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Studies on Physico-Chemical Parameters in Two Different Stations in Nagore Cauvery River Basin and Pattanachcheri Village at Nagore Coastal Region, Southeast Coast of Tamilnadu

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Abstract: ***The present study was determine the Monthly variations of physico-chemical parameters viz: Temperature, Salinity, pH, Dissolved Oxygen and Nutrients of the environment and are the factors which mainly influence the production and successful propagation of planktonic life in the coastal biotopes. The ranges of values of atmospheric and surface water temperature (0°C) 23 - 29°C and 24 - 31°C, salinity (‰) 6 - 35, pH 7.7 - 8.4, dissolved oxygen (ml l^{-1}) were 3.07 - 5.66. The values (Cg l^{-1}) of nutrients were nitrate (µM) 0.84 - 13.5, nitrite (µM) 0.07 - 1.89, phosphate (µM) 0.06 - 4.58, silicate (µM) 17. 96 - 237.67 respectively.***

Keywords: Physico-chemical parameters**,** Inorganic nutrients, Coastal biotopes and Water pollution

1. Introduction

The hydro biological study is a pre-requisite in any aquatic system for the assessment of its potentialities and to understand the realities between its different trophic levels and food webs. Further, the environmental conditions such as topography, water movement, salinity, oxygen, temperature and nutrients characterizing particular water mass also determine the composition of its biota. The physico-chemical parameters, species composition and seasonal variation in plankton abundance have been studied in other regions of Indian coastal waters [1], [2]. For confirming the good quality of water resources large number of physico-chemical parameters, extend and source of any pollution load must be known for which monitoring of physico-chemical parameters and pollutants is essential. Thus, the nature and distribution of the flora and fauna in the aquatic system are mainly controlled by the fluctuations in the physical and chemical characteristics of the water body. Hence, the present study was carried out to get information on the hydrobiology of water from the Nagore Cauvery river basin and Pattanachcheri village period of one year from October 2015 to September 2016.

There are various sources which are responsible to change the biodiversity of a particular area. Hydro- biological studies have shown that urbanization is the root cause of water pollution. The main environmental factors familiar as controlling community structure of plankton are physical and chemical characteristics. The availability of nutrients plays a significant role in the plankton diversity which can reflect the environmental conditions of the ecosystem. If the supply of nutrients is less than the uptake by plankton, nutrient concentrations decrease and limit additional growth of plankton that the nutrient concentrations varies with the seasons, location and plankton community structure especially, Nitrogen (N) limitation dominates in most of the marine systems. It initiates the marine food chain, by serving as food to primary consumers like zooplankton, shellfish and finfish [3] A number of authors have studied the physical and chemical characteristics of some Indian estuaries and brackish water [4]. Hence, the present study deals with the monthly variations of Physico-chemical parameters in Nagore Brackish waters, southeast coast of India. Rainfall data was obtained from the local meteorological unit of Government of India located at Nagapattinam. Field data like temperature, salinity, dissolved oxygen and pH were measured during morning to noon.

2. Materials and Methods

The study area (Figure 1) is located Cauvery river basin at the southern part of Bay of Bengal in South East coast of Tamilnadu. It is extending from 10º 30' to 10º 55' N latitude and 79º 45' to 79º 55' E longitude and medium tropical transition climate, characterized by monthly average temperature of above 27º C. The relative humidity ranges from 70 – 77%. The Nagore brackish water is situated near Nagapattinam on the east coast of Tamilnadu, India. The Nagore brackish water has its source in the Cauvery river Basin of Tamil Nadu. It has a year - round connection with the sea. This river flows in to the Bay of Bengal, near Nagapattinam of Tamil Nadu. In the harbor at Nagore, there are about many hundreds of mechanized boats and catamarans, employed for fishing. In the fishing vessels they are using paints and fuels from it the waste materials are released in to the harbor area. The domestic sewages agricultural drainages and the other sewage effluents are carried out into the Bay of Bengal through the small canals and rivers.

