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Full Length Research Paper

Seasonal variations of physico-chemical properties of the Great Vedaranyam Swamp, Point Calimere Wildlife Sanctuary, South-east coast of India

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The present study was attempted on the physico-chemical variability of the Great Vedaranyam Swamp of the Point Calimere Wildlife Sanctuary, South-east coast of India. Seasonal variation study was carried out to examine level of varying physico-chemical parameters such as temperature, salinity, pH, dissolved oxygen, nitrate, nitrite, electrical conductivity, phosphate, turbidity, total dissolved solids and water depth. The physico-chemical parameters have exhibited considerable seasonal and spatial variations. The qualitative study revealed the present status of the physico-chemical parameters, which would be very helpful for policy makers to take precautionary measures to save the swamp.

Key words: Seasonal variations, physico-chemical parameters, Point Calimere Wildlife Sanctuary, pH, salinity, temperature.

INTRODUCTION

Aquatic bionetwork plays vital component on the earth since the origin of life**.** In addition to drinking, water is used for food production of all means that is agriculture, aquaculture, and animal farming**.** The quality of water in any ecosystem provides significant information about the available resources for supporting life in that ecosystem. Good quality of water resources depends on a large number of physicochemical parameters, the magnitude and source of any pollution load; and to assess that, monitoring of these parameters is essential. Researches are being carried out till present (Mishra et al., 1993; Satpathy, 1996; Das et al., 1997; Padma and Periakali, 1999; Govindasamy et al., 2000; Rajesh et al., 2002; Jayaraman et al., 2003; Sharma and Gupta, 2004; Rajasekar et al., 2005; Sridhar et al., 2006; Anilakumary et al., 2007; Prabu et al., 2008; Raja et al., 2008; Pradhan et al., 2009; Srivastava et al., 2009; Damotharan et al., 2010; Prasanna and Ranjan, 2010). These include seasonal variations in the physico-chemical characteristics and nutrient dynamics in the network of water bodies found across the country. These works also include various types of water bodies like ponds, rivers, lakes, estuaries and reservoirs. However, very little information is available in relation to physico-chemical characteristics of water in the Point Calimere Wildlife Sanctuary. Hence, the present study was conducted to study the physico-chemical properties of water in the Great Vedaranyam Swamp of the Point Calimere Wildlife Sanctuary, India for a period of October 2007 to March 2010.

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MATERIALS AND METHODS

The Point Calimere is located along the Coramandal coast, Nagapattinam district (10°18' N, 79°51' E) of Tamil Nadu, India; it is bounded by a part of the bay of Bengal towards the northeast and palk strait on the south-west embracing a vast swamp area called Great Vedaranyam Swamp. The Great Vedaranyam Swamp is famous for migratory waterfowl's *viz*., flamingos, waders, ducks, gulls and terns. The entire swamp belt is about 30 km long and 9 km wide. The swamp represents a mixed ecosystem, influenced by both fresh water and seawater. Two industrial salt companies chemplast (Chemical and Plastics Limited) and DCW (dharangadhra chemical works) and a number of small and large salt units that produce edible salt and industrial salt operate in this

