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RESEARCH ARTICLE

HYDROBIOLOGY ASPECTS RELATED ON PHYTOPLANKTON DIVERSITY OF UPPANAR RIVER, CUDDALORE COAST (SOUTHEAST COAST OF INDIA)

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ABSTRACT

The present study was carried out in the Uppanar River (Cuddalore Coast) from September 2015 to August 2016. The samples were collected during morning hours and were analysed monthly for physical, chemical and biological parameters. The various physico-chemical parameters like Water temperature, pH, Dissolved Oxygen, inorganic nitrate, inorganic nitrite, inorganic phosphate, and reactive silicate were analyzed. Results have shown an increased concentration in physico-chemical parameters is more in summer compared to other seasons. In this study phytoplankton diversity were noticed that, total of 58 species of phytoplankton were identified from the two study sites of Uppanar river during the study period. Out of 58 species, 34 species belonged to Bacillariophyceae (diatoms), 13 species to Dinophyceae (Dinoflagellates), 6 species to Cyanophyceae (Blue-greens), 4 species to Chlorophyceae (Green) and 1 species to Chrysophyceae (Silicoflagellates).

INTRODUCTION

The distribution and productivity of flora and fauna of an estuary depend on various physico- chemical factors. They are salinity, pH, temperature of water and nutrients like phosphate, nitrate, nitrite, silicate etc mixed in it. The behavior and distribution of nutrients exhibit considerable seasonal variations depending on the local conditions like discharge of sewage water, rainfall, freshwater inflow and tidal intrusion. The seasonal distribution, abiotic and biotic processes affect the nutrient cycle of different coastal environments (Choudhury and Panigrahy, 1991). Physico-chemical aspects of the Ithikkara River have been investigated to assess the quality of water. The variations of the physico-chemical properties of the water samples directly influence the biotic communities and primary productivity of the water bodies at different stations (Sheeba and Ramanujan, 2009). , pH, turbidity, conductivity, total suspended solid (TSS), nitrates, total nitrogen & total phosphate are the most important physico-chemical properties of water (APHA, 1992). The assimilation of wastewater treatment mechanism is essential to have a sustainable environment (Shivaraju, 2011). Several recent studies on physico-chemical parameters and phytoplankton community of rivers are conducted on the Imo River, Nigeria (Ogbuagu and Ayoade, 2012), and Kenti River, Republic of Karelia (Chekryzheva, 2014).

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In North India, many recent studies have been conducted. These were focused on the Chandrabhaga River (Sharma *et al*., 2007), Sutlej River (Sharma *et al*., 2013) and Malik Dinkar, (2016) observed Dhamola river in Saharanpur and to study physico-chemical analysis of water. However, few studies have been conducted on physico-chemical parameters and phytoplankton composition of backwater stream Uppanar River of Cuddalore coast. Therefore, the present study aims to determine the influence of physico-chemical parameters related on phytoplankton composition of Uppanar River, the backwater stream ecosystem.

MATERIALS AND METHODS

Uppanar River is a tributary of Gadilam River, which originates from the foothills and runs for the distance of 95 km, joins with adjoining paravanar estuary forming Uppanar-Paravanar estuarine complex and confluenceing into the Bay of Bengal. Site- I is located nearest to the Sellankuppam Village and from the river mouth, it is about 3km distance. The average depth of this site is about three meters. The mean salinity is ranged between 17%^{O} and 26 %^{O}. The bottom of this site is characterised with mud deposits. Site- II is located Cuddalore OT, The depth of this site is about two meters. The minimum level of salinity is ranged between 25%^{O} and 30 %^{O}. The bottom of the site is characterised with mud deposits. Collection of water samples with mud were undertaken in Site I and II at monthly intervals over a period of one year from September 2015 to August 2016. Samples were collected from

