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Original Research Article

Physico-chemical parameters in Parangipettai coastal waters and Vellar estuary, Southeast coast of India

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A B S T R A C T

Keywords

Physical parameters, Inorganic nutrients, Monthly variation, Parangipettai Coast

Physico-chemical variables in the marine environment are subjected to wide spatio-temporal variations. The various physico-chemical parameters viz: temperature, salinity, pH, dissolved oxygen and nutrients of the environment are the factors which mainly influence the production and successful propagation of planktonic life in the coastal biotopes. The ranges of values of surface water temperature (0°C) 25.8– 30.1°C and 25.4– 30°C, salinity (‰) 18– 33 and 4– 31, pH 7.6– 8.3 and 7.7–8.2 dissolved oxygen (ml l^{-1}) were 3.7–5.41 and 3.7–5.2. The values (Cg l^{-1}) of nutrients were nitrate (µM) 8.79– 8.87 and 0.85–0.94, nitrite (µM) 1.93– 2.13 and 0.20–0.37, phosphate (µM) 3.86–4.15 and 0.14–0.19, silicate (µM) 148.3–120.7 and 11.6–14.4. The recorded values of primary productivity (mgcm-3hr^{-1}) ranged between 44.9–128 and 44.8–133 the chlorophyll "a" varied between 4.0–6.8 and 3.7–6.9.

Introduction

Physico-chemical parameters, species composition and seasonal variation in phytoplankton abundance have been studied in other regions of Indian coastal waters (Saravanakumar *et al.*, 2008; Vengadesh Perumal *et al.,* 2009). For confirming the good quality of water resources large number of physico-chemical parameters, extend and source of any pollution load must be know for which monitoring of physico-chemical parameters and pollutants is essential (Reddi *et al.,* 1993). 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. 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. In Indian estuaries and seas the physico-chemical characteristics had been carried out by many workers (Gouda and Panigrahy, 1996, Rajasegar, 2003).

Hence, the present study was carried out to get information on the hydrobiology of water from the Parangipettai coast and Vellar estuary for a period of one year from December 2009 to November 2010.

Materials and Methods

Study area

The present study was carried out during December 2009 to November 2010. The topography of the Parangipettai (Latitude 11º30. 42N, Longitude 079º47. 05E) and the Vellar estuary (Lat. N-11°29' and"E-79'46") is situated along the southeast coast of India, and it has a unique potential for marine and brackish water resources, being endowed with various aquatic biotopes viz., neritic, estuarine, backwaters and mangroves.

Rainfall data were obtained from the office of the meteorological unit of Govt. of India, located at the CAS in Marine Biology, Annamalai University (Parangipettai). Temperature was measured using a standard centigrade thermometer. Salinity was estimated with the help of refractometer (ERMA, Hand Refractometer, and Japan) and pH was measured using a ELICO Grip pH meter. Dissolved oxygen was estimated by the modified Winkler's method (Strickland and Parsons, 1972).

For the analysis of nutrients, surface water samples were collected in clean plastic bottles, kept immediately in an ice box, and transported to the laboratory. The collected water samples were filtered by using a Millipore filtering system and analyzed for dissolved inorganic nitrate, nitrite, phosphate and reactive silicate adopting the standard procedures described by Strickland and Persons (1972).

Results and Discussion

Rainfall is the most important cyclic phenomenon in tropical countries as it brings about important changes in the physical and chemical characteristics of the coastal environment. The rainfall in India is largely influenced by two monsoons viz., southeast monsoon on the west coast and northeast monsoon on the east coast (Perumal, 1993). The monthly total rainfall recorded varied from 75 to 4320 mm during the study period. The highest value of rainfall (4320 mm) was recorded in the month of December-2009 and lowest (75 mm) in the month of September-2010. No rainfall was recorded in the month of February, March and April 2010 at station I and II (Fig.1).

The surface temperature ranges were recorded 25.8 to 30.1°C and 25.4 to 30°C at stations 1 and 2 respectively. The maximum values of surface water temperature were recorded in the month of May-2010 and minimum were recorded in the month of December-2009 at both the stations (Fig.2). The observed high value of temperature in May was due to the intensity of solar radiation and evaporation freshwater influx and cooling and mix up with ebb and flow from adjoining neritic waters. The observed low value of October was due to strong land sea breeze and precipitation (Senthilkumar *et al.*, 2002; Santhanam and Perumal, 2003).

