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Research Article

SEASONAL CHANGES OF HYDROGRAPHICAL PARAMETERS IN PARANGIPETTAI COASTAL WATERS, SOUTHEAST COAST OF INDIA

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ABSTRACT

Physico-chemical parameters were determined along the Parangipettai coastal waters, southeast coast of India. All the physico-chemical parameters such as water temperature, salinity, pH, dissolved oxygen, total suspended solids and nutrients like nitrate, nitrite, ammonia, inorganic phosphate, reactive silicate and particulate organic carbon were studied for a period of four seasons (Summer 2015–Postmonsoon 2016). Water temperature (22.0 to 34.0°C), salinity (23.0 and 34.0 psu), pH (7.8 and 8.5), Dissolved oxygen content (4.14 to 6.56 mg/l) and Total suspended solids (72.81 to 172.43ppm) varied significantly in all the seasons. Concentrations of nutrients, viz. nitrates (0.36–1.27 µmol/l), nitrites (3.55–5.97 µmol/l), ammonia (0.02–0.09 µmol/l), inorganic phosphate (0.33–2.32 µmol/l), reactive silicates (24.73–71.50 µmol/l) and particulate organic carbon (78.35–129.09 µmol/l) also varied independently based on the seasonal changes.

Keywords: Parangipettai, Seasonal variation, Physico-chemical, Nutrients

INTRODUCTION

Physico-chemical parameters play an important role in determination of various biological processes (growth, physiology, reproduction, etc.) and the general productivity of aquatic ecosystem. The physico-chemical parameters such as temperature, salinity, dissolved oxygen and nutrients are of profound biological significance and are used as population indicators (Head, 1985). Water quality plays a decisive role in resource management. In order to implement proper conservatory measures, it is important to assess the physical and chemical conditions of the coastal region (Prasad and Patil, 2008).

The information on nutrients and its circulation pattern along the coast is of paramount importance in understanding the numerous ocean processes, since nutrients play a major role in controlling the productivity and in turn influence the other trophic levels. They are also considered as limiting factors of the aquatic environment and their transportation within the system governed by various processes such as upwelling, sedimentation, waves and currents etc. and therefore it is essential to have a thorough monitoring of the nutrients and their impact on the primary production and biological health.

As the Parangipettai coast is surrounded by some of the world's most heavily populated lands, large changes are expected in the supply of nutrients and organic matter to the coastal and open waters in this region. Hence, the present study was made to assess the present status of hydrographical features (water temperature, pH, Salinity, DO, TSS, NO_2, NO_3, NH_3, IP, Silicate and POC) of Parangipettai coastal waters, southeast of India.

MATERIALS AND METHODS

Study Area:

Parangipettai is a small coastal town located about 40 km south of Cuddalore, East coast of India, comprising of riverine, estuarine, backwater, mangrove and neritic biotopes. Parangipettai coastal waters within the Bay of Bengal (Latitude 11°21'55.88"N and Longitude 79°49'1.20"E) has always perennial connection with Vellar and Coleroon estuary. To study the present status of physico-chemical and nutrient parameters (water temperature, pH, Salinity, DO, TSS, NO_2, NO_3, NH_3, IP, Silicate and POC) of Parangipettai coast, five stations were fixed extending horizontally from mouth of Vellar estuary to Coleroon estuary with an interval of 3 km between the each stations. The sampling locations and geographical coordinates are shown in Table. 1 and Fig.1

Nearshore waters	Latitude	Longitude
NS- 1	11°30'41.10"N	79°47'47.17"E
NS- 2	11°29'6.68"N	79°49'14.51"E
NS- 3	11°26'48.19"N	79°49'27.09"E
NS- 4	11°24'30.87"N	79°50'14.37"E
NS- 5	11°21'55.65"N	79°50'28.00"E

Table 1: Geographical locations of sampling stations in Parangipettai coastal waters

Figure 1: Study area map

Sample Collection and Analysis:

Water samples for the analysis of physical and nutrient parameters were collected seasonally from the above mentioned stations during low and high tide from summer 2015 to postmonsoon 2016. The surface water samples were collected using precleaned plastic buckets and were transferred to pre-cleaned polypropylene bottle of 1 litter capacity. The bottles and buckets used for collection were cleaned by 20% v/v nitric acid and then washed with 2 m hydrochloric acid and distilled water. The temperature of surface water and bottom water was measured using a standard centigrade mercury thermometer. Salinity was measured with the help of a digital portable Refractometer and the seawater pH was measured using ERMA pH pen. Dissolved oxygen was estimated by the modified Winkler's method Strickland and Parsons and expressed as mg/l. For the analysis of water nutrients, samples were collected in clean polyethylene bottles and kept in an ice box and transported immediately to the laboratory of the total water sample 500 ml of the water sample

was filtered using millipore filtering systems and analyzed for dissolved inorganic phosphate, nitrate, nitrite and reactive silicate by adopting the Grasshoff *et al.* (1999). Further, the samples were analyzed using (LAMBDA-750) UV-VIS-NIR Spectrophotometer and nutrient concentrations are expressed in µMol/l.

