



Studies on the physico-chemical status of muthupettai mangrove, south east coast of INDIA

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ABSTRACT

Mangrove and estuaries are the fertile eco system serving nursery and feeding ground to the many marine organisms. However the water quality parameters of the particular environment are prime factor which determining the breeding and spawning periodicity of the many marine shell and fin fishes. In the present investigation the water quality parameters showing seasonal variation and it is pertinent to say that the variations recorded during the present study may be due to the environmental fluctuations in relation with season.

Key Words: Mangrove, estuary, Physico-chemical and species impact.

INTRODUCTION

Mangroves provide an ecologically important habitat for a wide diversity of many species. Their distribution depends upon the geographical, biological, ecological and physicochemical characteristics of the water. Different species of shellfish and finfish that benefit from conditions advantageous for reproduction, feeding and wintering [1]. The hydrodynamic conditions in an estuary are quite complex, as they are influenced by river flow, tide, wind and density factors. Further, they are modified due to earth's rotation, bottom friction and the geometric properties of the estuarine system [2]. The different environmental conditions are generally subjects to the eggs and larvae to high rate of mortality in the environment. Hydrological study is a prerequisite to the assessment of the potentialities, distribution of plants and animals and also to understand the realities between its different trophic level and food webs [3]. The physicochemical characteristics have been studied by many workers in estuary environment [4, 5, 6 & 7]. The aim of the present study was to determine whether the physical and chemical parameters of seasonal variability in Muthupettai coastal environment.

MATERIALS AND METHODS

Water samples were collected at monthly interval in four stations for a period of two year from January 2006 to December 2007 to analyze various physicochemical parameters. Rainfall data for the study area was collected from the meteorological unit. Temperature (°C) was measured using a standard Celsius thermometer with the accuracy of $\pm 0.5^{\circ}\text{C}$. Salinity was estimated with the help of a hand refractrometer (ERMA, Japan) and pH was measured using an ELICO Grip pH meter. Dissolved oxygen was estimated by the modified Winkler's method [8].

RESULTS

Rainfall

The total annual rainfall of 1271.4 mm was recorded in first year (2006). Maximum rainfall was recorded in the months of October (2006) 302 mm and minimum 10 mm was in the months of January (2006), similarly the total

annual rainfall of 1225.3 mm was recorded in second year (2007). Maximum rainfall was recorded in the months of October (2006) 289 mm and minimum 30.2mm was in the months of February (2006) and no rainfall was recorded in January and March in the second year (Fig 1).

Atmospheric Temperature

During the First year at station I, the surface water temperature varied from 35°C (April) to 25 (October). At station II, the temperature fluctuated from 34.5 °C (May) to 24.3 °C (December). However at station III, the atmospheric temperature ranged from 35(May) to 26°C (October). At station IV, the temperature varied from 34.2 °C (June) to 25.3 °C (November) and second year at station I, the temperature varied between 34.6°C (May) and 24 °C (December). At station II, the temperature fluctuated from 34.8 °C (May) to 24.9 °C (December). At station III, it varied from 35 (June) to 25.3 (December). With respect to station IV, it fluctuated between 34.3 °C (May) and 25.8°C (December) (Fig 2).

Water Temperature

During the first year at station I, the temperature varied between 29.4°C (January) and 18.6°C (December). At station II, the temperature fluctuated from 29°C (July, September) to 18.5°C (October). At station III, it varied from 28°C (April, July) to 19°C (October). With respect to station IV, it fluctuated between 28°C (January) and 16.9°C (December) and second year at station I, the surface water temperature varied from 30.1°C (May) to 16.5°C (December). At station II, the temperature fluctuated from 29°C (September) to 18.6°C (October). However at station III, the water temperature ranged from 28°C (February, September) to 16.5°C (December). At station IV, the temperature varied from 27.4°C (April) to 17°C (December). In general, the water temperature level increased from monsoon season reaching the maximum during the summer months (Fig 3).

