

Influence of seasonal changes on physico-chemical characteristics of Uppanar estuary, southeast coast of India

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Abstract

Background/Objectives: To study the seasonal changes influencing the various abiotic factors in estuaries and shallow coastal waters.

Methods/Statistical analysis: Water sample was collected from Uppanar estuary for a period of one year to analyze various physico-chemical parameters during the study period.

Findings: the present work was carried out on physico-chemical characteristics of water in Uppanar estuary, southeast coast of India during the study period. The findings of physical parameters are: water temperature values ranged from 24.0 to 32.0°C, salinity values of 15 ppt - 36.5ppt, pH values ranged from 8.3 – 7.4, turbidity range 1 to 2000 NTU, TSS (total suspended solid) from 1108mg/l - 1040 mg/l, and DO (dissolved oxygen) range 3.7 to 5.2 ml/l. Chemical parameters of water: NO₂ ranged from 0.239 to 3.745 µM/l, NO₃ values varied from 3.86 to 12.54 µM/l, TN (total nitrogen), ranged from 9.32 to 28.19 µM/l, IP (inorganic phosphate) values varied from 0.110 to 0.89 µM/l, TP concentration ranged from 1.19 to 32.62 µM/l.

Application/Improvements: The physical and chemical properties of water immensely influence the uses of a water body for the distribution and richness of biota and also influence both vertical and horizontal migration of aquatic organisms.

Keywords: Physico-chemical, Chemical parameters.

1. Introduction

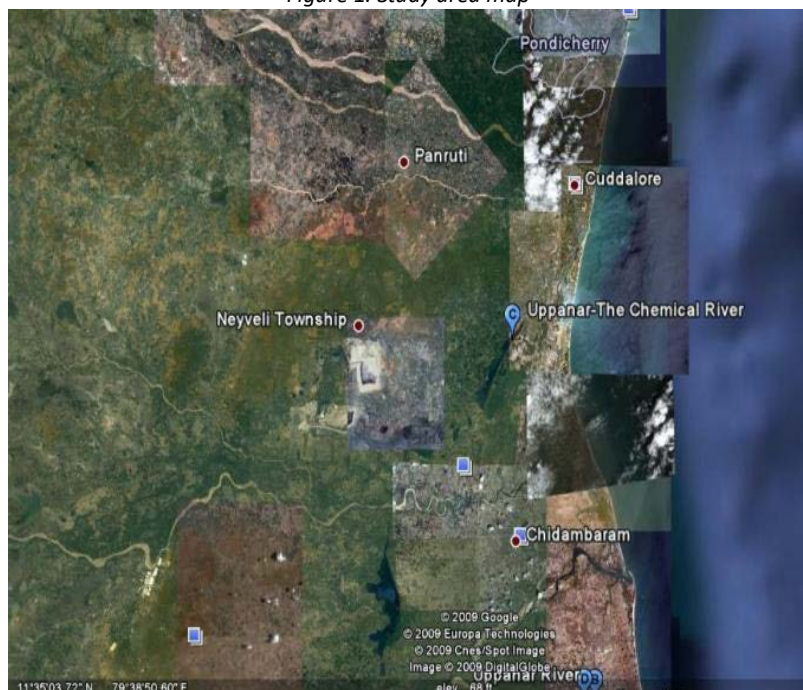
Estuarine system is one of the most important sources to the coastal or near shore ecosystem. Physico-chemical characteristics may describe the quality of water [1], [2]. Some correlation was possible among these parameters and the significant one would be useful to indicate the quality of water [3], [4]. Rivers and lakes change the water quality with seasons influencing even when there is no pollution present. Water quality assessments provide basic scientific information about water quality parameters and ecologically relevant toxicological threshold values to protect specific water uses.

The distinguish way that pollutants enter the marine environments: land runoff into the coastal zone mainly via rivers [4], [2]. The man made pollutants occupied the river which first affects its quality and then systematically disrupting the community of delicate food web. Pollution seriously impaired the conditions of the rivers estuaries. Industrial effluents impact the water bodies due to increased pollution [4]. Physical and chemical parameters influencing the aquatic environment are: temperature, rainfall, pH, salinity and Dissolved Oxygen. For the survival of aquatic organisms, these parameters involved as limiting factors [5], [3]. The present investigations have been carried out to assess the quality of water in Uppanar estuary and provide significant information about the available resources for supporting life in that ecosystem [6].