Salinity fluctuated between 18 to 33 ppt at station 1 and 4 to 31 ppt at station 2. The highest salinity of 33 ppt was recorded in May-2010 (summer season) and the lowest of 18 ppt in December 2009 (Monsoon season) at station 1. In the station 2, the maximum of salinity (30 ppt) was found in the month of April-2010 and minimum was recorded in the month of December-2009 (Fig.3). 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). The minimum salinity was recorded during the monsoon season and the maximum was recorded during summer season as reported earlier by Sundaramanickam *et al.*, (2008).

The range of hydrogen ion concentration (pH) was 7.6–8.3 and 7.7–8.2 (Fig.4) and in surface waters it remained alkaline throughout the study period. 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 (Paramasivam and Kannan, 2005). The recorded high summer pH might be due to the influence of seawater penetration and high biological activity (Das *et al.,* 1997) and due to the occurrence of high photosynthetic activity (Subramanian and Mahadevan, 1999).

The values of dissolved oxygen were found to be ranged between 3.7 and 5.41 mg l^{-1}. The highest concentration of dissolved oxygen (5.41 mg l^{-1}) was recorded in the month of November-2010 (Monsoon season) and lowest concentration of 4.1 mg l^{-1} was recorded in the of April-2010 (summer season) at station 1. In station 2, the lowest and highest concentration of dissolved oxygen was noted 3.7–5.2 mg l^{-1} in the month of July–November-2010 respectively (Fig.5). The observed high monsoonal values might be due to the cumulative effect of higher wind velocity coupled with heavy rainfall and the resultant freshwater mixing as suggested by Das *et al.*, 1997.

In the present analysis, the highest amount of nitrate (8.79 and 8.87 µM) was recorded in the month of December-2009 at stations I & II respectively and the lowest concentration of nitrate was observed (0.85 and 0.94 µM) in the month of March and April-2010 at stations I & II respectively (Fig.6). The increased nitrates level was due to fresh water inflow, mangrove leaves (litter fall) decomposition and terrestrial run-off during the monsoon season (Karuppasamy and Perumal, 2000; Santhanam and Perumal, 2003). 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).

The maximum of nitrite concentration (1.93 and 2.13 µM) was observed in the month of December-2009 and the lowest concentration of nitrite (0.20 and 0.37 µM) was noted in the month of April and March 2010 at stations I and II respectively (Fig.7). 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 (Mani and Krishnamurthy, 1989; Murugan and Ayyakkannu, 1991).

The maximum values of inorganic phosphate (3.86 and 4.15 µM) were observed in the month of November-2010 and the minimum values of inorganic phosphate (0.14 and 0.19 µM) was recorded in the month of May-2010 at stations I & II respectively (Fig.8). The recorded high concentration of inorganic phosphates during monsoon season might possibly be due to intrusion of upwelling seawater into the creek, which in turn increased the level of phosphate (Nair *et al.,* 1984). Low summer values could be attributed to the limited flow of freshwater, high salinity and utilization of phosphate by phytoplankton (Senthilkumar *et al.,* 2002).

The highest concentration of silicate (148.3 and 120.7 µM) in the month of December-2009 and the minimum of silicate (11.6 and 14.4 µM) in the month of June and September-2010 at stations I & II respectively (Fig.9). The recorded high concentration of inorganic silicate content was higher than the other nutrients (NO_3, NO_2 and PO_4) and higher value was noticed during monsoonal season when the salinity was very low which may be due to heavy influx of fresh water (Rajasegar, 2003). The low value of silicate recorded during post monsoonal season could be attributed to uptake of silicates by phytoplankton for their biological activity (Mishra *et al.,* 1993).

The maximum of primary production was observed in the ranges of 128 to 133 ($mgCm^{-3}hr^{-1}$) at stations I and II respectively (Fig.10). Higher primary productivity (mg cm-3 hr-1) was observed during the summer season (May), and low productivity during monsoon season. 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).

Chlorophyll 'a'

The chlorophyll 'a' (mg m^{-3}) values ranges for stations 1 and 2 were 4.0 to 6.8 and 3.7 to 6.9 respectively (Fig.3). The maximum value of Chlorophyll 'a' was recorded (May, 2010) during summer and the low value was observed (December, 2009) during monsoon (Fig.10). The recorded low monsoonal values could be due to freshwater discharges from the rivers (dilution), causing turbidity and less availability of light (Kawabata *et al.,* 1993; Godhantaraman, 2002; Thillai Rajasekar *et al.,* 2005).