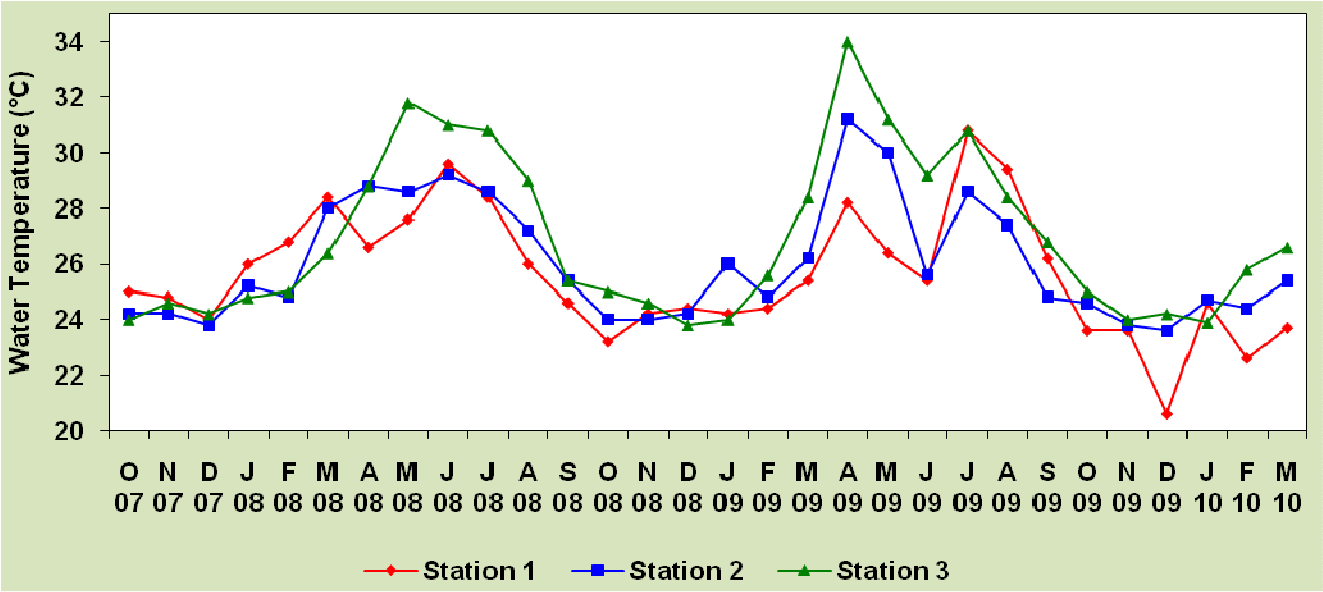

Figure 1. Monthly variations of water temperature in different stations during the study period.

area. The Point Calimere Wildlife Sanctuary was declared as a Ramsar site on 19th August, 2002.

The swamp water samples were collected from five locations (in 3 different stations) selected in the immediate fsurroundings of the area covered by swamp water. The samples were collected in from 10 to 11am. One composite sample from each site was collected per month during the period of study. Physico-chemical properties such as water temperature, dissolved oxygen, electrical conductivity, nitrate, nitrite, pH, phosphate, salinity, total dissolved solids, turbidity and water depth of swamp water were determined following standard methods given by Welch (1952), Trivedy and Goel (1984), Wetzel and Likens (1991) and APHA (2005). Rainfall data were obtained from the meteorological unit (Government of India) located at Vedaranyam.

RESULTS

Temperature

Water temperature was recorded more or less similar in all the stations and differs during seasons (Figure 1). Water temperature during the sampling of different seasons was found to vary from 20. 6 to 34.0ºC. The maximum temperature was observed during summer (January to March) and minimum was recorded during monsoon (October to December).

Salinity

Water salinity varied between 8.0 and 61.0 ppt (Figure 2). The maximum salinity was recorded during the month of May (summer) and the minimum was observed during the month of December (monsoon). The station wise variations of salinity maximum in station 3 and the minimum in station.

pH

Water pH was recorded more or less similar in all the stations as well as seasons (Figure 3). The pH for the water samples varied between 7.0 and 9.8 and these values ranged from a minimum average in October to December (monsoon) to a maximum average in April to June (summer).

Dissolved oxygen

The dissolved oxygen content was showed more or less similar in all seasons except monsoon, it is high (Figure 4). The dissolved oxygen content varied from 5.00 to 9.11 ml/l. The seasonal variation of the dissolved oxygen content maximum observed during November to December (monsoon) and the minimum during April to May (summer). The station wise variations of DO maximum in station 3 and the minimum in station 1.

Electrical conductivity

The EC was showed very narrow changes in all stations as well as seasons. The EC values varied between 344 and 888 mho/cm. The maximum value was recorded in station 3 and the minimum in station 1. The seasonal variation of the EC values was showed higher during summer season and lower during monsoon season (Figure 5).

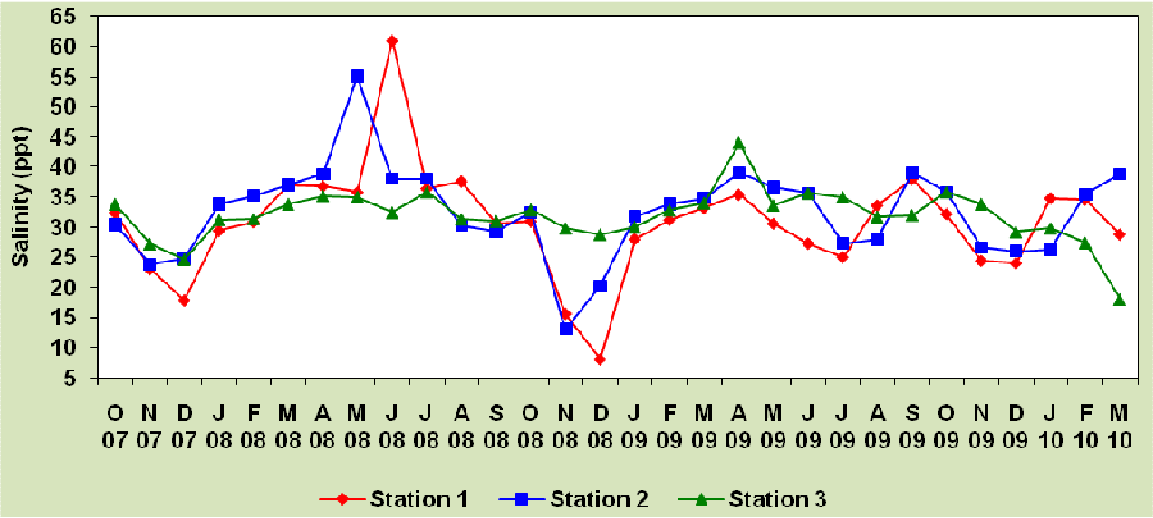

Figure 2. Monthly variations of salinity in different stations during the study period.