2. Study area

The Uppanar estuary is situated at Cuddalore coast (Lat.11° 43'N, Long. 79° 46' E), South-East Bay of Bengal. This river joins with the Bay of Bengal by the mouth of Gadilam River.

Figure 1. Study area map



3. Materials and Methods

1. Physico-chemical parameters in water

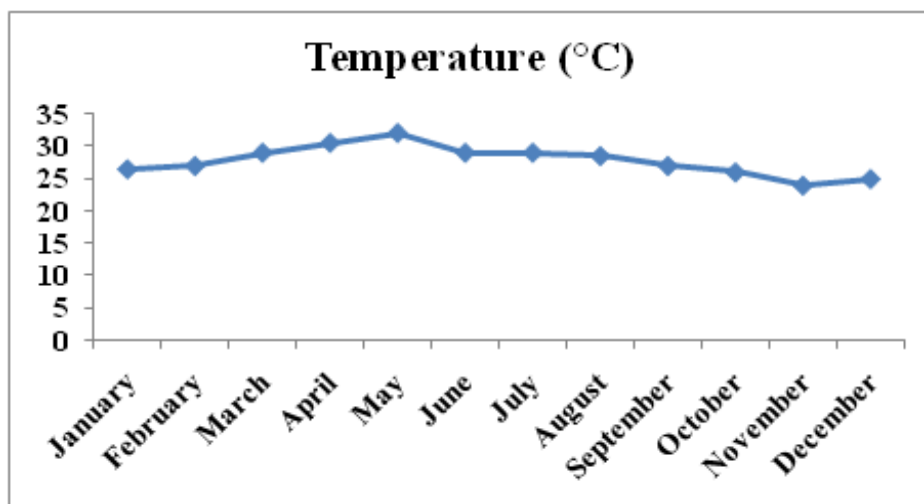
Surface water samples were collected at monthly interval in Uppanar estuary for a period of one year from Jan’ 2011 to Dec’ 2011 to assess the various physico-chemical parameters (Figure 1). For the analysis of nutrients, surface water samples were collected in clean polythene bottles and kept immediately in an icebox and transported to the laboratory. The water samples were filtered and analyzed for dissolved nitrite, nitrate, total nitrogen and inorganic phosphate by adopting standard procedure of [6], [7].

4. Results

1. Temperature

The water temperature values varied from 24.0 to 32.0°C. Minimum was recorded during the monsoon period in Nov’ 2011 and maximum during summer in May 2011 (Figure 2).

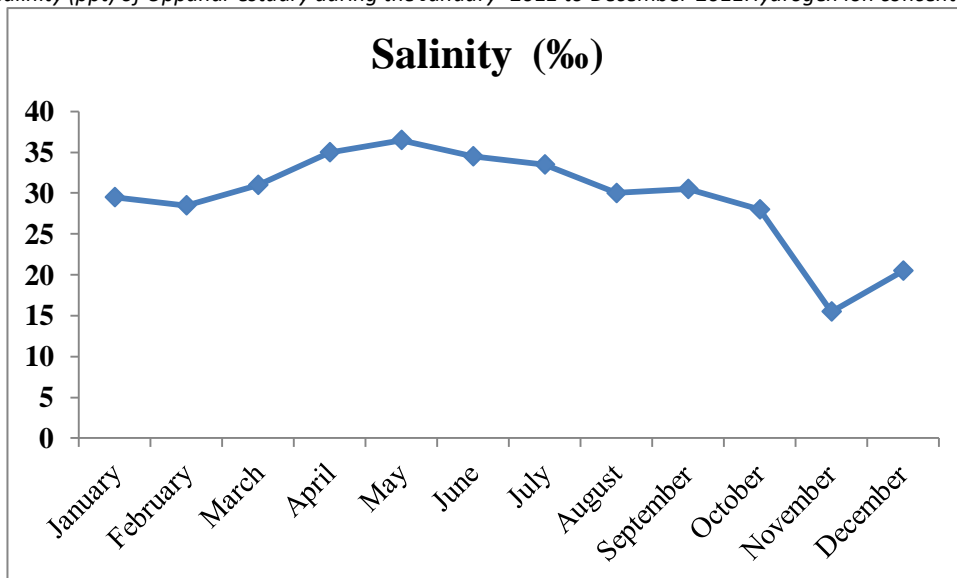
Figure 2. Temperature (°C) of Uppanar estuary during the January- 2011 to December-2011 salinity



2. Salinity

The high concentration of salinity was recorded during summer and low concentration was observed during monsoon (Figure 3). The highest values of salinity (36.5ppt) in summer (May' 2011) and low value of 15 ppt was found in monsoon.

