15 species of zooplanktons have been identified. Alkalinity is significant because it regulates the pH of water in the system. Without this buffering capacity, small additions of acids or bases would result in significant changes in pH, which could be deleterious for aquatic life. Alkalinity also influences the distribution of several organisms in watery environments. For example, most freshwater amphipod species are restricted to low-medium carbonate waters, although some species, such as *Gammarus lacustris*, can be found in high carbonate waters (Pennak, 1985). Estuarine and marine profiles of nitrate, nitrite and ammonium concentration taken were analysed. While nitrate profiles indicate conservative mixing, those of nitrite and ammonium exhibit maxima indicative of estuarine and marine water. The low contents of nitrites during January were due to less freshwater input, higher salinity, higher pH and also uptake by phytoplankton. In the present investigation, ammonia was found to be high in lower reaches and this may be partly due to the death and subsequent decomposition of phytoplankton and also might be the excretion of ammonia by planktonic organisms (Segar and Hariharan, 1989).

In the present study, the total dissolved solids are comparatively more during January in lower reaches. It is due to industrial waste, animal waste, agricultural waste, etc. and also caused by evaporation and less rainfall. (Verma *et al*., 1978). Have observed that a large number of dissolved solids may result in high osmotic pressure. The high number of solids recorded in Sample II could be attributed to the effluent discharge as evidenced.Our study showed the accumulation of calcium content was more in lower reaches. This may be due to more calcium contents in effluents discharged in that area. Total phosphorus content was found to be higher during January in lower reaches than in upper reaches. Biological oxygen demand (BOD) is a measure of the amount of oxygen required to remove waste organic matter from water in the process of decomposition by aerobic bacteria and Chemical oxygen demand (COD) measures the amount of oxygen consumed in the water by chemical and biological processes. By our observation, the month of January 2023 showed a low level of COD in lower reaches when compared to upper reaches. This is because the oxygen is consumed more by the aquatic animals due to effluent stress. Dissolved oxygen (DO) concentration varies according to many factors; the main factors are due to photosynthesis and respiration by plants and animals in water. the amounts of dissolved oxygen content during January 2023 showed a minimum quantity in lower reaches when compared to upper reaches. This is because the oxygen is consumed more by the aquatic animals due to effluent stress.

Figure 4. Distribution of Zooplanktons in Vanjur area sample.

CONCLUSION

This study concludes the Mela Vanjur, Vettar estuary area marine water is highly influenced by ecological water chances. Generally, marine water sources have drastically changed by entering fresh water, rainwater and unwanted mixing of environmental liquid and solid waste. Assessment of water quality is essential to check the suitability of a water source for the designated use. Several water quality measures are evaluated and compared to standard levels. Based on this concept, we studied and recorded the all physio-chemical parameters and zooplankton of selected study sites. This study fully supports the conservation of the coastal area environment. As the scientific faculties and students, we should continuously research in greater depth to better understand the future effects of climate change on zooplankton diversity to ensure that they are accurately interpreted.

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