the study sites, just below the surface and transferred to the pre-cleaned polypropylene containers. After collection, all the samples were immediately brought to the laboratory and preserved in 4% formalin for further studies. The physico-chemical parameters such as atmospheric temperature, soil temperature, pH, salinity, dissolved oxygen (DO), inorganic nitrate, inorganic nitrite, inorganic phosphorus and reactive silicate were analyzed from the water with mud soil samples during September 2015 to August 2016. The atmospheric temperature and water temperature were measured by using a mercury thermometer. pH was determined by using electrical digital pH meter. Salinity was estimated with the help of a refract meter (ERMA, Hand Refractometer, Japan), and the values were expressed in the unit of ‰. Dissolved oxygen was estimated by Winkler's method (Strikland and Parsons, 1972) Dissolved oxygen values were expressed in mg/L. For the analysis of nutrients, surface water samples were collected in clean polyethylene bottles, kept immediately in an icebox, and transported to the laboratory.

RESULTS

Atmospheric temperature varied between 27 to 36°C during the study period. The maximum temperature 35°C was recorded during the summer in May 2016 at site I. At site I, the maximum temperature 36°C was recorded during the summer in May 2016 (Fig. 1). Surface water temperature showed the maximum temperature 33°C was recorded during the summer in May 2016 at site I and at site II, it was 33.5°C during the summer in May 2016 (Fig. 2). At site I, the minimum pH value 6 was recorded during the monsoon in November 2015 and at site II, the minimum pH 6.3 was noticed during the monsoon in December 2015. The maximum value of pH 6.6 was recorded during the summer in June 2016 at site I and at site II, the maximum value of pH 7.7 was recorded during the summer in June 2016 (Fig. 3). The maximum value of 8.1 mg/L was recorded during the monsoon in November 2015 at site I and at site II, it was 8.1 mg/L during the monsoon in November 2015 (Fig. 4).