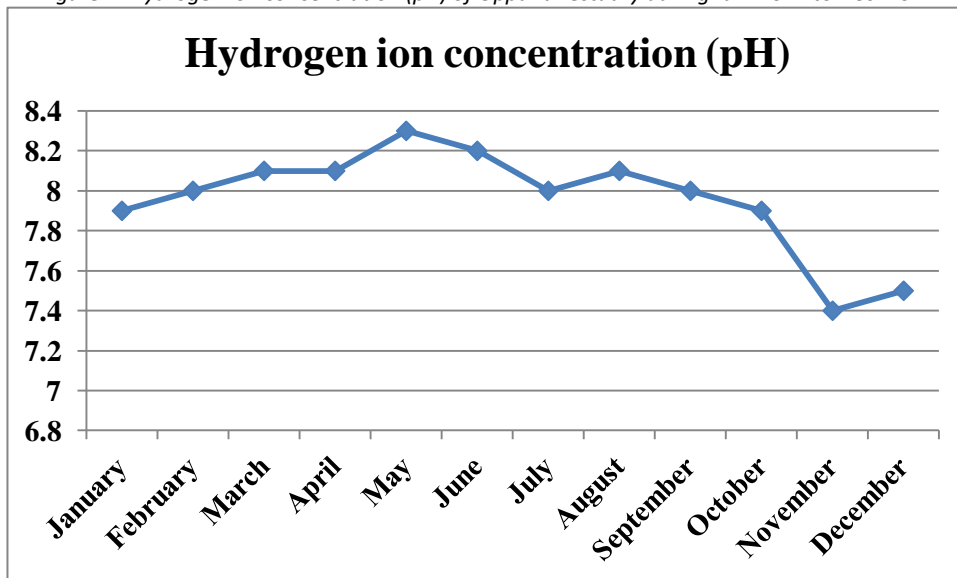
Figure 3. Salinity (ppt) of Uppanar estuary during the January- 2011 to December-2011



3. pH concentration

Hydrogen ion concentrations (pH) in surface water remained alkaline throughout the study period without any marked difference. The maximum value of pH (8.3) was observed during the summer and the minimum values of pH (7.4) was recorded in monsoon (Figure 4).

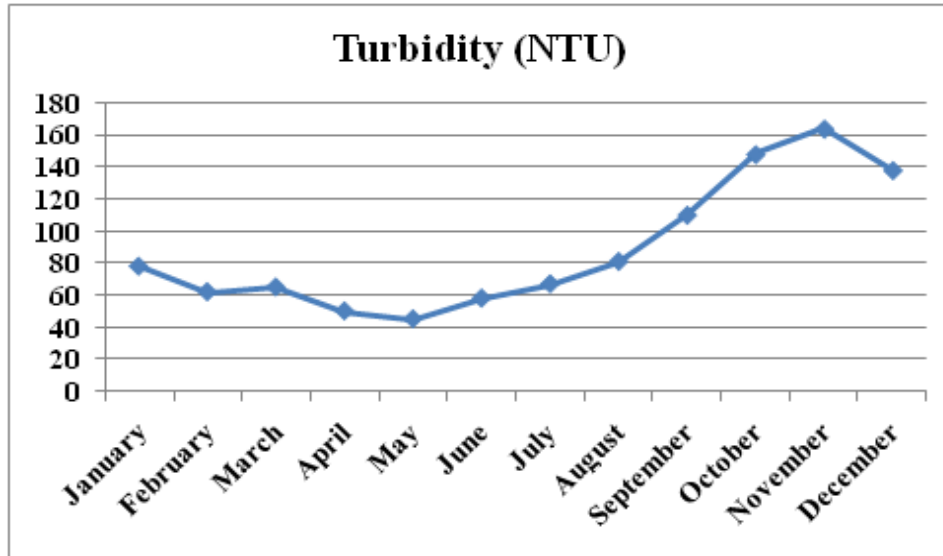
Figure 4. Hydrogen ion concentration (pH) of Uppanar estuary during Jan' 2011 to Dec' 2011