Atmospheric and Temperature (surface water) was measured using a standard centigrade mercury thermometer. Salinity was estimated with the help of a Refractometer model-E2 (ERMA, Hand Refractometer, and Japan) and seawater pH was measured using a ELICO Grip pH meter, Dissolved oxygen was estimated by the modified Winkler's method. For the analysis of nutrients, surface water samples were collected in clean plastic bottles and kept in an ice box and

transported immediately to the laboratory. The water samples were filtered through the Millipore filtering system (MFS) for required filtered sample. The dissolved oxygen, nitrite, nitrate and reactive silicate by adopting the standard methods described by Strickland and Parsons (1972). For the present study, two sampling sites were chosen. Station 1 is Nagore Cauvary river basin and Nagore Pattanachcheri village is station 2. Monthly samplings were made during forenoon from October 2015 to September 2016 for four seasons viz. monsoon (October-December), post-monsoon (January-March), summer (April-June) and pre-monsoon (July-September). Monthly variations of physico-chemical parameters *viz*., Temperature, Salinity, pH, Dissolved oxygen, Nitrate, Nitrite, Total Phosphate and Reactive Silicate. The mean and standard deviation was calculated.

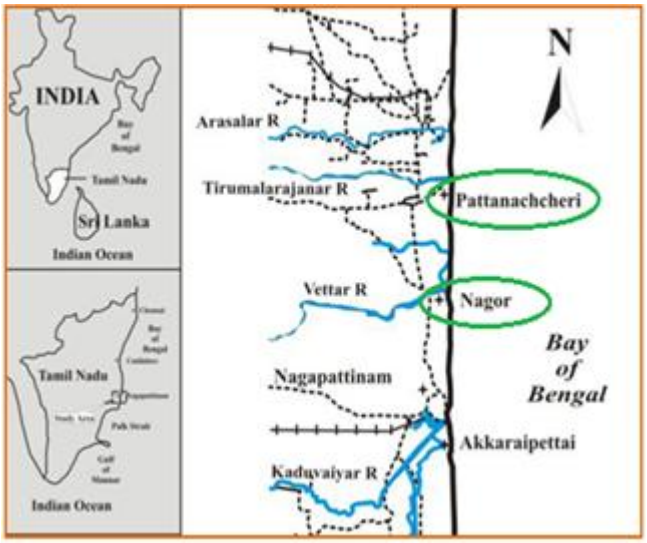

Figure 1: Study area map

3. Results and Discussion

Atmospheric temperature: Atmospheric and surface water temperature varied from 23.0 to 29.0^{0}C and 24.0 to 31.0^{0}C, respectively at the two stations, with minimum and maximum mean values of 26.57±1.83 (Stn.1) and 27.1±1.42 (Stn.2) and 27.25±1.53 (Stn.1) and 28.31±1.74 (Stn.2). Salinity values varied from 6.0 to 35.0‰, with minimum and maximum mean values of 21.91±9.95‰ (Stn.1) and 25.5±9.65‰ (Stn.2). pH in water ranged between 7.7 and 8.4, with minimum and maximum mean values of 8.12±0.20 (Stn.1) and 8.19±0.16 (Stn.2). Variation in dissolved oxygen content was from 3.07 to 5.66 ml l^{-1}, with minimum and maximum mean values of 4.26±0.60 ml l^{-1} (Stn.1) and 4.54±0.50 ml l^{-1} (Stn.2). Nitrate values varied from 0.84 to 13.5 µM, with minimum and maximum mean values of 4.93±2.55 µM (Stn.1) and 4.70±3.43 µM (Stn.2). Nitrite values ranged between 0.07 and 1.89 µM, with minimum and maximum mean values of 0.93±0.57 µM (Stn.1) and 0.95±0.46 µM (Stn.2). Phosphate concentration varied from 0.06 to 4.58 µM, with minimum and maximum mean values of 2.35±1.34 µM (Stn.1) and 1.88±1.02 µM, (Stn.2). Silicate values ranged between 17.96 to 237.67 µM, with minimum and maximum mean values of 109.74±79.41 µM (Stn.1) and 93.87±77.83 µM (Stn.2). (Table 1 and Figure 2)

Table 1: Monthly variations in Atmospheric temperature recorded of stations I and II during October 2015 to September 2016

Atmospheric Temperature		
Months	*Station-1*	*Station-2*
Oct. 2015	25.5	26
Nov.	23	24.5
Dec.	25	26
Jan. 2016	24	25
Feb.	27	26.5
Mar.	26.9	28
Apr.	29	28
May	29	29
June	26	27.2
July	27.5	28
Aug.	28	29
Sep. 2016	28	28