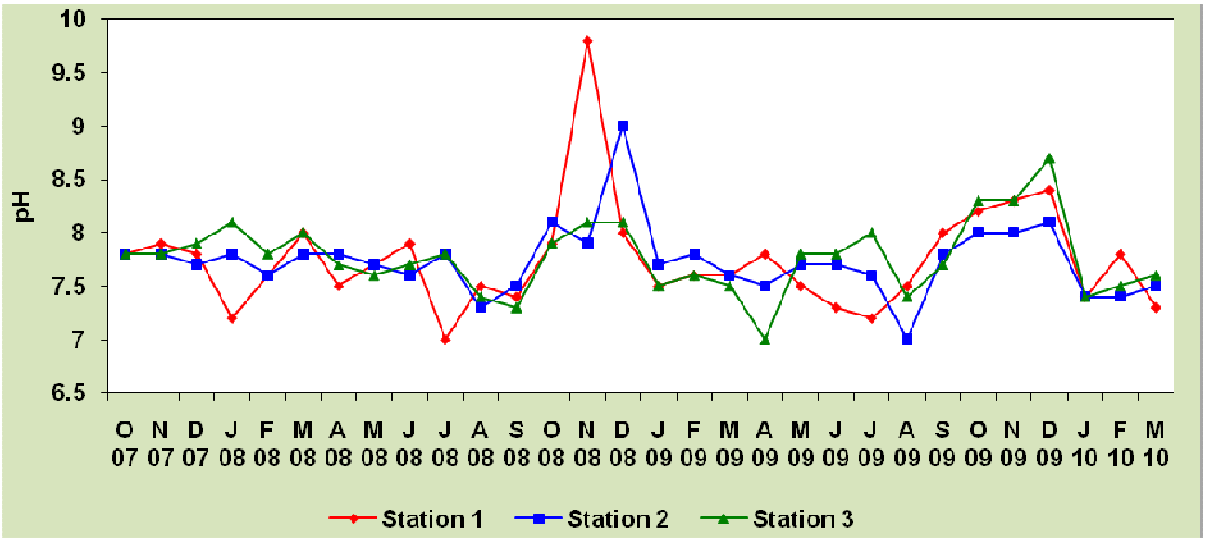

Figure 3. Monthly variations of pH in different stations during the study period.

Nitrate

The nitrate content was fluctuated between the stations as well as the seasons (Figure 6). The nitrate values varied from 0.11 to 0.90 mg/l. The maximum value was observed in station 3 and the minimum in station 1. The seasonal variations of nitrate values were recorded maximum during monsoon / post-monsoon and minimum during summer season.

Nitrite

Nitrite was recorded more or less similar in all the stations and seasons (Figure 7). Nitrite contents fluctuated between 0.01 and 0.06 mg/l. The maximum nitrates was observed during monsoon (October to December) and minimum was recorded during summer (January to March).

Phosphate

The phosphate was fluctuated between the stations as well as the seasons (Figure 8). The phosphate values varied from 0.01 to 0.24 mg/l. The maximum value was observed in station 2 and the minimum in station 3. The seasonal variations of phosphate values were recorded maximum during monsoon / pre-monsoon and minimum during summer season.

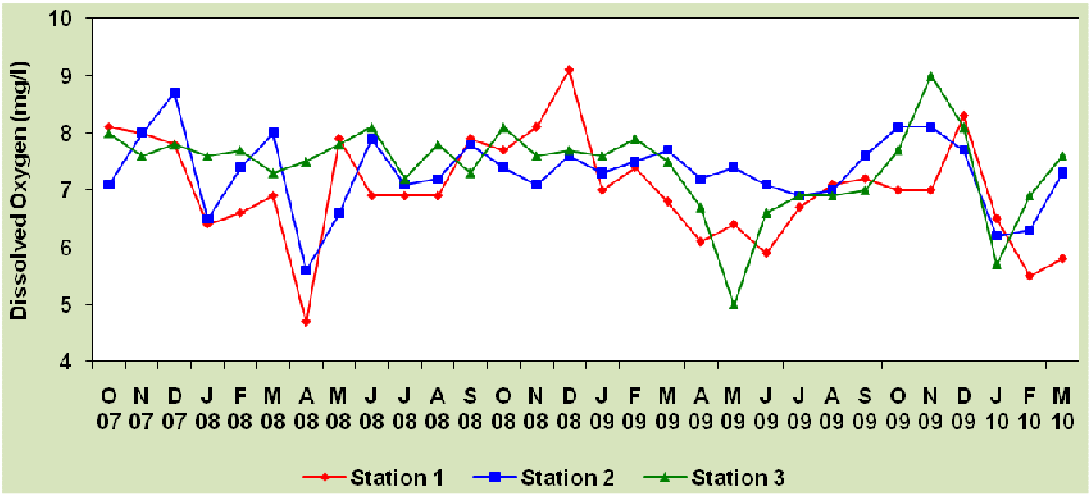

Figure 4. Monthly variations of dissolved oxygen in different stations during the study period.