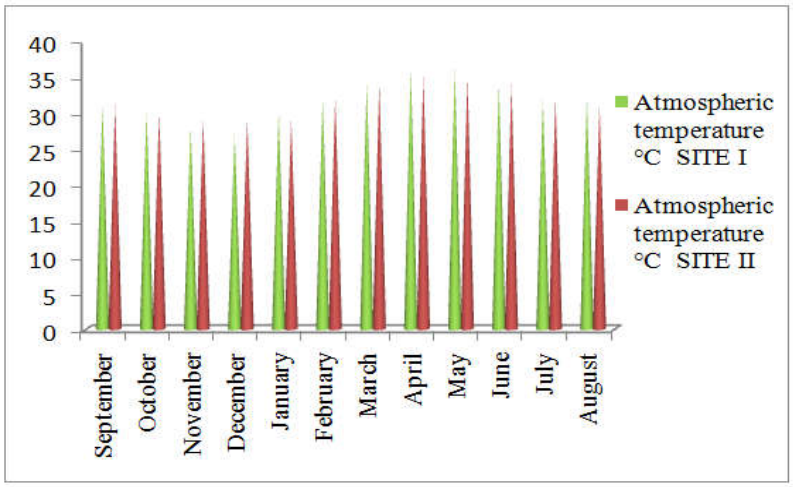

Fig. 1. Monthly variations of Air Temperature at Sites I & II

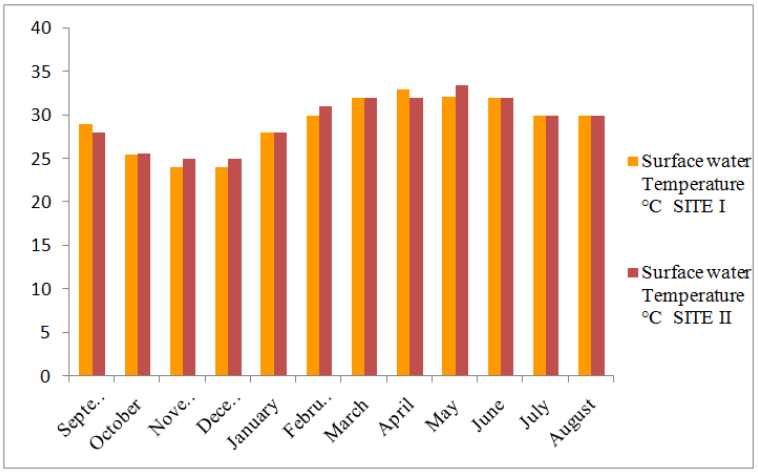

Fig. 2. Monthly variations of Surface Water Temperature at Sites I & II

The water samples were then filtered using a Millipore filtering system and analysed for inorganic nitrate, inorganic nitrite, inorganic phosphate, and reactive silicate adopting the standard procedures described by Strikland and Parsons (1972). Phytoplankton samples were collected from two different sites (Site I & Site II) of Uppanar river from September 2015 to August 2016.

At site I, the minimum salinity 17‰ was recorded during the monsoon in November and December 2015. At site II, the minimum of 11‰ was recorded during the monsoon in November and December 2015, whereas the maximum salinity value of 26.2 ‰ was recorded during the summer in May 2016 at site I and at site II, it was recorded as 23 ‰ during the summer in May 2016 (Fig. 5).