RESULTS

Physico-chemical (nutrients) parameters are ascertain as one of the most important features that are capable of assessing the marine environment and have showed wide spatial and temporal variations. The each physico-chemical parameters explained clear seasonal variations, which are very typical to the tropical marine ecosystem. During the study period, the surface and subsurface water temperature recorded at five stations in Parangipettai coastal waters ranged from 22.0 to 34.0^{o}C. The minimum Sea Surface Temperature (SST) was observed during monsoon 2016 at station-NS-2 and the maximum was registered during summer 2015 at station-NS-2 (Fig 2a). The observed salinity values ranged between 23.0 and 34.0 PSU. The minimum salinity was observed during monsoon 2016 at station-NS-4 and the maximum was registered during summer 2015 at station-NS-3 (Fig. 2b). The pH concentration ranged from 7.8 (station-NS-1 during monsoon 2016) to 8.5 (station-NS-3SS during summer 2015) (Fig. 2c). The DO concentration varied between 4.14 and 6.56 mg/l, registering maximum during monsoon 2016 at station-NS-4SS and minimum at station-NS-5 during premonsoon 2016 (Fig. 2d). Total suspended solids (TSS) ranged from 72.81 to 172.43 ppm with the maximum during monsoon 2016 at station-NS-5SS and minimum during premonsoon 2016 at station-NS-2 (Fig. 2e).

The nutrient parameters, nitrite concentration varied from 0.36 (summer 2015 at station-NS-3) to 1.27 µmol/l (monsoon 2016 at station-NS-4SS) (Fig. 2f). The nitrate concentration ranged from 3.55 to 5.97 µmol/l. The minimum NO3 was observed during premonsoon 2016 and maximum was observed during monsoon 2016 at station-NS-5 (Fig. 2g). Ammonia ranged from 0.02 to 0.09 µmol/l with the maximum during premonsoon 2016 at station-NS-1SS and minimum during postmonsoon 2016 at station-NS-3 (Fig. 2h). The minimum inorganic phosphate concentration (0.33 µmol/l) was recorded during premonsoon 2016 at station-NS-3 and the maximum concentration (2.32 µmol/l) was registered during monsoon 2016 at station-NS-3SS (Fig. 2i). The reactive silicate concentration ranged from 24.73 to 71.50 µmol/l with the higher value during monsoon 2016 at station-NS-2SS and the lowest during postmonsoon 2016 at station-NS-1 (Fig. 2j). The Particulate organic carbon concentration ranged 78.35–129.09 µgc/g with the maximum during postmonsoon 2016 and minimum during premonsoon 2016 at station-NS-2 (Fig. 2k).