4. Turbidity

Turbidity materials in water that affect transparency or light scaling of water. The turbidity ranged 1 to 2000 NTU. The high value (164 NTU) was recorded during summer (Figure 5).

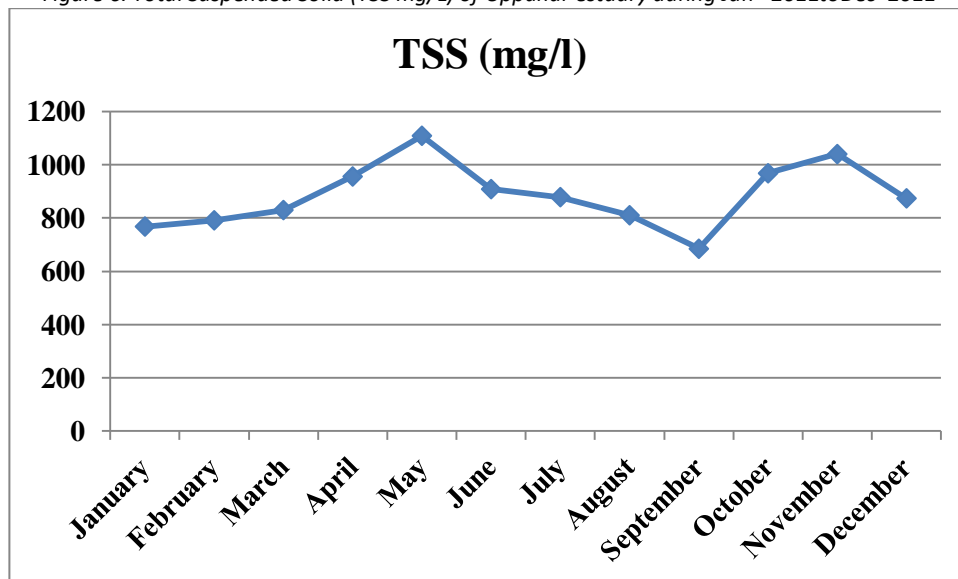
Figure 5. Turbidity (NTU) of Uppanar estuary during the January- 2011 to December-2011



5. Total suspended solids (TSS)

The higher concentration of total suspended solids (TSS) was recorded during summer and monsoon periods (1108mg/and 1040 mg/l) (Figure 6).

Figure 6. Total Suspended Solid (TSS mg/L) of Uppanar estuary during Jan' 2011toDec' 2011



6. Dissolved Oxygen (DO)

Variation of dissolved oxygen (DO) content ranged from 3.7 to 5.2 ml/l. It is well known that the temperature and salinity affect the diffusion of O₂. In the present study, higher value of DO (5.2 mg/l) was recorded during monsoon (Nov' 2011).

7. Nitrite and Nitrate

Nitrite (NO₂) the nitrite values ranged from 0.239 to 3.745 μM /l during the study period. The maximum concentration of NO₂ (3.745 μM /l) was found in monsoon season (Nov'2011) and minimum value 0.239 μM /l was recorded during the pre-monsoon season (Figure 8). Freshwater flow constituted the main source of the nutrients in the estuaries. Nitrates values ranged from 3.86 to 12.54 μM /l (Fig. 8 & 9).