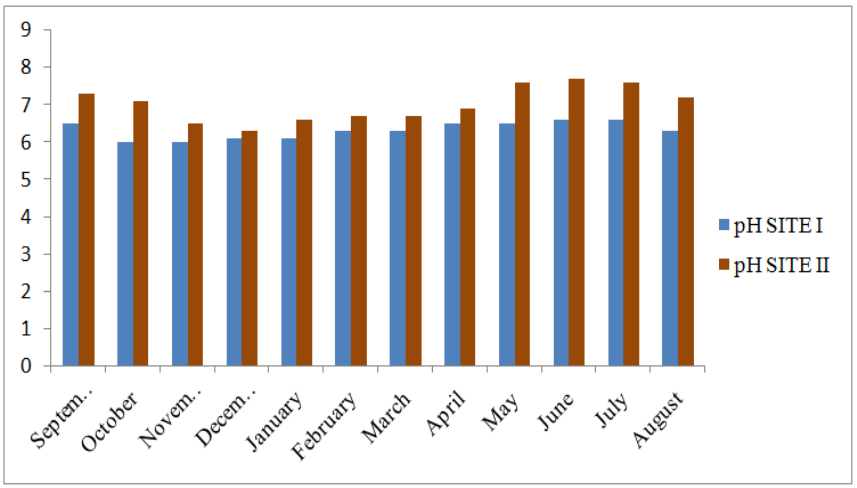

Fig. 3. Monthly variations of pH at Sites I & II

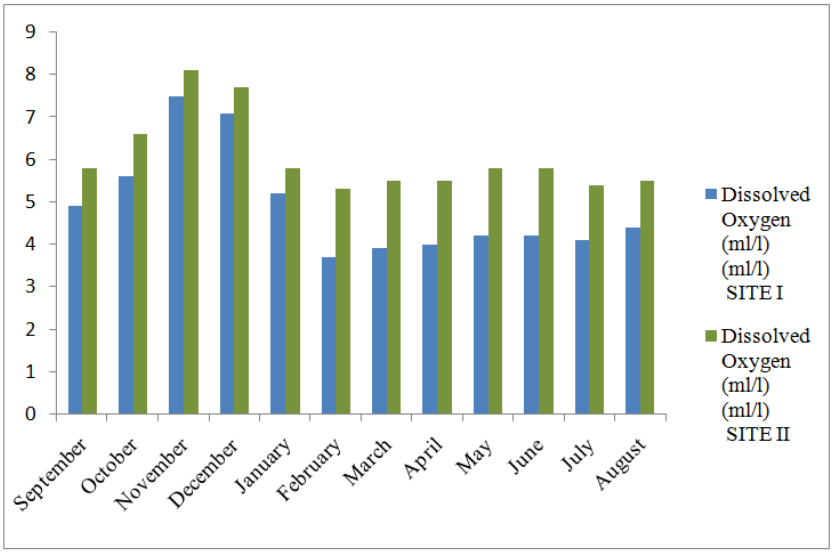

Fig. 4. Monthly variations of Dissolved Oxygen at Sites I & II

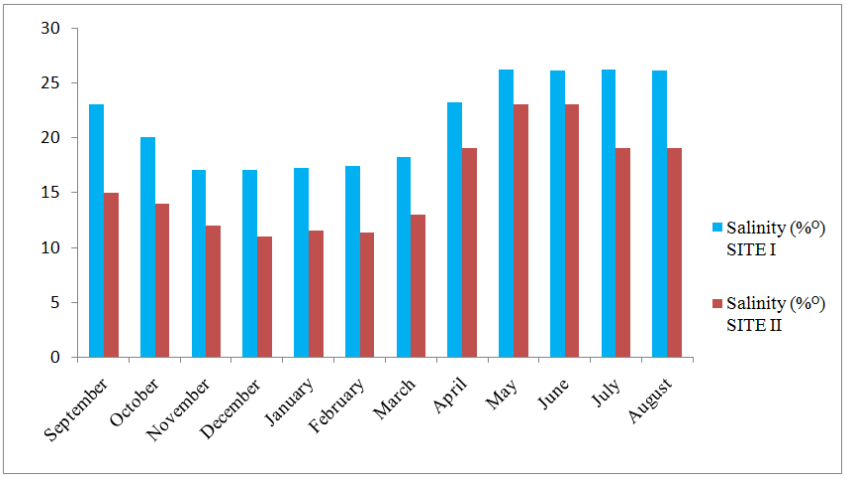

Fig. 5. Monthly variations of Salinity at Sites I & II

The maximum value of nitrate 52.3µM was recorded during the monsoon in November 2016 at site I and at site II, the maximum value of nitrate 53.5µM was recorded during the monsoon in November 2015 (Fig. 6).

The maximum value of nitrite 5µM was recorded during the monsoon in November and December 2015 at site I and at site II, the maximum value of nitrite 6.3µM was recorded during the monsoon in November 2015 (Fig. 7).