Salinity

The first year at station I, the salinity varied between 20‰ (December) to 33‰ (July). Salinity varied from 18‰ (November) to 33‰ (May and June) in station II. However in station III, the minimum salinity was recorded in October (18 ‰) and maximum in May (33 ‰). At station IV, the salinity fluctuated between 16 ‰ (November) and 35 ‰ (May) and second year, at station I, the salinity varied between 17 ‰ (November and December) to 33‰ in Aug, May, and July. In station II, it fluctuated from 15‰ (November) to 33‰ (May). The salinity ranged from 16‰ (October) to 34 ‰ (May) in station III. However at station IV, it ranged between 16‰ (November) and -36‰ (May). The fluctuations in salinity observed presently may be attributed mainly to rainfall and monsoonal flood. However, the minimum salinity was recorded during monsoon and the maximum in summer (Fig 4).

pH (Hydrogen-ion concentration)

During the first year, the pH values ranged between 7.9 (April) to 8.3 (June) in station I, 7.2(December) to 8.2 (May) in station II, at station III, it varied between 7.3 (December) to 8.2(May) and 7.2 (December) to 8.2 (May) in station IV respectively and second year, pH showed variation ranging from 7.54 (November) to 8.2 (June) in station I. In station II, the values fluctuated between 7.72 (November) and 8.27 (May). But at station III, almost similar values were recorded 7.69 (November) and 8.34 (June). However at station IV, the pH fluctuated between 7.8 (December) and 8.28 (June) (Fig 5).

Dissolved Oxygen

During the first year, at station I, the dissolved oxygen content varied from 5.66 $\mu\text{ mol/l}$ (February) to 4.11 $\mu\text{ mol/l}$ (July). At station II, the dissolved oxygen level fluctuated from 5.0 $\mu\text{ mol/l}$ (February) to 2.8 $\mu\text{ mol/l}$ (October). Similarly at station III, the dissolved oxygen values were between 4.5 $\mu\text{ mol/l}$ (June) and 3.1 $\mu\text{ mol/l}$ (September). However, at station IV, the minimum dissolved oxygen value was recorded (5.54 $\mu\text{ mol/l}$) during February and the minimum (4.0 $\mu\text{ mol/l}$) in November and second year, at station I, dissolved oxygen varied between 4.5 ml/l (July) to 3.5 $\mu\text{ mol/l}$ (December). At station II, the range was between 4.5 $\mu\text{ mol/l}$ (July) and 2.9 $\mu\text{ mol/l}$ (March). At station III, the dissolved oxygen varied from 4.7 $\mu\text{ mol/l}$ (July) to 3.1 $\mu\text{ mol/l}$ (December). However at station IV, it varied from 4.2 $\mu\text{ mol/l}$ (July) to 3.2 $\mu\text{ mol/l}$ (October) (Fig3).

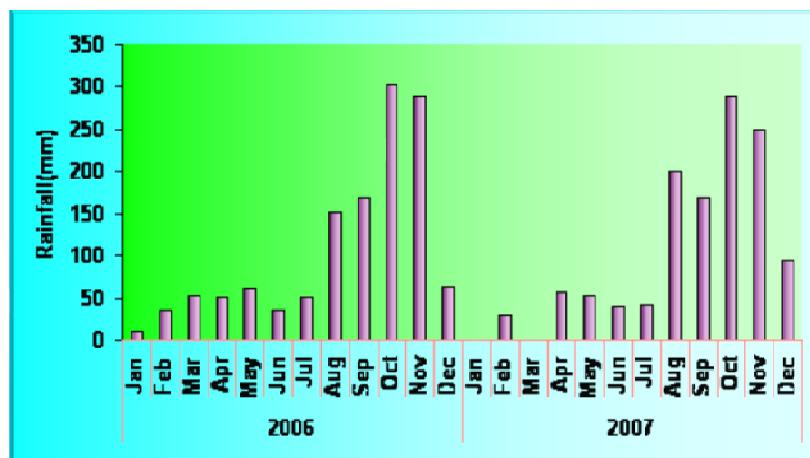


Fig1. Is depicting rainfall recorded along Muthupettai coast during the two years of study period (January-2006 to December- 2007).