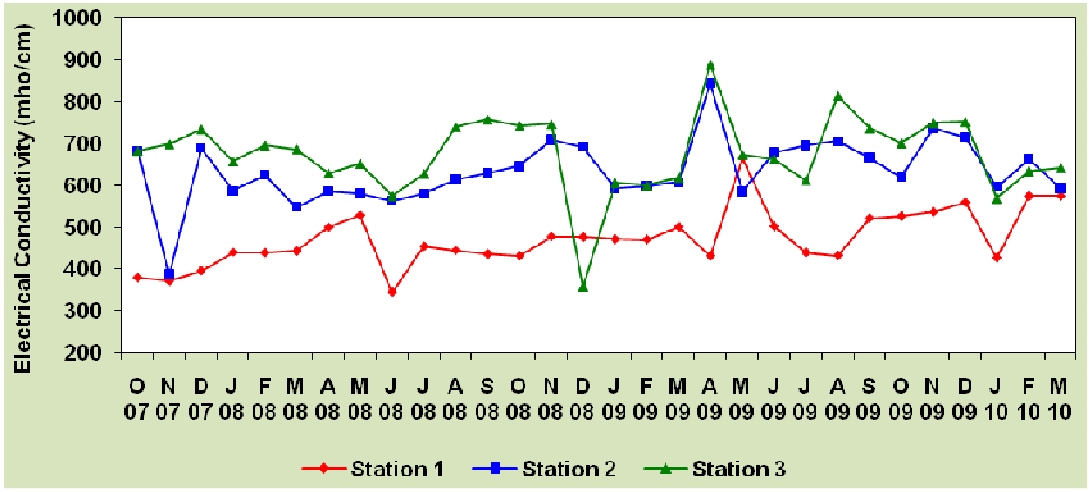

Figure 5. Monthly variations of electrical conductivity in different stations during the study period.

Total dissolved solids

The TDS varied between 236.0 and 503 mg/l (Figure 9). The maximum TDS was recorded during the month of November to December (monsoon) and the minimum was observed during the month of May to June (summer). The station wise variations of salinity maximum in station 2 and the minimum in station 3.

Turbidity

The turbidity varied from 3.0 to 18.0 NTU (Figure 10). The seasonal variation of the turbidity maximum observed during monsoon and the minimum during summer. The station wise variations of turbidity maximum in station 1 and the minimum in station 3.

Water depth

The water depth was showed very narrow changes in all stations as well as seasons. The depth of water column varied between 6.0 and 28.0 cm. The maximum value was recorded in station 1 and the minimum in station 3. The seasonal variation of the water depth was showed higher during monsoon season and lower during summer season (Figure 11).

Meteorological observations

The rainfall recorded during the study period (October 2007 to March 2010) is given in Figure 12. The maximum rainfall was recorded during the month of November 2008 (1105 mm) and the minimum was in the months of March

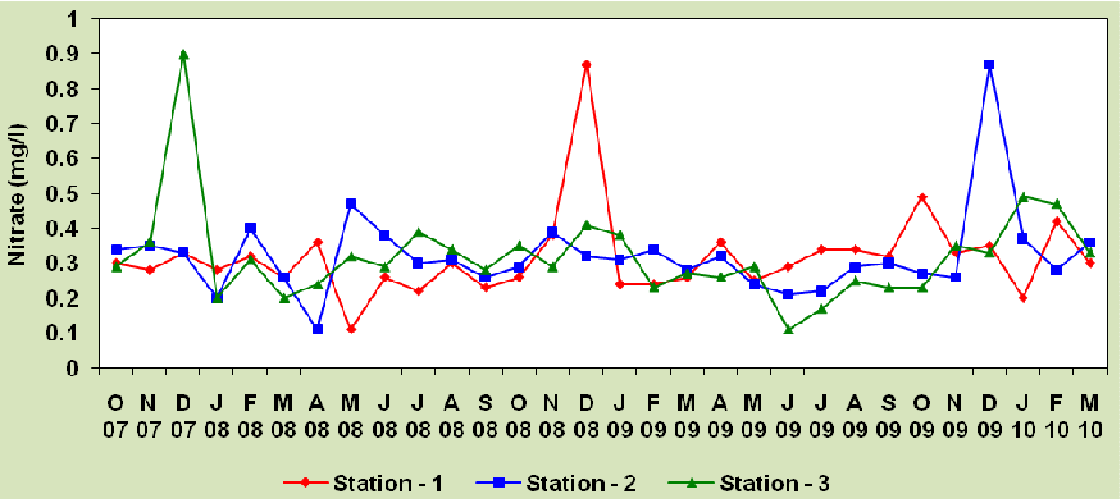

Figure 6. Monthly variations of nitrates in different stations during the study period.