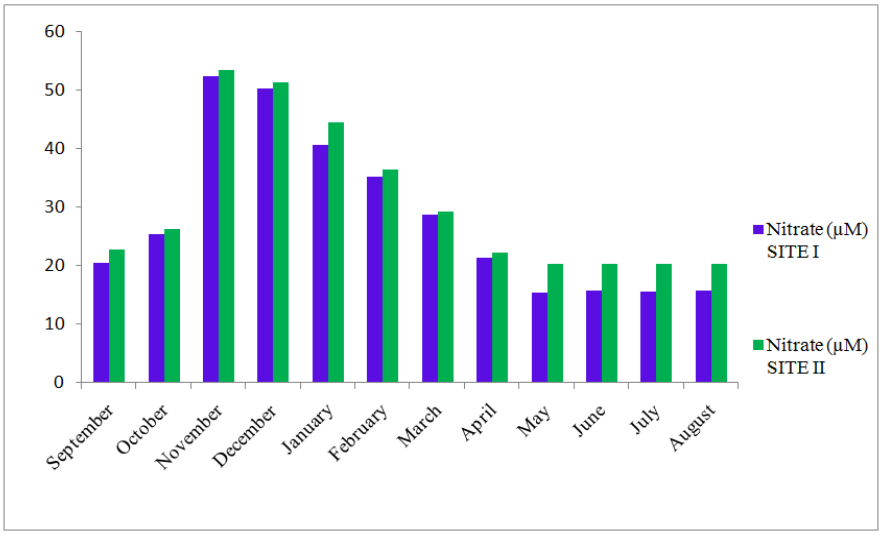

Fig. 6. Monthly variations of Inorganic Nitrate at Sites I & II

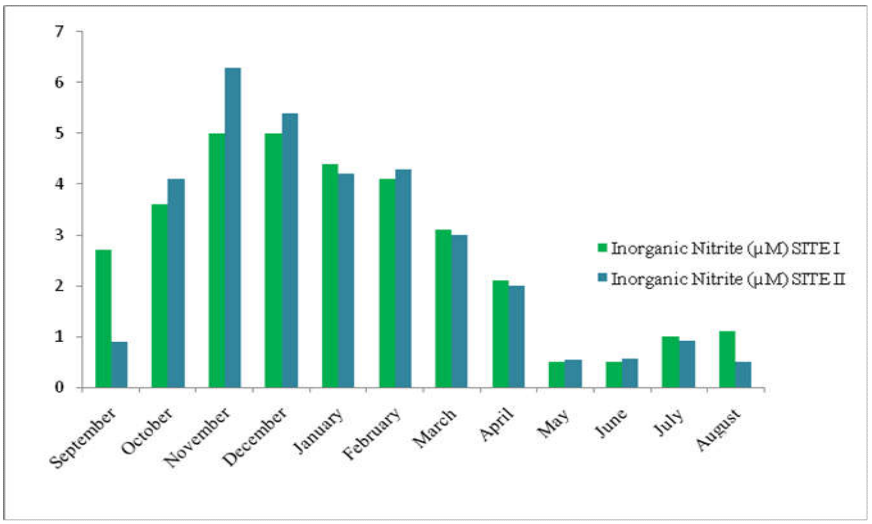

Fig. 7. Monthly variations of Inorganic Nitrite at Sites I & II

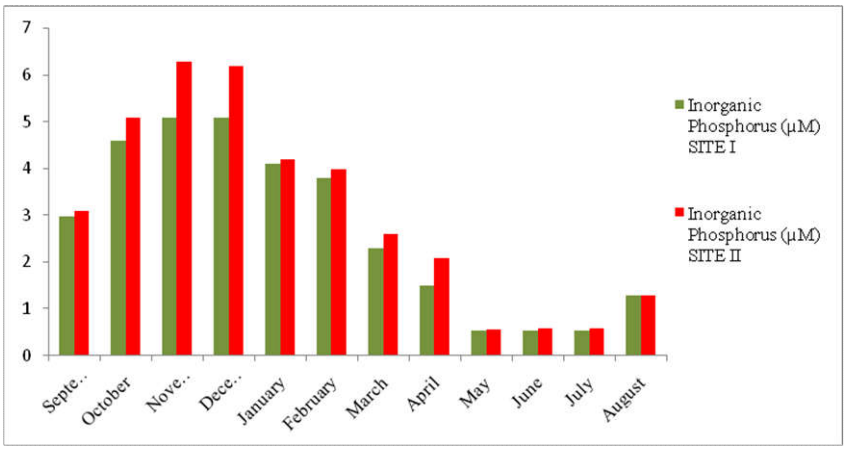

Fig. 8. Monthly variations of Inorganic Phosphorus at Sites I & II

The maximum value of phosphate 5.1µM was recorded during the monsoon in November 2015 at site I and at site II, the maximum value of phosphate 6.3µM was recorded during the monsoon in November 2015 (Fig. 8). The maximum value of silicate 134.2 µM was recorded during the monsoon in November 2015 at site I and at site II, the maximum value of silicate 149.3 µM was recorded during the monsoon in November 2015 (Fig. 9). In this study, total of 58 species of phytoplankton were identified from the two study sites of Uppanar river during the study period. Out of 58 species identified, 34 species belonged to Bacillariophyceae (diatoms), 13 species to Dinophyceae (Dinoflagellates), 6 species to Cyanophyceae (Blue-greens), 4 species to Chlorophyceae (Green) and 1 species to Chrysophyceae (Silicoflagellates).