Figure 7. Dissolved Oxygen (DO) of Uppanar estuary during Jan' 2011 to Dec' 2011

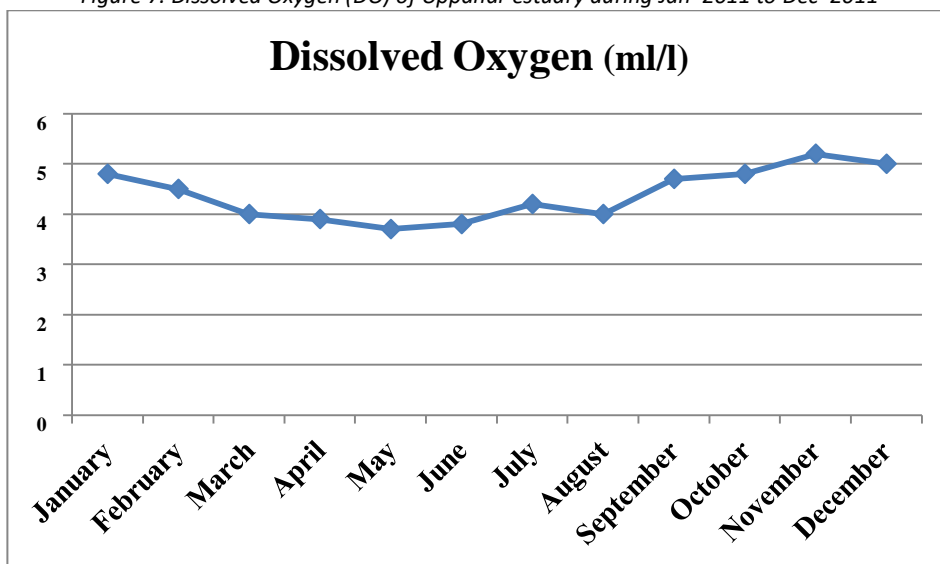


Figure 8. Nitrite (NO_2 $\mu m/l$) concentration of Uppanar estuary during Jan' 2011 to Dec' 2011

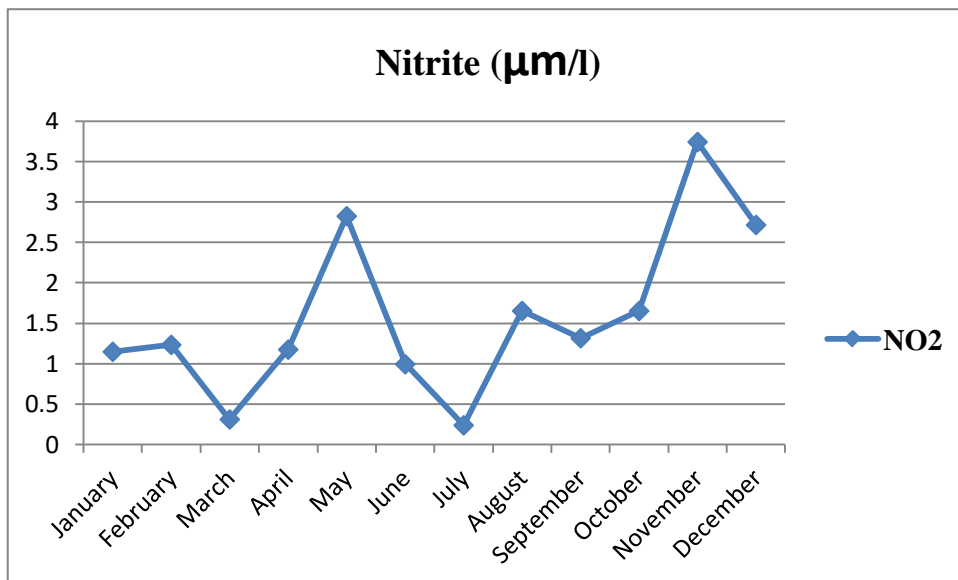
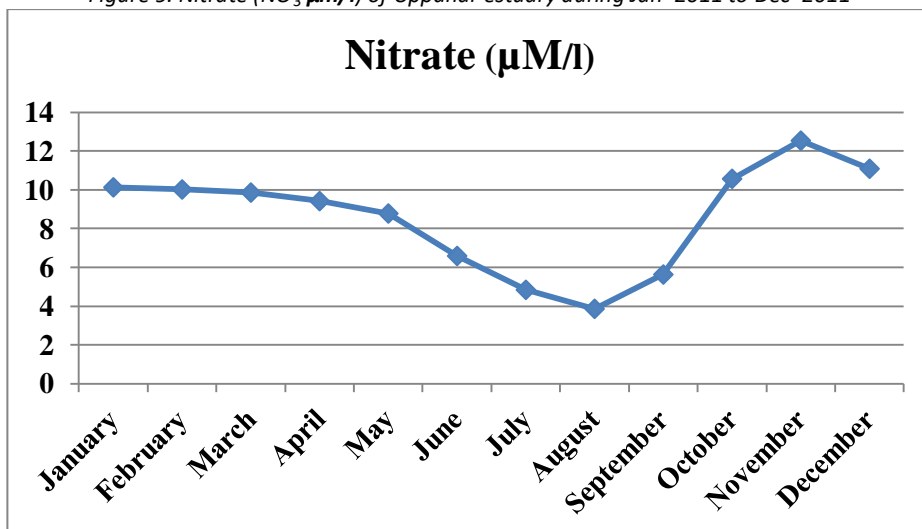