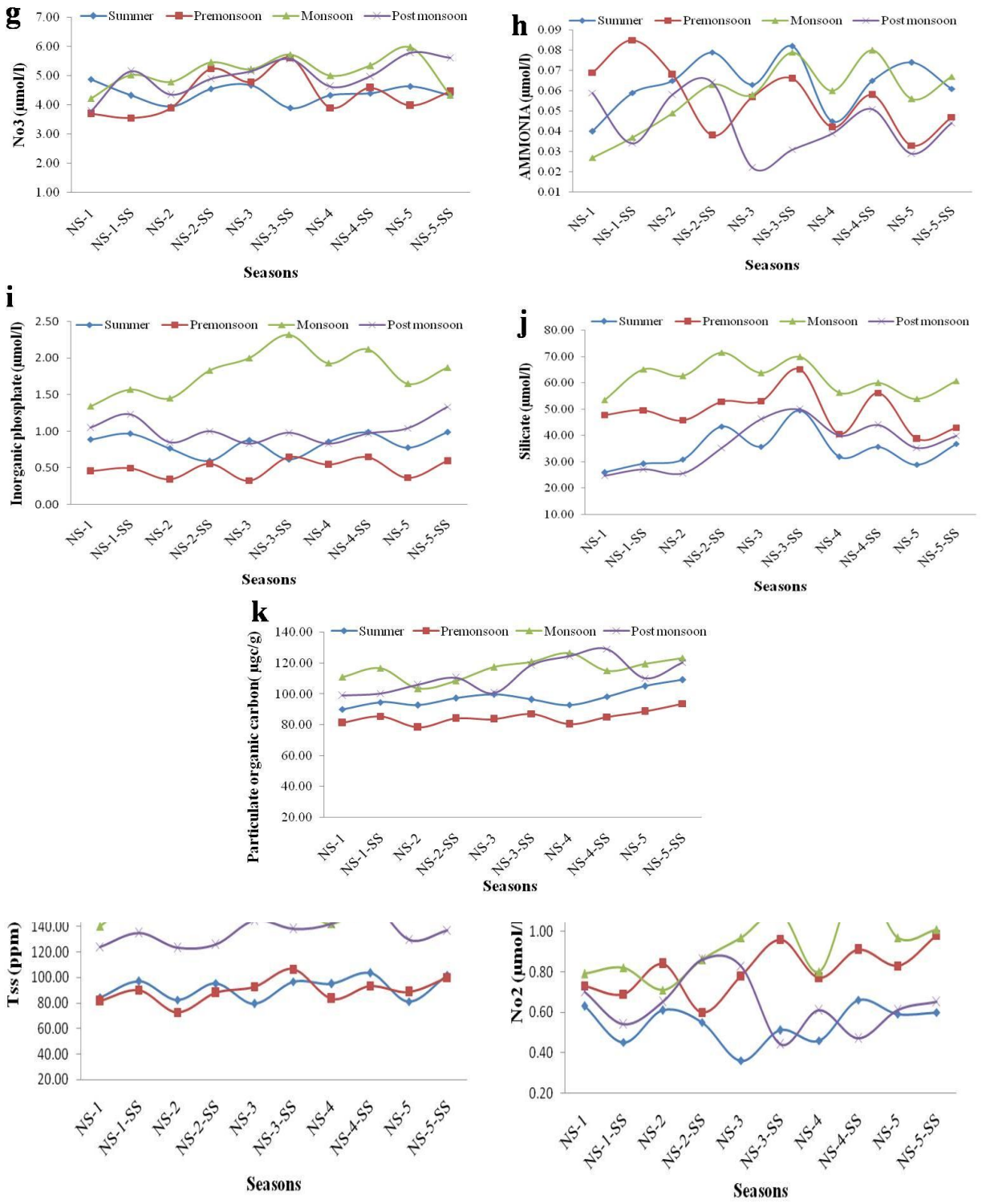

Figure 2: Physico-Chemical characteristics of Parangipettai coastal waters during summer 2015 to post Monsoon 2016.

DISCUSSION

This short time series data may allow us to understand the effects of short time variations in the physico-chemical conditions and the eutrophication in the coastal waters of southeast coast of India. The concentrations of nutrients in the water entering the estuaries were generally low, did not vary notably during the study period and did not affect the growth of the other biological livings. However, the monsoon seasons (southwest and northeast monsoon) the nutrient inputs from river runoff trigger in various nutrients and primary production of the coastal waters of the Bay of Bengal (Madhu *et al.,* 2002; Madhupratap *et al.,* 2003). Hence, the present study investigated the seasonal changes in physico-chemical and nutrient concentration in the southeast coast of India.

The surface and subsurface water temperature varied from 22.0 to 34.0 ^{o}C mainly with seasonal changes. Higher surface water temperature recorded during the summer 2015 at station-NS-2 might be due to the increased solar radiation (Richardson *et al.,* 2000; Balakrishnan *et al.,* 2015). Salinity fluctuated much between the seasons, registering the maximum (34.0 PSU) during summer 2015 at station-NS-3, coinciding with the medium amount of rainfall and average rate of evaporation (Govindasamy *et al.,* 2000; Palanichamy and Rajendran, 2000) prevailing in the region.

pH was maximum in summer 2015 at station NS-3-SS due to the influence of daily photosynthetic activity by planktons (Das *et al.,* 1997) which removes dissolved carbon dioxide in the water column thereby increasing the pH level. Generally, fluctuations in pH values during different seasons of the year can be attributed to factors like removal of CO2 by photosynthesis through bicarbonate degradation, dilution of seawater by freshwater influx, reduction of salinity and temperature and decomposition of organic matter as stated by Paramasivam and Kannan (2005), Balakrishnan *et al.* (2015). The DO level varied between 4.14 mg/l (premonsoon 2016) and 6.56 mg/l (monsoon 2016). Present findings were found contradictory to the earlier reports (Satpathy *et al.,* 2009) that recorded increased DO level from premonsoon 2016 to monsoon 2016 in this part of Bay of Bengal.

The total suspended solids content (72.81 to 172.43 ppm) was higher than that of all other physico-chemical parameters. This could be largely due to the heavy inflow of monsoon inputs, apart from the physical mixing of seawater with freshwater in the monsoon season (Balakrishnan *et al.,* 2015). Phosphate concentration in coastal waters was influenced by the mixing of the freshwater with the seawater in the land, addition through localized upwelling and uptake of phytoplankton (Satpathy et al. 2010; Balakrishnan *et al.,* 2015). Maximum inorganic phosphate (2.32 µmol/l) concentration was recorded during monsoon 2016 while low concentration (0.33 µmol/l) was observed during premonsoon 2016.

The present study showed the abundance of nutrients at the southern Bay that might have resulted due to the discharge of nutrient-rich water from the rivers at the southeast coast of India to the Bay of Bengal during southwest monsoon season. The ability to identify limiting nutrients has thus becomes of considerable importance for our understanding of the biological (Pelagic) ecology (Havens 2000). However, such limiting nutrient factors vary for closed water bodies and water bodies influenced by the external discharges.

CONCLUSION

Analyses of present data sets revealed that the southeast coast of Bay of Bengal does not exhibit a small-scale spatial variability. Parangipettai coastal water is subjected to seasonal fluctuations in physico-chemical parameters depending upon the seasonal tidal amplitude and freshwater influx resulting in a continuous exchange of organic, inorganic, plant and animal matters.

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