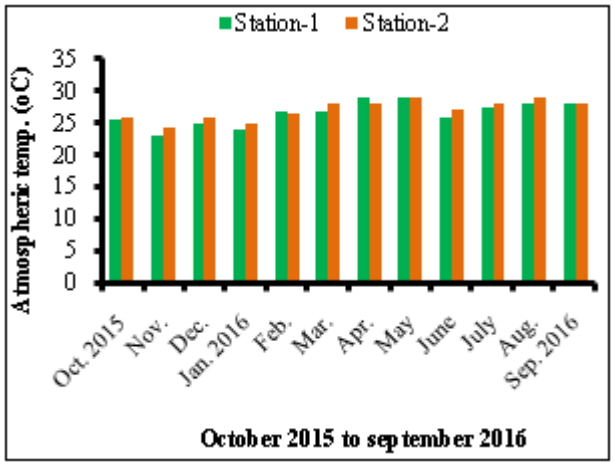

Figure 2: Monthly values of Atmospheric temperature recorded of Nagore Cauvery river basin and Pattanachcheri village (stations I and II)

Surface water temperature: The surface water temperature (Table 2 and Figure 3) showed an increasing trend from December through April and was influenced by the intensity of solar radiation, evaporation, freshwater influx and flow from adjoining neritic waters. The observed low value of November due to strong land sea breeze and precipitation and the recorded high value during summer could be attributed to high solar radiation. The observed spatial variation in temperature could be due to the viable intensity of prevailing streams and the resulting mixing of water.

Table 2: Monthly variations in Surface water temperature recorded of stations I and II during October 2015 to September 2016

Surface water temperature		
Months	*Station-1*	*Station-2*
Oct. 2015	27	28
Nov.	24	24.5
Dec.	25	27
Jan. 2016	27	26
Feb.	26	28
Mar.	28	29
Apr.	29	30

May	29	31
June	28	29
July	29	29.5
Aug.	28	28.8
Sep. 2016	27	28

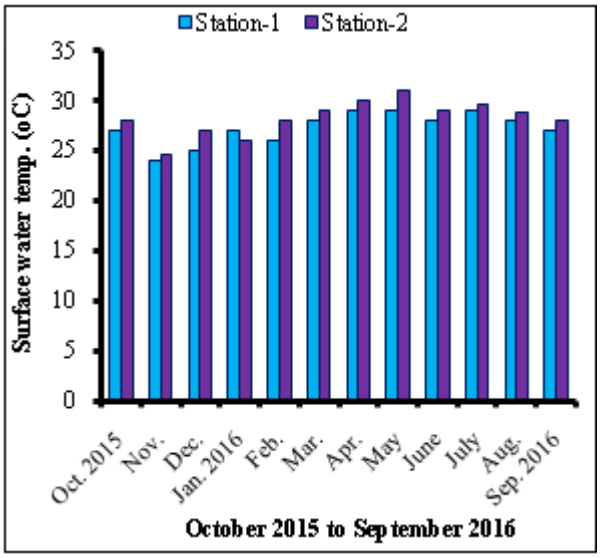

Figure 3: Monthly values of Surface water temperature recorded of Nagore Cauvery river basin and Pattanachcheri village (stations I and II)

Salinity: 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 ecosystem [5]. Presently wide salinity variations were observed between two stations and during different seasons. The salinity was found to be high during summer season and low during the monsoon season at both the stations. The recorded higher values (35.0‰) could be attributed to the low amount of rainfall, higher rate of evaporation and also due to neritic water dominance, as reported by earlier workers in other areas [6]. During the monsoon season, the rainfall and the freshwater inflow from the land in turn moderately reduced the salinity (7.0‰). The minimum salinity was recorded during the monsoon season and the maximum was recorded during summer season as reported earlier by [7]. (Table 3 and Figure 4)

Table 3: Monthly variations in Salinity recorded of stations I and II during October 2015 to September 2016

Salinity		
Months	*Station-1*	*Station-2*
Oct. 2015	12	24
Nov.	9	7
Dec.	7	8
Jan. 2016	6	14
Feb.	22	28
Mar.	25	31
Apr.	32	30
May	30	33
June	29	35
July	28	33
Aug.	32	30
Sep. 2016	31	33