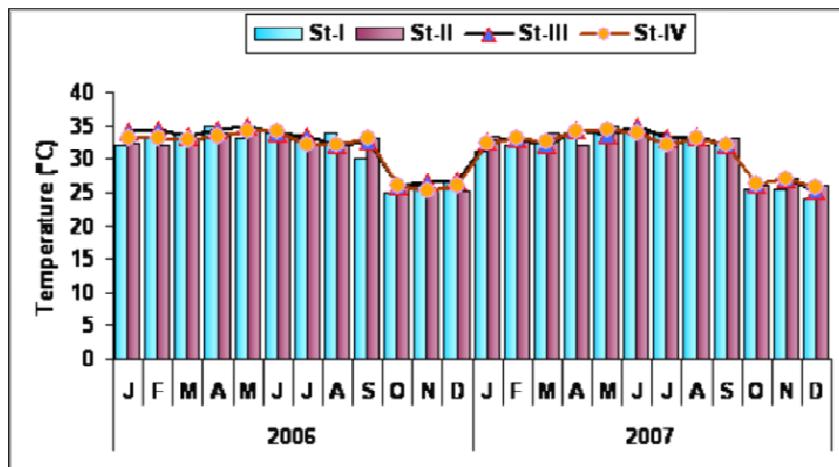


Fig2. Is depicting the atmospheric temperature recorded along Muthupettai coast during the two years of study period (January-2006 to December-2007).

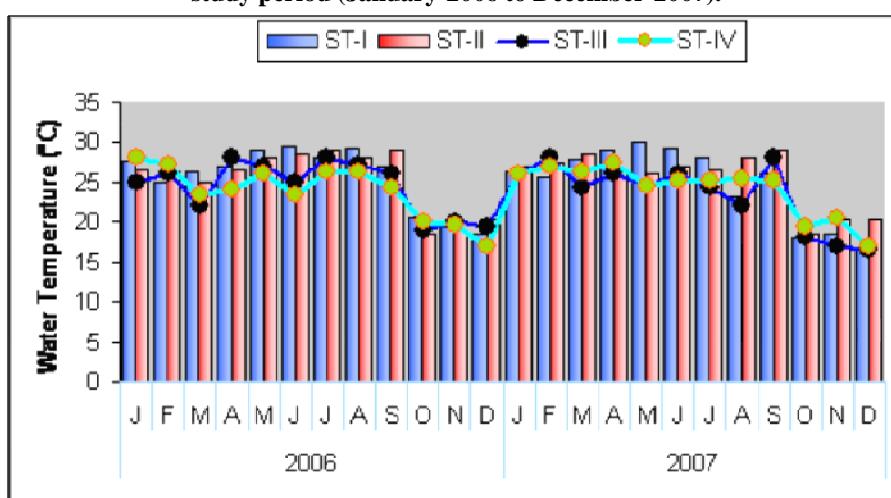


Fig3. Is depicting the surface water temperature recorded during the study period January- 2006 to December-2007) along Muthupettai waters.

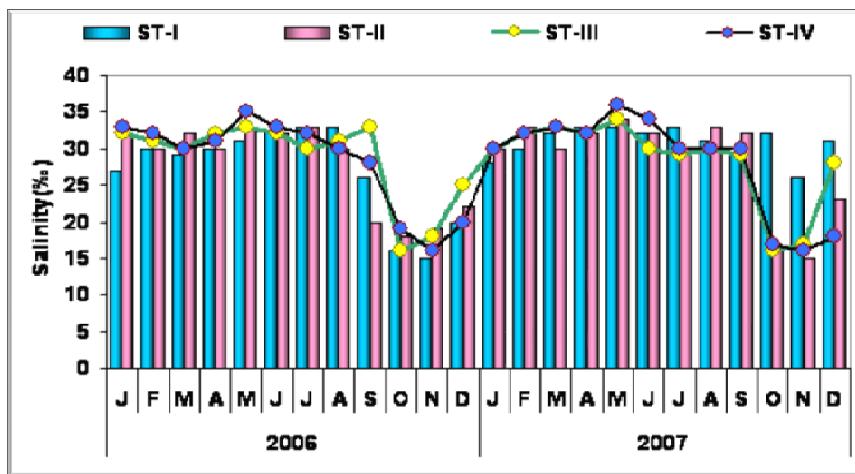


Fig 4. Is representing the salinity noticed during the study period (January-2006 to December-2007).