Fig.1 Monthly values of rainfall recorded at Parangipettai region (Common to stations I and II)

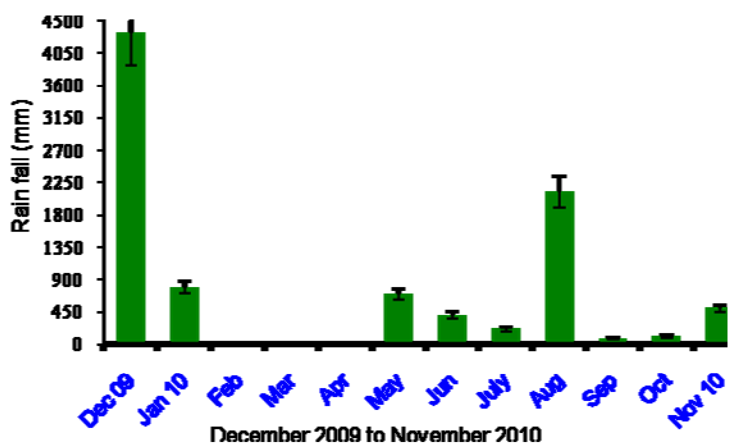


Fig.2 Monthly values of water temperature recorded of Parangipettai coastal waters (stations I and II).

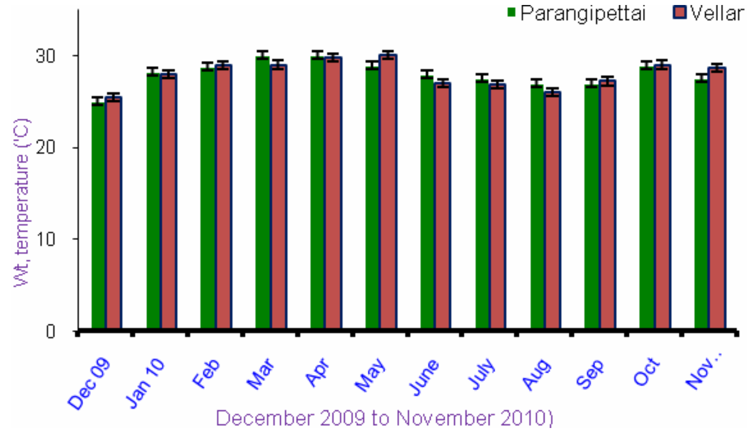


Fig.3 Monthly values of salinity recorded of Parangipettai coastal waters (Common to stations I and II).

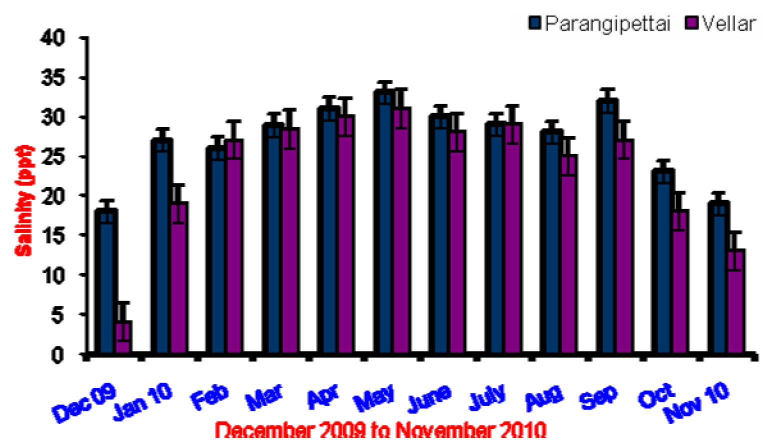


Fig.4 Monthly values of pH recorded of Parangipettai coastal waters (Common to stations I and II).

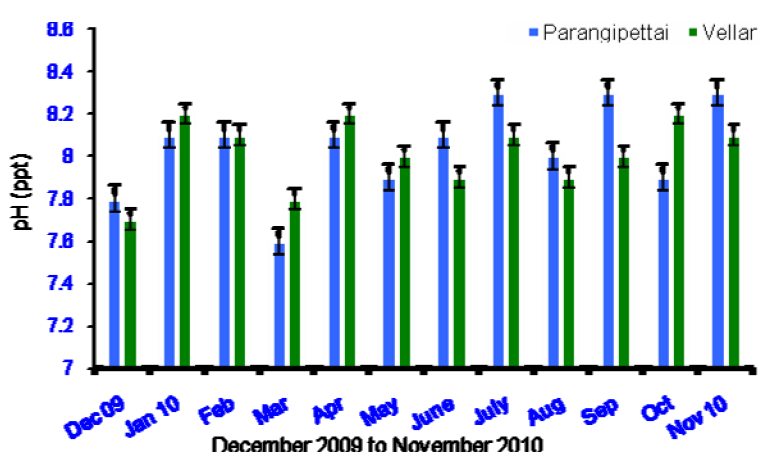


Fig.5 Monthly values of pH recorded of Parangipettai coastal waters (Common to stations I and II).