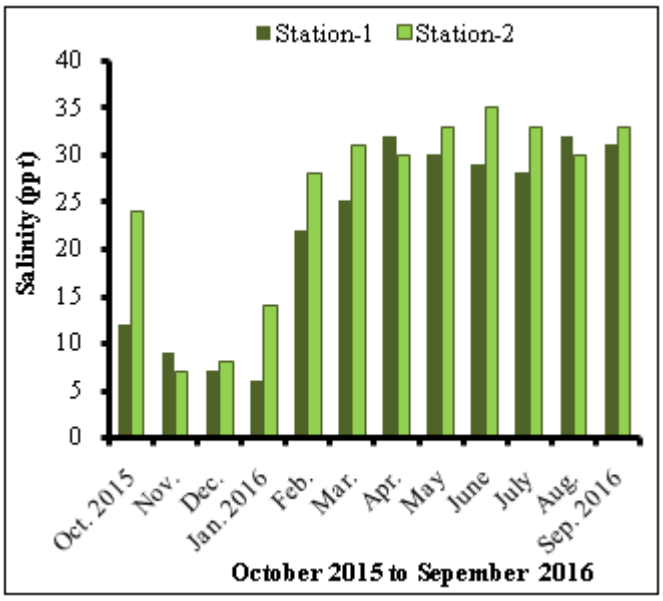

Figure 4: Monthly values of Salinity recorded of Nagore Cauvery river basin and Pattanachcheri village (stations I and II)

pH: Hydrogen ion concentration (pH) in surface waters remained alkaline throughout the study period at all the stations with summer maximum (8.4) and monsoon minimum (7.7). Generally, its seasonal variation is attributed to factors like removal of CO_2 by photosynthesis through bicarbonate degradation, dilution of seawater by freshwater influx, low primary productivity, reduction of salinity and temperature, and decomposition of organic matter [8]. The recorded high summer pH might be due to the influence of seawater penetration and high biological activity and due to the occurrence of high photosynthetic activity [9]. (Table 4 and Figure 5)

Table 4: Monthly variations in pH recorded of stations I and II during October 2015 to September 2016

pH		
Months	*Station-1*	*Station-2*
Oct. 2015	8.1	8.3
Nov.	7.8	7.8
Dec.	8.2	8.3
Jan. 2016	7.7	8.2
Feb.	8.2	8.1
Mar.	8.3	8.1
Apr.	8.4	8.4
May	8	8.1
June	8.2	8.1
July	8.2	8.4
Aug.	8.4	8.3
Sep. 2016	8	8.2

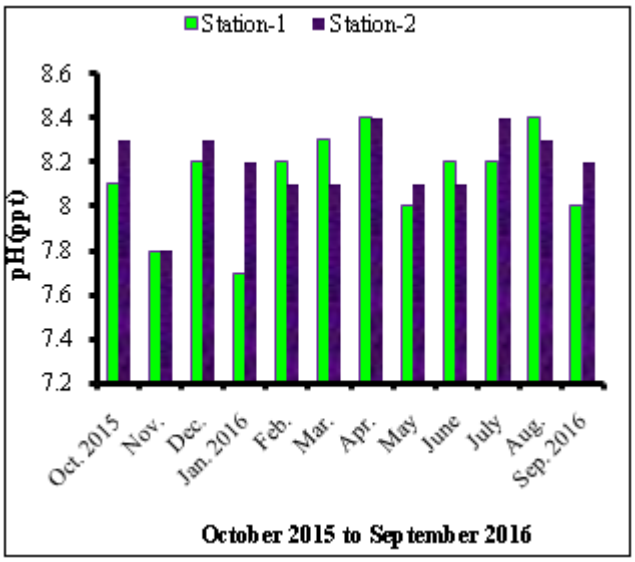

Figure 5: Monthly values of pH recorded of Nagore Cauvery river basin and Pattanachcheri village (stations I and II)

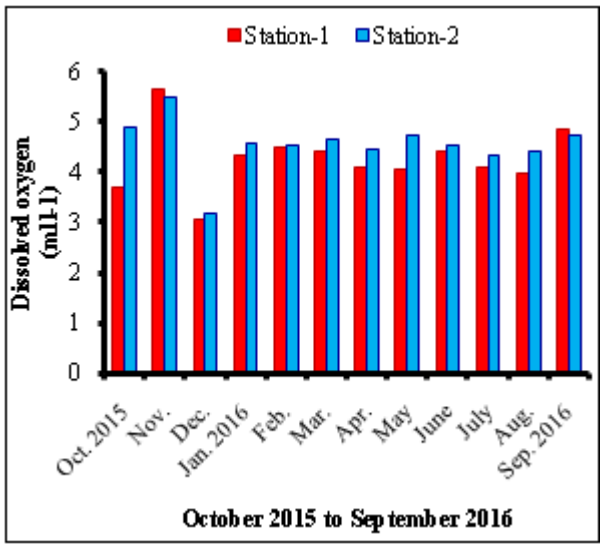

Figure 6: Monthly values of Dissolved oxygen recorded of Nagore Cauvery river basin and Pattanachcheri village (stations I and II)