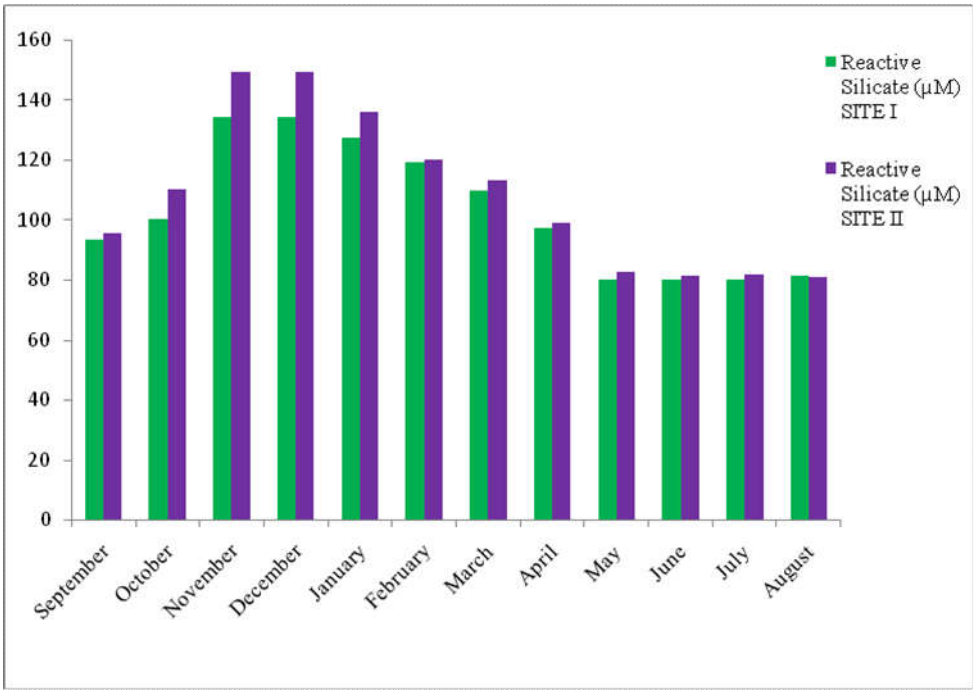

Fig. 9. Monthly variations of Reactive Silicate at Sites I & II

DISCUSSION

The physico-chemical variables of the estuarine environment are subjected to wide temporal variation. The Uppanar estuarine environment is greatly influenced by the northeast monsoonal rains. Analysing the seasonal fluctuation in the physic-chemical parameters, it found that the higher temperature was recorded during the summer season and the lower temperature was recorded during the monsoon season from both the sites. The similar findings have also been reported from Uppanar backwater (Murugan and Ayyakkannu, 1991) and Goa coastal waters (Goswami and Padmavathi, 1996). In general, in any ecosystem, not a single species grows independently and indefinitely, because all the species are interlinked and have cyclic transformation of nutrients. The physicochemical changes in the environment may affect particular species and induce the growth and abundance of other species, which lead to the succession of several species in a course of time (Muthukumar *et al.,* 2007). The environmental conditions, such as water movement, salinity, oxygen and temperature also determining the composition of its biota (Soundarapandian *et al.,* 2009). In the present study, the physicochemical parameters were analyzed in Paravanar estuary at two sites during September 2011 to August 2012. The temperature ranged from 27°C to 36°C in both the sites and it may be to the optimal temperature for the growth of blue green algae. Sreelekshmi and BennoPereira, 2017 and Liji (2010) observed a pH range of 6.7 to 8.7 from Vellayani Lake, the present study also observed a pH value between 6.5- 8.1. Odum (1971) suggested that pH of an aquatic eco system is a function of the dissolved carbon dioxide content which intern is decreased by photosynthesis and increased by respiration. The study detects a negative correlation between pH and carbon dioxide during the month of March. A minimum dissolved oxygen concentration of 4ppm is required for healthy growth of fish and for sustaining plankton population (Sridhar *et al.,* 2006). Similar distribution pattern and physico-chemical charactertics were recored in present study.