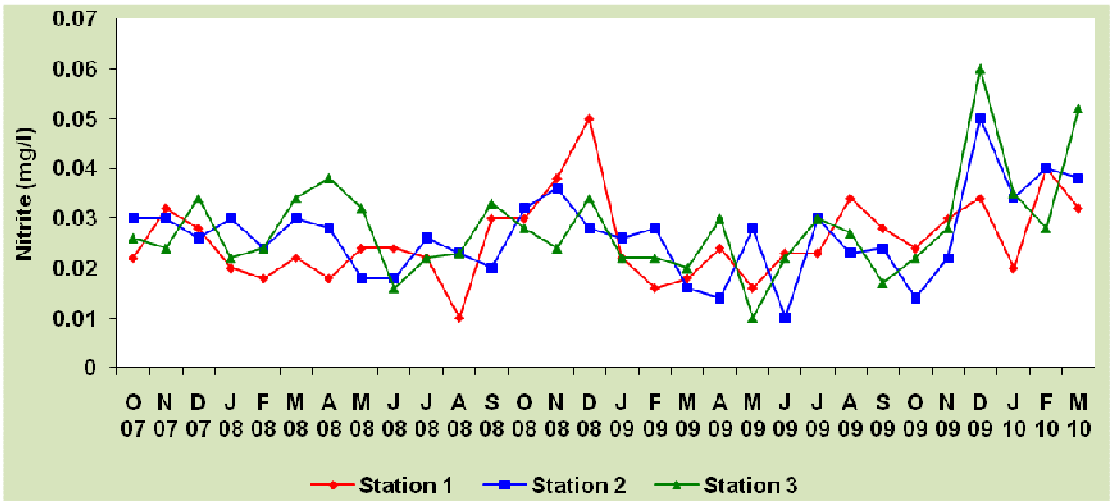

Figure 7. Monthly variations of nitrites in different stations during the study period.

2010 (6.2 mm). The quantum of rainfall was more (72.1%) during the northeast monsoon period (October to December).

DISCUSSION

The physico-chemical variable of the present study area is subjected to wide spatial temporal variation. Rainfall is the most important cyclic phenomenon in tropical countries as it brings important changes in the hydrographical characteristics of the marine and estuarine environments. In the present study, the peak values of rainfall are records during the monsoon month (October to December). The rainfall in India is largely influenced by two monsoons viz., southwest monsoon on the west coast, northern and northeastern India and by the northeast monsoon on the southeast coast.

The temperature is one of the important physical factors, which affects the chemical and biological reactions in water. It regulates the rate of photosynthesis in aquatic ecosystem. The temperature variation is one of the factors in the swamp and estuarine system, which may influence the physico-chemical characteristics and also influence the distribution and abundance of flora and fauna (Soundarapandian et al., 2009). In the present study, it has been observed that high temperature is noticed in the months of April to June at all stations associated with longer photoperiod, bright sunshine and dry wind and lower temperature in the months of October to December was due to cloudy sky and rainfall brought down the temperature to the minimum. Similar

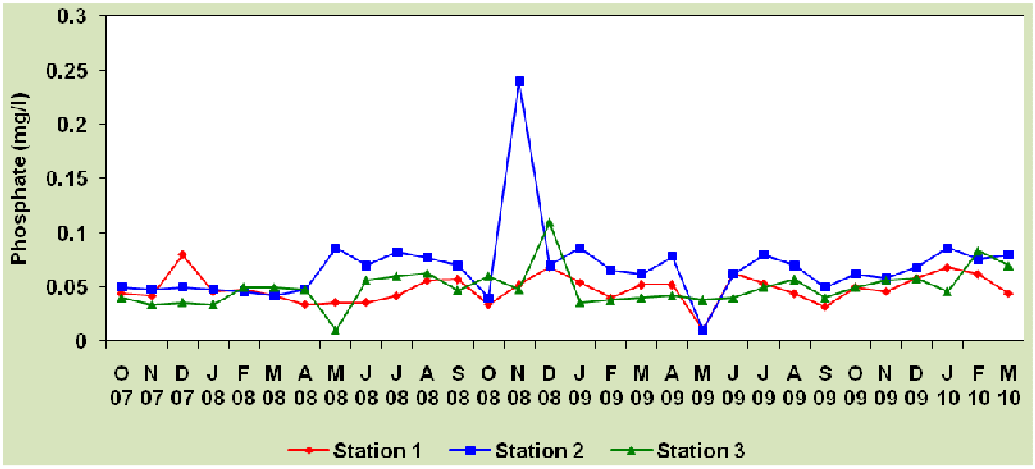

Figure 8. Monthly variations of phosphates in different stations during the study period.