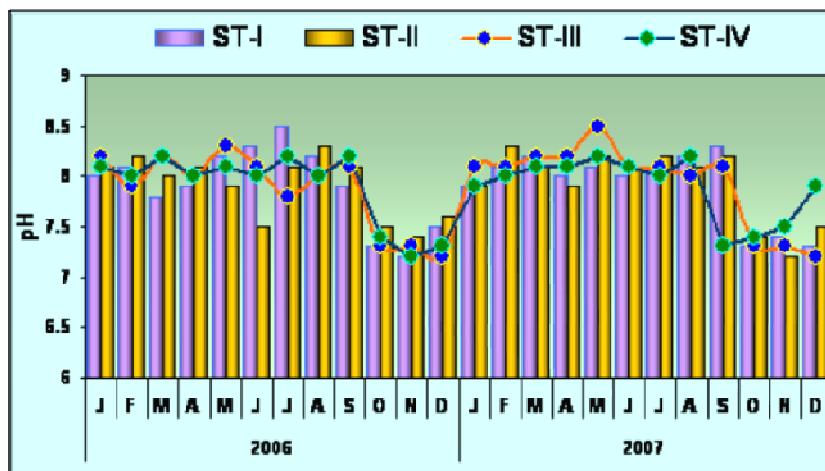


Fig 5. Is illustrated the hydrogen-ion concentration (pH) recorded along Muthupttai waters at station I to IV during the study period (January-2006 to December-2007).

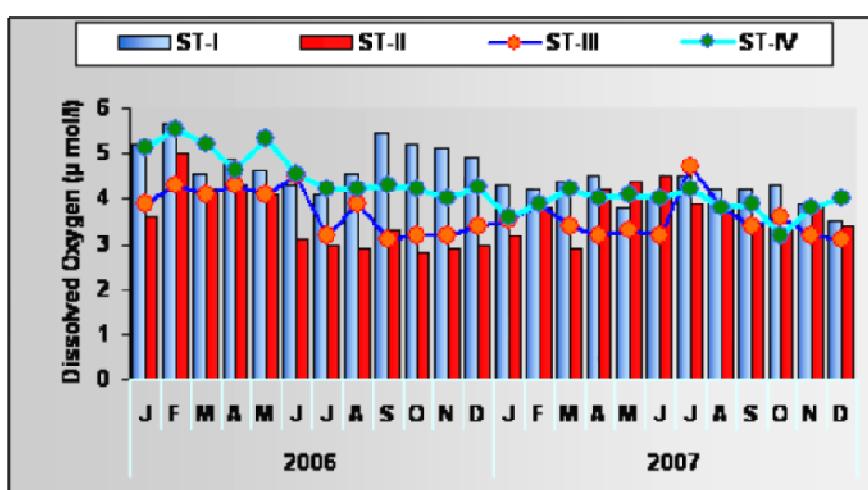


Fig 6. Is illustrated the Dissolved Oxygen (DO) recorded along Muthupttai waters at station I to IV during the study period (January-2006 to December-2007).

Table 1. Two-way ANOVA for differences in surface water temperature between seasons and stations along Muthupettai coastal waters during the study period (January- 2006 to December-2007)

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	1140.513	23	49.58754	23.47393	4.01E-24	1.686897
Columns	48.04583	3	16.01528	7.58137	0.000187	2.737492
Error	145.7592	69	2.112452			
Total	1334.318	95				

Two-way analysis of variance done separately for the two years of study period showed significant differences between the seasons but not between the stations along Muthupettai estuary waters (Table 1).

Table 2. Two-way ANOVA for differences in Salinity between seasons and stations along Muthupettai coastal waters during the study period (January-2006 to December-2007)

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	2620.99	23	113.9561	13.76525	1.29E-17	1.686897
Columns	10.03125	3	3.34375	0.403906	0.750645	2.737492
Error	571.2187	69	8.278533			
Total	3202.24	95				

Two-way analysis of variance done separately for the two years of study period showed significant differences between the seasons but not between the stations along Muthupettai estuary waters (Table 2).

Table 3. Two-way ANOVA for differences in pH between seasons and stations along Muthupettai coastal waters during the study period (January-2006 to December-2007)

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	9.536562	23	0.414633	11.88923	5.83E-16	1.686897
Columns	0.006146	3	0.002049	0.058742	0.981173	2.737492
Error	2.406354	69	0.034875			
Total	11.94906	95				

Two-way analysis of variance done separately for the two years of study period showed significant differences between the seasons but not between the stations along Muthupettai estuary water (Table 3).