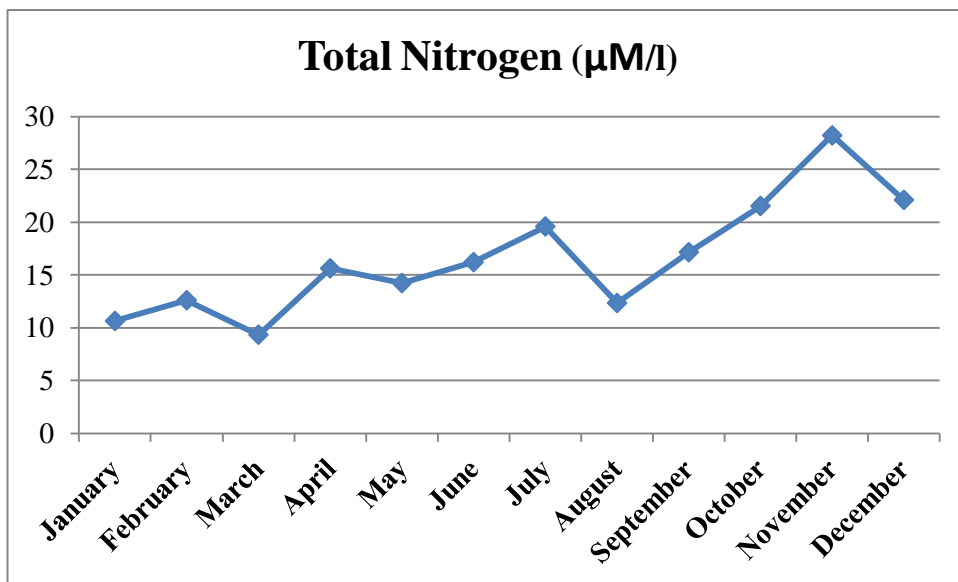
Figure 9. Nitrate (NO_3 $\mu m/l$) of Uppanar estuary during Jan' 2011 to Dec' 2011



8. Total nitrogen

Total nitrogen concentrations ranged from 9.32 to 28.19 $\mu\text{M/l}$ was recorded in this station. The minimum concentration was recorded in Aug'2011 and maximum in Nov'2011(Figure 10).

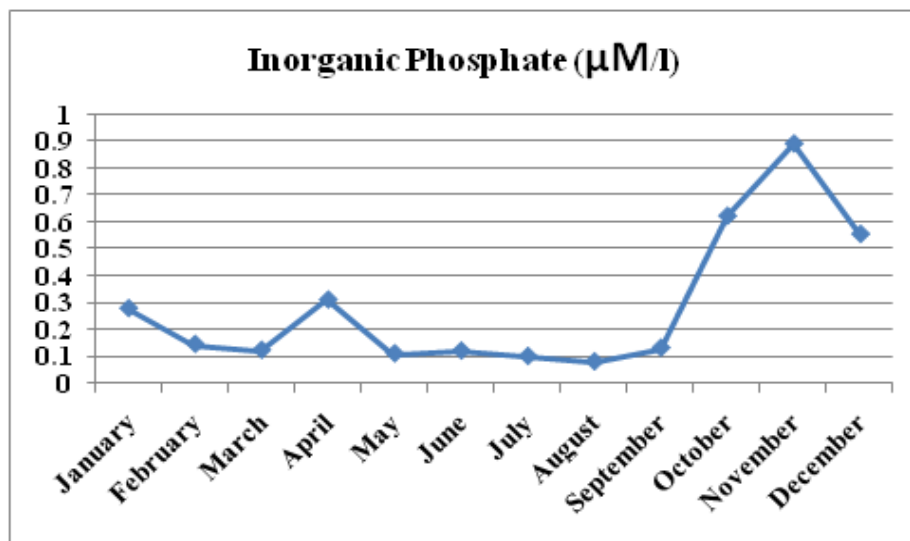
Figure 10. Total Nitrogen (TN) of Uppanar estuary during Jan' 2011 to Dec' 2011