Dissolved oxygen: Variation in dissolved oxygen content was from 3.07 to 5.66 mg l^{-1}. In the present investigation, higher values of dissolved oxygen were recorded during monsoon season which might be due to the cumulative effect of higher wind velocity coupled with heavy rainfall and the resultant freshwater mixing attributed that seasonal variation of dissolved oxygen is mainly due to freshwater flow and terrigenous impact of sediments [10]. (Table 5 and Figure 6)

Table 5: Monthly variations in Dissolved oxygen recorded of stations I and II during October 2015 to September 2016

Dissolved oxygen		
Months	*Station-1*	*Station-2*
Oct. 2015	3.7	4.9
Nov.	5.66	5.49
Dec.	3.07	3.18
Jan. 2016	4.34	4.57
Feb.	4.49	4.54
Mar.	4.43	4.66
Apr.	4.1	4.46
May	4.05	4.71
June	4.43	4.54
July	4.08	4.33
Aug.	3.96	4.4
Sep. 2016	4.85	4.73

Behavioral and distribution of nutrients such as nitrate, nitrite, phosphate and silicate in the coastal waters would exhibit considerable seasonal variations depending on the local conditions of rain fall, quantum of freshwater in flow, tidal incursions and nutrients consumption by plankton biomass and regeneration. Low concentration of nutrients observed during the summer season may perhaps, due to a decrease in fertilizer waste disposal from the terrestrial region and consumption of nutrients by plankton biomass. Seasonal fluctuations of nutrients have also been reported in Tranquabar - Nagapattinam coastal areas in Arasalar and Kaveri estuaries and in Madras-Kovalam coastal zone. Nutrients are considered as one of the most important parameters in the brackish water environment influencing growth, reproduction and metabolic activities of living beings. Distribution of nutrients is mainly based on the season, tidal conditions and freshwater flow from land source.

Nitrates: The recorded highest nitrates value (13.5 µM) during monsoon season could be mainly due to the organic materials received from the catchment area during ebb tide. The recorded highest monsoonal nitrate value could be mainly due to the organic materials received from the catchment area during ebb tide. Another possible way of nitrate input could be through oxidation of ammonia form of nitrogen to nitrite formation. The recorded low values (0.84 µM) during non-monsoon period may be due to its utilization by plankton as evidenced by high photosynthetic activity and the dominance of neritic seawater having a negligible amount of nitrate. (Table 6 and Figure 7)

Table 6: Monthly variations in Nitrate recorded of stations I and II during October 2015 to September 2016

Nitrate		
Months	*Station-1*	*Station-2*
Oct. 2015	7.43	6.4
Nov.	9.21	13.5
Dec.	4.81	8.52
Jan. 2016	5.57	2.1
Feb.	1.86	2.23

Mar.	0.97	0.84
Apr.	0.89	0.95
May	3.96	3.89
June	6.84	5.76
July	7.52	4.89
Aug.	4.66	3.07
Sep. 2016	5.46	4.32

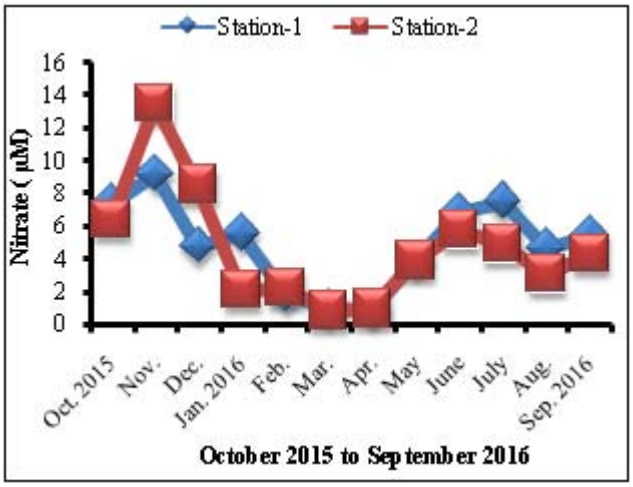

Figure 7: Monthly values of Nitrate recorded of Nagore Cauvery river basin and Pattanachcheri village (stations I and II)