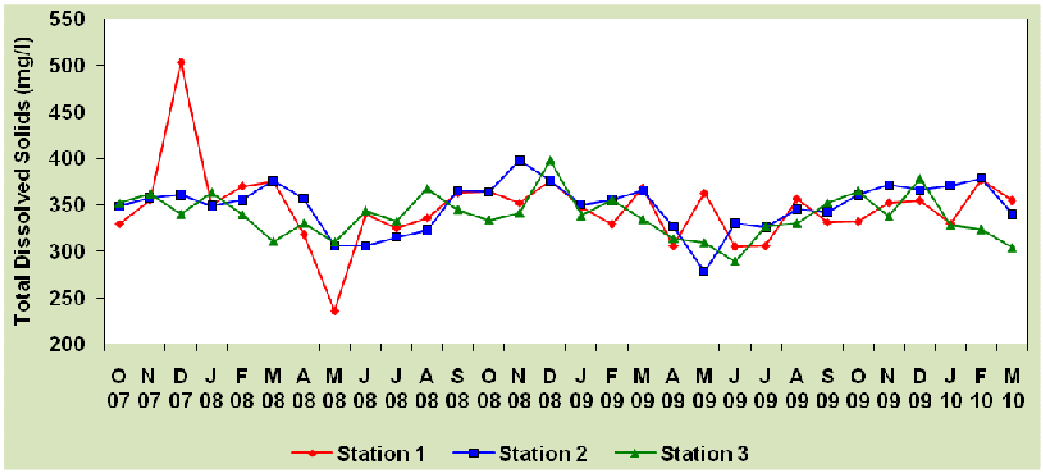

Figure 9. Monthly variations of total dissolved solids in different stations during the study period.

observations have been reported by Senthilkumar et al. (2002), Santhanam and Perumal (2003), Gupta et al. (2008), Sundaramanickam et al. (2008) and Jayabhaye (2009) from different wetlands.

Salinity is one of the important factors which profoundly influence the abundance and distribution of the animals in estuarine environment and inshore waters. Generally, the maximum salinity value is recorded during summer may be describe to the higher degree of evaporation in the study area. The low values are found during October to December is due to heavy rainfall and large quantity of freshwater inflow. Similar trend in the salinity values were also observed from various parts in southeast coast of India (Seenivasan, 1998; Palanichamy and Rajendran, 2000; Sulochana and Muniyandi, 2005; Prabu et al., 2008; Soundarapandian et al., 2009; Damotharan et al., 2010).

The effect of pH on the chemical and biological properties of liquids makes its determination very important. It is one of the most important parameter in water chemistry and measured as intensity of acidity or alkalinity on a scale ranging from 0 to 14. The pH concentration gets changed with time due to the changes in temperature, salinity and biological activity. Most of the natural waters are generally alkaline due to the presence of sufficient quantities of carbonate (Trivedy and Goel, 1984). The pH remains alkaline throughout the study period at all stations registering a maximum during monsoon, which could be attributed to the high salinity of water. The high pH observe during monsoon season may be due to the influence of fresh water influx, dilution of sea water, low temperature and organic matter decomposition as suggested by Ganesan (1992). Similar trend in pH was reported by Seenivasan (1998) from the Vellar estuarine system, Palanichamy and Rajendran (2000) from Palk Bay, Prabu et al. (2008) from Pichavaram mangroves, Damotharan et al. (2010) from Point Calimere coastal waters and Sundaramanickam et