The variation in salinity in the study area was mainly influenced by the rainfall during monsoon and entry of sea water when the bar opens as reported by Kumar (2007) earlier in Manakudy mangroves. The salinity acts as a limiting factor in the distribution of living organisms and its variation caused by dilution and evaporation is most likely to influence the fauna in the coastal ecosystems (Balasubramanian and Kannan, 2005; Sridhar *et al.,* 2006). Sundaramanickam *et al.*, 2008; Santhoshkumar and Ashokbrabhu, 2014, Sreelekshmi and BennoPereira, 2017 reported the minimum salinity during the monsoon season and the maximum during summer season. The low amount of dissolved oxygen, which had a significant effect in reducing the cyanobacterial population. The similar type of results have also been reported by Muthukumar *et al.,* 2007; Subha & Chandra, 2005; Pingale & Deshmukh, 2005; Rani *et al.,* 2005. P^H is an essential parameter for the determination of water character and to differentiate the medium. It is a variable, influencing biochemical relations and possibly affecting species distribution (Thamizh Selvi and Sivakumar, 2011). It also affects the concentration and potentially influences the toxicity and limitation in the environment (Sreelekshmi and BennoPereira, 2017). Higher value of pH during the summer season was due to the uptake of CO_2 by photosynthesizing organisms. The low pH observed during the monsoon season was due to the influence of freshwater influx, dilution of seawater, low temperature and organic matter decomposition as suggested by (Paramasivam and Kannan, 2005). The recorded low values of nitrate may be due to its utilization by phytoplankton as evidenced by high photosynthetic activity and also due to the neritic water dominance, which contained only negligible amount of nitrate (Govindasamy *et al.,* 2000). Nitrite concentration was higher during the monsoon season, which was again due to the heavy rain run off water inflow. The minimum was recorded during the summer season and it may be due to high salinity. Similar observations were made earlier from Arasalar and Kavari estuaries (Ambikadevi, 1993 and Pondicherry coast Annanthan, 1994).

The nitrite values were higher at site II as the areas received large amount of freshwater inflow. The recorded high nitrite values could be due to the increased phytoplankton excretion, oxidation of ammonia and reduction of nitrate and by recycling of nitrogen and also due to bacterial decomposition of planktonic detritus present in the environment (Govindasamy *et al.,* 2000). The recorded low nitrite values during summer season may be due to less freshwater inflow and high salinity (Murugan and Ayyakkannu, 1991). The inorganic phosphate content was found to be very high during the monsoon due to the effect of excess land drainage and it could be attributed to the erosion of phosphate rocks. The monsoon season was due to large quantity of freshwater inflow and heavy rainfall inputs. The low value recored during the summer season was due to the decreased land runoff and due to the utilization of phosphate by higher amount of flora population. The similar type of observation was earlier reported from Coleroon estuary for Patterson Edward and Ayyakannu, 1991.

The recorded low primary productivity during monsoon could be related to the wash of the phytoplankton to the neritic region by the monsoonal flood besides reduction of salinity, which could have affected the phytoplankton population (Rajasegar *et al.,* 2000). The similar finds also reported by Santhosh Kumar and Ashok Prabu, 2014 and Ramesh *et al*., 2017. The reactive silicate content was comparatively higher than the NO_3, NO_2, and PO_4. Seasonal variations dissolved reactive silicate was apparent in the present study. Higher concentration was recorded during the monsoon season and this could be attributed to the heavy influx of freshwater derived from land drainage. The silicate from the bottom sediment might have been exchanged with the overlying water due to the turbulent nature water during this season. Similar observation was made from Kodiakkarai coastal sanctuary, (Anbazhgan, 1998), Uppanar estuary, (Murugan and Ayyakkanu, 1991) and water stream of Garhwal Himalayas (Ramesh *et al*., 2017). David A Ford *et al.*, 2017 was studied Phytoplankton form the base of the marine food chain, and knowledge of phytoplankton community structure is fundamental when assessing marine biodiversity.

Conclusion

The physico-chemical atmospheric temperature, soil temperature, pH, salinity, dissolved oxygen (DO)parameters inorganic nitrate, inorganic nitrite, inorganic phosphate, and reactive silicate at two the sampling sites in the study area were within the limits after heavy rain and after month of monsoon season were greater than desirable limits at two sampling sites. The distribution of phytoplankton community also recorded desirable limits at two sampling sites.

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