Nitrite: The recorded higher nitrite values during monsoon season (1.89 µM) could be due to the increased plankton excretion, oxidation of ammonia, reduction of nitrate, and the recycling of nitrogen and bacterial decomposition of planktonic detritus [11], and also due to denitrification and air-sea interaction exchange of chemicals. The recorded low nitrite value (0.07 µM) during summer season may be due to high salinity. (Table 7 and Figure 8)

Table 7: Monthly variations in Nitrite recorded of stations I and II during October 2015 to September 2016

Nitrite		
Months	*Station-1*	*Station-2*
Oct. 2015	0.23	0.74
Nov.	1.84	1.89
Dec.	1.69	1.45
Jan. 2016	0.6	0.54
Feb.	0.39	0.09
Mar.	0.58	0.47
Apr.	0.07	0.92
May	0.54	0.81
June	1.09	0.96
July	1.54	1.21
Aug.	1.32	1.04
Sep. 2016	1.33	1.31

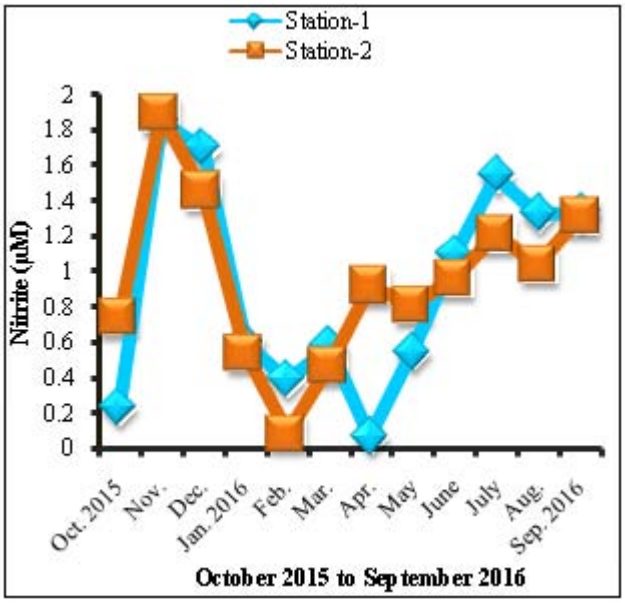

Figure 8: Monthly values of Nitrite recorded of Nagore Cauvery river basin and Pattanachcheri village (stations I and II)

Phosphate: The observed high monsoonal inorganic phosphate value (4.58µM) might be due to the regeneration and release of total phosphorus from bottom mud into the water column by turbulence and mixing also attributed to the higher monsoonal values. Moreover, the bulk of weathering of rocks soluble alkali metal phosphates (in the upstream area) are carried into the estuaries. The addition of super phosphates applied in the agricultural fields as fertilizers and alkyl phosphates used in households, as detergents can be other sources of inorganic phosphates during the season. The post-monsoonal low value (0.06 µM) could be attributed to the limited flow of freshwater, high salinity and utilization of phosphate by plankton. The variation may also be due to the processes like adsorption and desorption of phosphates and buffering action of sediment under varying environmental conditions. (Table 8 and Figure 9)

Table 8: Monthly variations in Phosphate recorded of stations I and II during October 2015 to September 2016

Phosphate		
Months	*Station-1*	*Station-2*
Oct. 2015	4.58	3.2
Nov.	3.57	3.63
Dec.	2.27	2.04
Jan. 2016	2.83	2.14
Feb.	1.6	2.12
Mar.	0.89	0.76
Apr.	0.59	0.22
May	0.06	0.09
June	2.3	2.12
July	3.86	2.09
Aug.	2.03	1.74
Sep. 2016	3.64	2.43