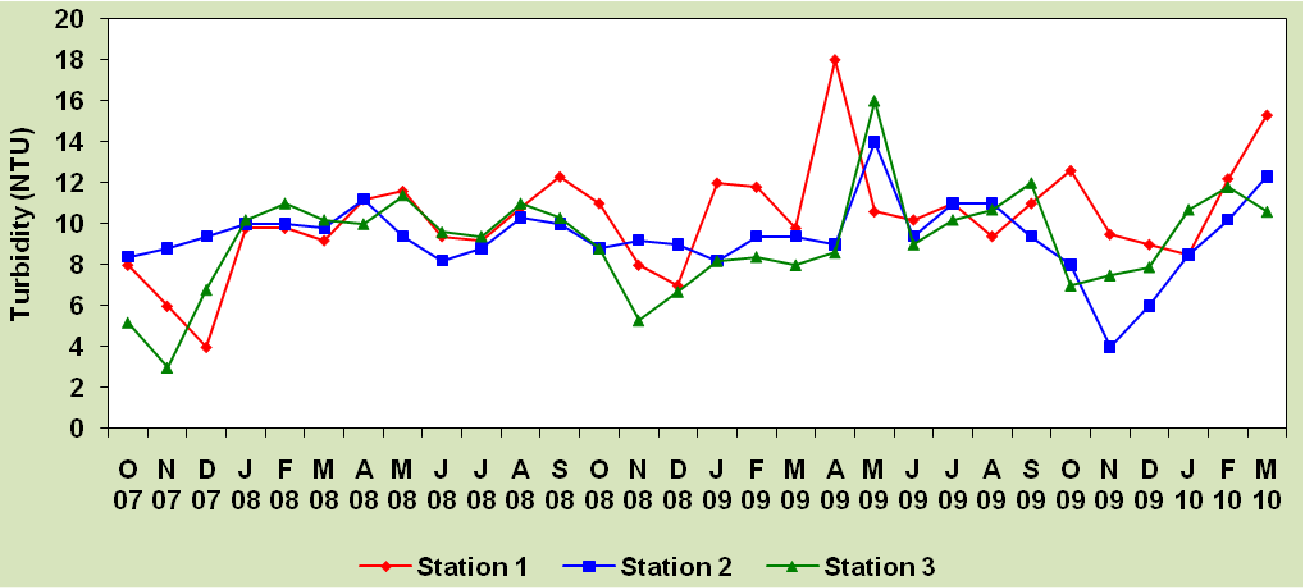

Figure 10. Monthly variations of turbidity in different stations during the study period.

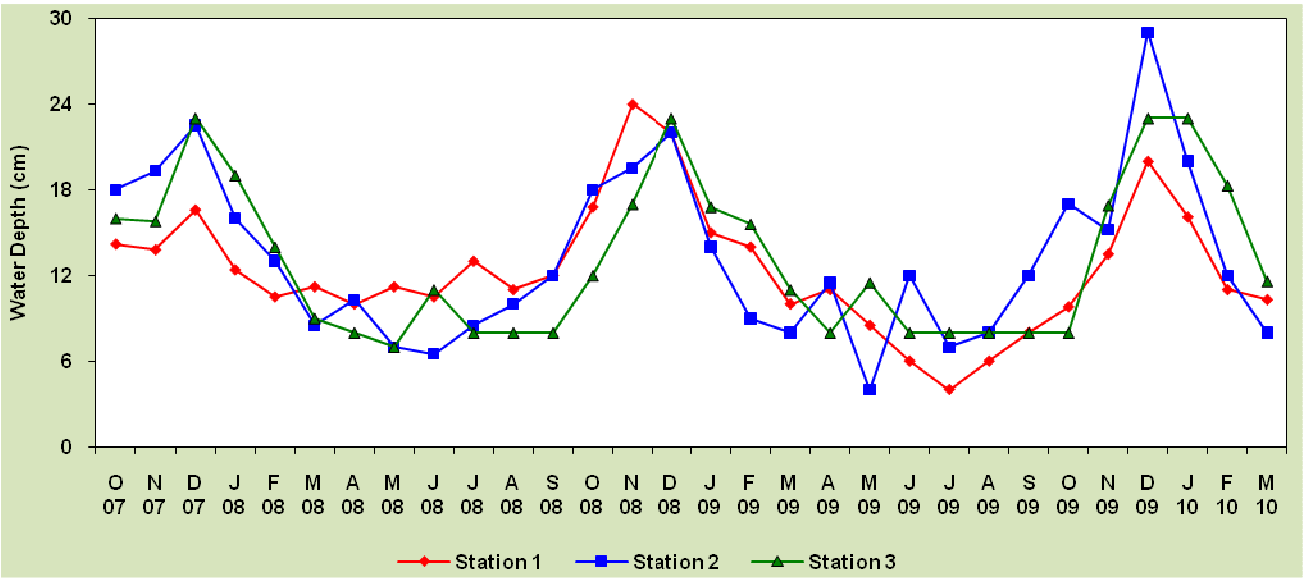

Figure 11. Monthly variations of water depth in different stations during the study period.

Parangipettai and Cuddalore coast of India.

The oxygen dissolved in water is a very important parameter in water analysis as it serves as an indicator of the physical, chemical and biological activities of the water body. Two main sources of dissolved oxygen are diffusion of oxygen from the air and photosynthetic activity. Oxygen is considered to be the major limiting factor in water bodies with high concentration of organic materials. It is well known that the temperature and salinity affect the dissolution of oxygen (Vijayakumar et al., 2000). Higher dissolved oxygen concentration observed during monsoon season may be due to the cumulative effect of higher wind velocity joined with heavy rainfall and the resultant freshwater mixing (Das et al., 1997; Prabu et al., 2008; Sundaramanickam et al., 2008; Damotharan et al., 2010).