9. Inorganic phosphates (IP)

The Inorganic phosphates (IP) values ranged from 0.110 to 0.89 $\mu\text{M/l}$ in the present study.

Figure 11. Inorganic phosphate (IP) of Uppanar estuary during Jan' 2011 to Dec'2011



5. Discussion

The variations could be occurred due to the wave and tidal action, sunlight, community metabolism and evaporation. The temperature can exert its influence on the chemical characteristics of water. The variations of the temperature change in seasons its occurring monsoonal weather conditions. Distribution of many benthic organisms and its variation caused by precipitation and evaporation due to this, the salinity variation is influencing the fauna in the marine environment especially, intertidal zones [9], [10].

The changes of salinity in the estuaries influence the freshwater inflow due to land runoff with rainfall during monsoon or tidal variations [2], [11]. During the monsoon season, the low concentration of salinity 15.5 ppt was observed due to the rainfall and freshwater inflow [12]. Generally, fluctuations of pH values are influenced due to the seasonal variations and removal of CO₂ by photosynthesis through bicarbonate degradation reduction of salinity, temperature and decomposition of organic materials as stated [13], [14]. The highest turbidity might have caused by in presence of suspended matter such as clay, silts, organic and inorganic matter, plankton, detritus as well as microscopic organisms. It has been reported that the increased wind and wave action during monsoon season and resulted in the turbulent conditions in the estuarine water [14], [15]. The TSS is typically compounds of fine clay or silt particles, plankton, organic, inorganic compounds or other microorganisms. TSS can be influenced by changes of pH. The changes of pH will cause some of the solutes to precipitate or will affect the solubility of the suspended matter. During summer and monsoon periods, the TSS content water was found to be maximum due to increased phytoplankton, zooplankton, detritus matters, and wind and wave action [5]

The DO concentration might be influencing the higher wind velocity, rainfall and resultant freshwater mixing; due to this the high concentration of DO 5.2 ml/l was recorded during monsoon (Figure 7). DO is indicative of the health of an aquatic system. The vital metabolism of aerobic organism has been involved which depends on the amount of DO available in the environment and it is essential for maintaining aesthetic qualities water as well as for supporting life [16], [17]. The nitrite concentration might be increased due to phytoplankton excretion, oxidation of ammonia and reduction of nitrate and from recycling by nitrogen and bacterial decomposition of detritus in the environment. The minimum value of nitrite (0.239 mg/l) was recorded during the pre-monsoon season (Figure 8) due to the limited or absence of freshwater inflow and high salinity [7]. The maximum concentration of nitrate (12.54 µM /l) was recorded in monsoon season due to the receiving the organic materials through the freshwater inflow and storm water input. The low value 3.86 µM/l was recorded during pre-monsoon period (Figure 9). It might be due to the utilization of this nutrient by phytoplankton [3].

Total nitrogen concentrations ranged from 9.32 to 28.19 µM. The minimum was recorded in Aug'2011 and maximum in Nov'2011 (Figure 10). It is considered as important parameters in the marine environment which is influencing the growth, reproduction and metabolic activities of aquatic organisms. The maximum value of IP was (0.89 µM/l) observed during monsoon and it might be due to an intrusion of upwelling of seawater and freshwater runoff into estuarine environment. Low value of IP concentration (0.110 µM/l) was recorded during pre-monsoon season (Figure 11) due to the absence or limited of freshwater inflow and utilization of inorganic phosphate by phytoplankton [18], [22].

6. Conclusion

The water qualities are influencing both vertical and horizontal migration of aquatic organisms. It affects the distribution, diversity and feedings of the organisms due to increasing or decreasing of physico-chemical parameters.

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