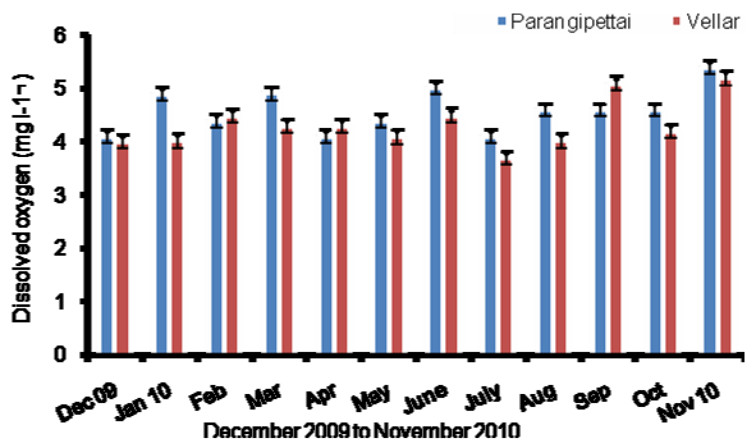


Fig.6 Monthly variation in nitrate at Parangipettai coastal waters (stations I andII)

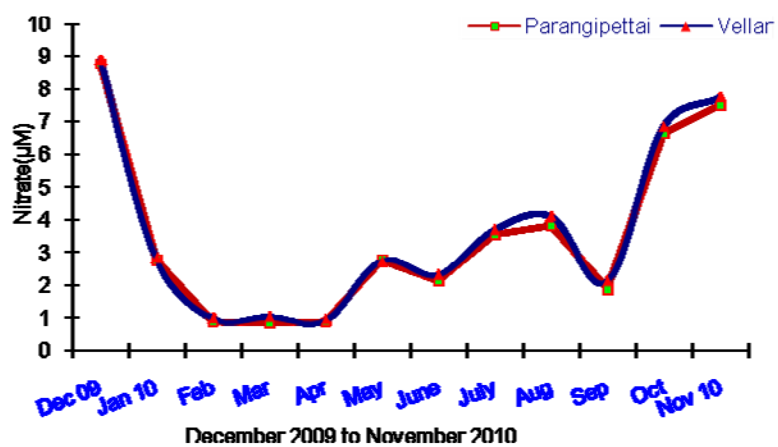


Fig.7 Monthly variation in nitrite at Parangipettai coastal waters (stations I andII)

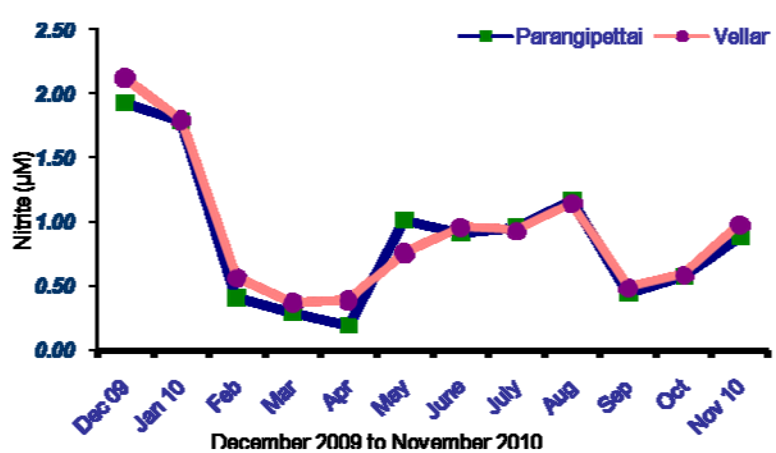


Fig.8 Monthly variation in Inorganic Phosphates at Parangipettai coastal waters (stations I and II)