Nitrates are the most oxidized forms of nitrogen and the end product of the aerobic decomposition of organic nitrogenous matter. Natural waters in their unpolluted state contain only minute quantities of nitrates. The recording highest nitrates value during monsoon / post-monsoon season may be mainly due to the organic materials receiving from the catchment area during rainfall (Das et al., 1997). The increasing nitrates level is

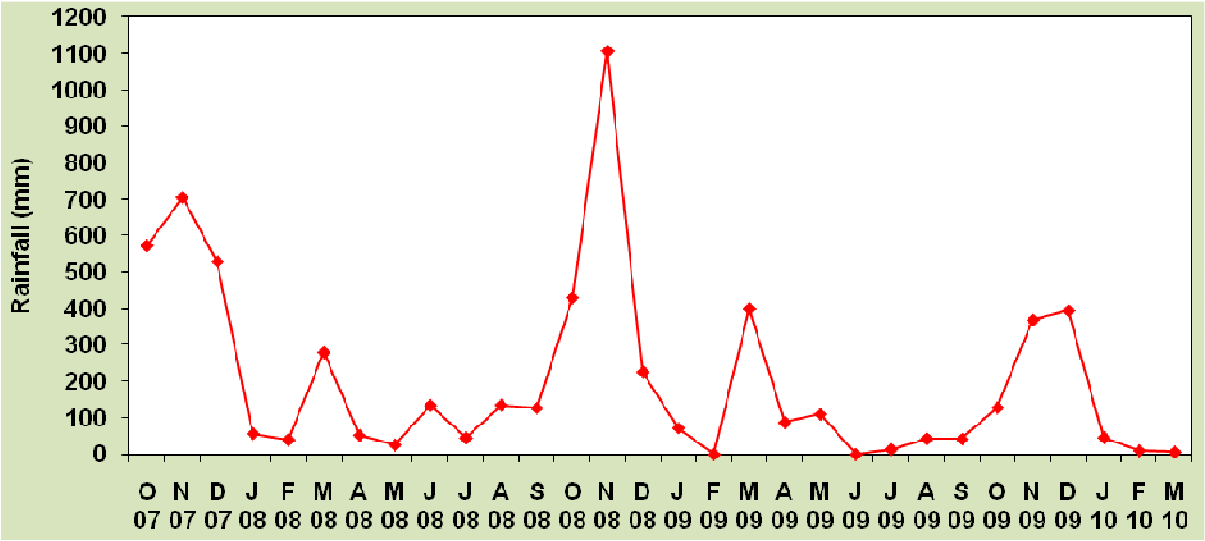

Figure 12. Monthly variations of rainfall in the study area during the study period.

due to fresh water inflow, litter fall decomposition and terrestrial run-off during the monsoon / post-monsoon season (Karuppasamy and Perumal, 2000). Another possible way of nitrates entry is through oxidation of ammonia form of nitrogen to nitrite formation (Rajasegar, 2003). The low values records during summer / pre-monsoon period may be due to its utilization by phytoplankton as evidenced by high photosynthetic activity and also due to the neritic water dominance, which contained negligible amount of nitrate (Rajashree and Panigrahy, 1996; Das et al., 1997; Govindasamy et al., 2000).

The peak values of nitrite observe during the monsoon may be attributes to the influence of seasonal rainfall. The higher concentration of nitrite and seasonal variation may also be attributes to the variation in phytoplankton excretion and oxidation of ammonia (Kannan and Kannan, 1996). Low values of nitrite observed during the summer may be due to the lesser amount of freshwater inflow and higher salinity. Similarly maximum value in monsoon and minimum value in summer season was also recorded by Satpathy (1996) from coastal waters of Kalpakkam, Prabu et al. (2008) from Pichavaram mangroves, Sundaramanickam et al. (2008) from Parangipettai and Cuddalore coast and Damotharan et al. (2010) from Point Calimere coastal waters, India.

The phosphates are essential for the growth of organisms and a nutrient that limits the primary productivity of the water body. Inorganic phosphorous plays a dynamic role in aquatic ecosystem, when present in low concentration is one of the most important nutrients. High concentration of phosphates observed during monsoon / post-monsoon seasons may possibly be due to intrusion of upwelling seawater into the swamp, which increased the level of phosphate. The result of low phosphates value during summer / pre-monsoon may be attributed to the limited flow of freshwater, high salinity and utilization of phosphate by phytoplankton (Senthilkumar et al., 2002; Rajasegar, 2003). The variation may be due to the various processes like adsorption and desorption of phosphates and buffering action of sediment under varying environmental conditions (Rajasegar, 2003).

Turbidity is a measure of water clarity how much the material suspended in water decreases the passage of light through the water. In the present study, maximum turbidity is during monsoon season, while minimum value is during summer season. During monsoon season silt, clay and other suspended particles contribute to the turbidity values while during summer season settlement of silt, clay resulting low turbidity. Bathusha and Saseetharan (2007), Garg et al. (2006), Prasad and Patil (2008), Saravanakumar et al. (2008) and Upadhyay et al. (2010) have also reported high turbidity during rainy season.

The present baseline information of the physico-chemical properties of water would form a useful tool for further ecological assessment and monitoring of this wetland of Point Calimere Wildlife Sanctuary.

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