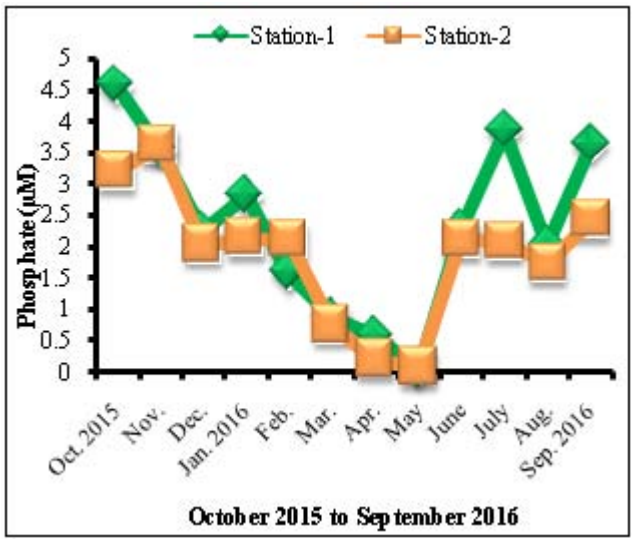

Figure 9: Monthly values of Phosphate recorded of Nagore Cauvery river basin and Pattanachcheri village (stations I and II)

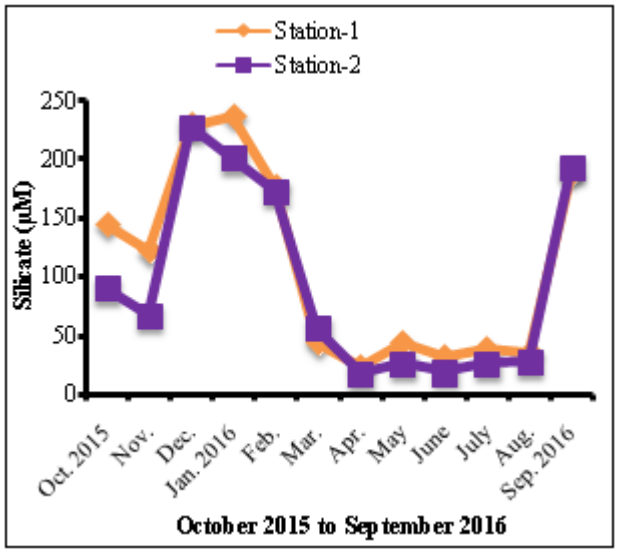

Figure 10: Monthly values of Silicate recorded of Nagore Cauvery river basin and Pattanachcheri village (stations I and II)

Silicate: The silicate content was higher than that of the other nutrients (NO3, NO2 and PO4) and the recorded high monsoon values (237.67 µM) could be due to large influx of monsoonal freshwater derived from land drainage carrying silicate leached out from rocks and also from the bottom sediment. The removal of silicates by adsorption and co-precipitation of soluble silicate silicon with humic compounds and iron. The observed low summer and post-monsoonal values (17.96 µM) could be attributed to uptake of silicates by plankton for their biological activity. (Table 9 and Figure 10)

Table 9: Monthly variations in Silicate recorded of stations I and II during October 2015 to September 2016

Silicate		
Months	*Station-1*	*Station-2*
Oct. 2015	145	90.16
Nov.	121.92	66.98
Dec.	229.51	228.03
Jan. 2016	237.67	201.1
Feb.	177.76	173.4
Mar.	44.1	56.24
Apr.	23.26	17.96
May	43.81	25.96
June	31.37	19.64
July	38.42	25.88
Aug.	35.97	27.91
Sep. 2016	188.2	193.24

4. Conclusion

The physico-chemical variation condition of the brackish water of Nagore coast, in general is in good quality. However, in the two areas, the physico-chemical parameters are not very much varied. The results of the physico-chemical variables investigated from Cauvery river basin indicated that most of the parameters did not exceed the safe limits. The mean pH of the river was still basic. Cauvery river basin is a good example of a site where contributions of pollutants both from natural (lithogenic) sources and anthropogenic activities. The major sources of pollution of the Cauvery river basin are the industrial effluents, return flows, agricultural runoff, municipal and domestic sewage besides pedogenic background contributions. The present study reveals that surface temperature slightly varied in the month of December and pH has smaller variation in all the months. Salinity was lowest value in the month of October. Dissolved oxygen little varied in month of November. Nitrate and nitrite, phosphates, Silicate was found to be slightly varied monthly. The variation in Physico-chemical variation mainly depends on monsoon rains. The physico-chemical analysis of Pattanachcheri village showed an optimum pH in the suitable range for most of the biological life because the reactions in the neutral range to slightly alkaline is most favourable. The fluctuations in Physico-chemical parameter influence the natural activity and efficiency of marine organism.

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