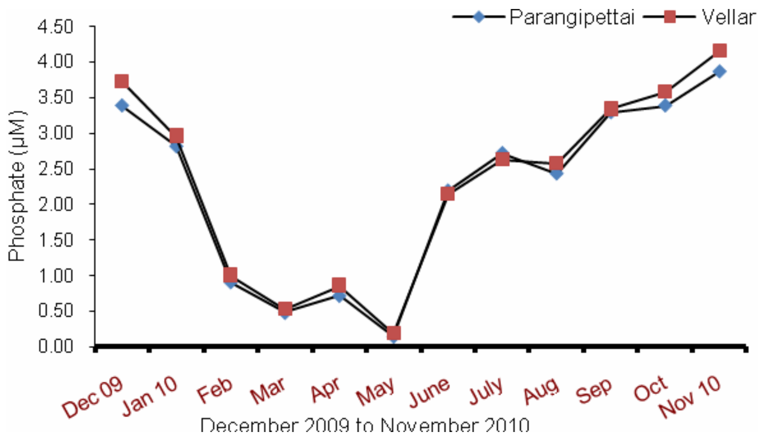


Fig.9 Monthly variation in Silicate at Parangipettai coastal waters (Stations I andII)

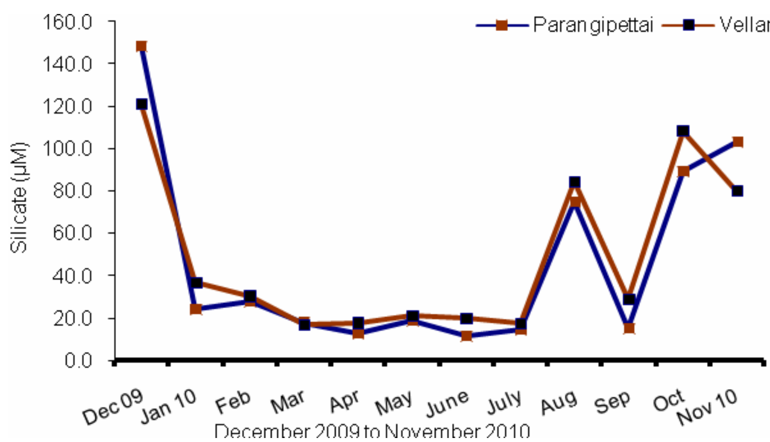


Fig.10 Monthly variation in primary productivity at Parangipettai coastal waters (Stations I and II)

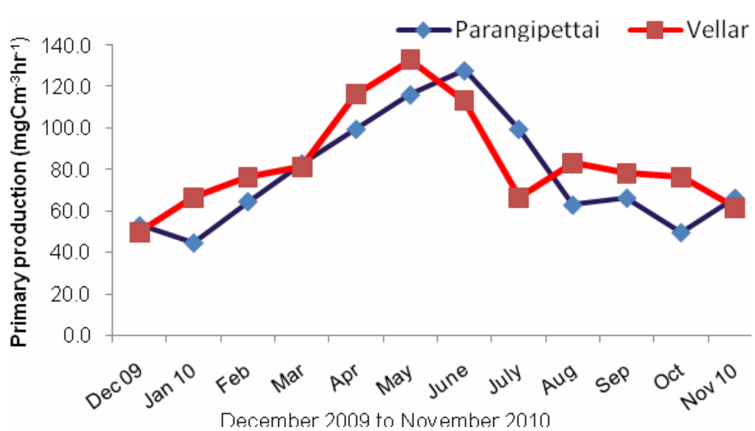
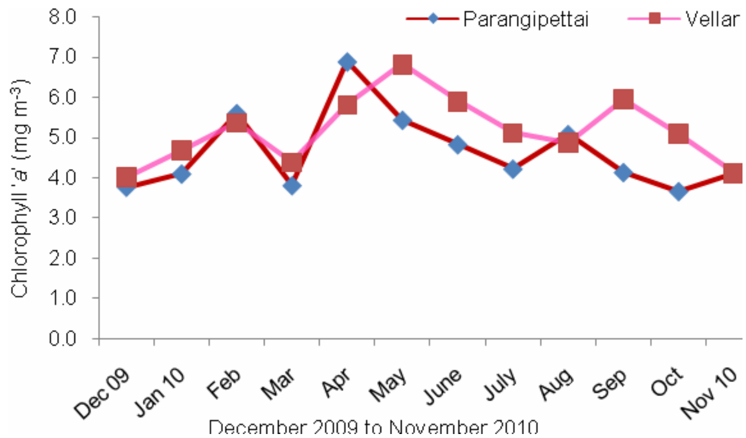


Fig.11 Monthly variation in Chlorophyll 'a' at Parangipettai coastal waters (Stations I and II)



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