Table 4. Two-way ANOVA for differences in Dissolved Oxygen between seasons and stations along Muthupettai coastal waters during the study period (January-2006 to December-2007).

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	13.88135	23	0.603537	2.988639	0.00024	1.686897
Columns	14.73547	3	4.911822	24.32272	7.53E-11	2.737492
Error	13.93412	69	0.201944			
Total	42.55094	95				

Two-way analysis of variance done separately for the two years of study period showed significant differences between the seasons but not between the stations along Muthupettai estuary waters (Table 4).

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 and estuarine environments. In the present study, peak values of rainfall were recorded during the monsoon months (October to December) and lower values during summer months (April to June) observed presently were in agreement with the observations made by earlier workers [9, 10 & 11]. Temperature variation is one of the factors in the coastal and estuarine ecosystems, which can influence the

physicochemical characteristics of coastal and estuarine waters to a greater extend. The higher values of atmospheric temperature in summer and lower values in monsoon observed in the present study confirmed the established trends along the southeast coast and is in agreement with the observations made by [12, 13, 14, 15, 9 &10]. The surface water temperature largely depends upon the intensity of solar radiation, evaporation, freshwater influx, cooling and mixing due to currents and tidal flow. Surface water temperature also showed a similar trend of monthly variation as that of air temperature and the high values were reported during the summer and lower values during the monsoon season. The gradual increase in water temperature from monsoon to summer may perhaps be due to the direct result of atmospheric conduction and radiation. Similar findings were reported [9, 10 & 11].

Salinity is considered to be the basic and prime factor among the environmental variables in the marine environment which influences greatly the dynamic situation of the estuarine and coastal waters by the inflow of freshwater and the prevailing temperature. It is one of the most fluctuating parameters, typified with wide range of variations in both estuarine and coastal environments. Generally, the changes in the salinity in the brackish water habitats such as estuary, backwater, mangroves and coastal waters are due to the influx of freshwater from river, by land runoff caused by monsoon or by tidal variations. The maximum salinity was recorded during the summer and the minimum during monsoon period in both years. Higher values in summer could be attributed to high degree of evaporation with decreased freshwater inflow and land drainage. Drop in salinity during monsoon may perhaps be due to heavy showers and consecutive floodwater from up streams as reported by [16 & 10]. The hydrogen-ion concentration (pH) often changes with time due to temperature, salinity changes and biological activity. The pH remained alkaline throughout the study period in all the stations with maximum values during the summer, which could be attributed to the high salinity of water and also due to the uptake of carbondioxide by the photosynthetic organisms. The photosynthetic activity may cause high pH, because of bicarbonate degradation by carbonic anhydrase associated with photosynthesis [17]. Most of the natural waters are generally alkaline due to the presence of sufficient quantities of carbonate [18]. Generally higher values of pH were recorded in (stations I) than others. [19] Have opined that the pH of water changes with time due to exposure to biological activity and temperature. The low values of pH noticed during monsoon season may perhaps be due to dilution and mixing of coastal waters by rain floods that leads to reduction in salinity and temperature and decomposition of organic matter. This study agreement with previous studies [13, 20, 16, 10 & 21].

Dissolved oxygen is one of the most important parameters, which reflects the physical and biological processes prevailing in the water. The dissolved oxygen content depends upon the photosynthetic activities, monsoonal floods and the turbulence caused by the winds [21]. In the present study, the dissolved oxygen concentration was low during summer and high during monsoon months in all the stations. [22] Opined that temperature is a major factor controlling oxygen saturation in water. Solubility of oxygen in water is inversely proportional to temperature [23]. The low dissolved oxygen concentration observed during summer may be attributed to the higher salinity of the water, higher temperature and less inflow of freshwater coupled with biological processes such as consumption of available oxygen by the organisms for respiration and active decomposition of organic matter during summer. And the first year, the dissolved oxygen contents were higher compared to second year, which may perhaps be due to the increased rainfall during the first year. The trend noticed in the present study is in accordance with the findings of [20, 16 & 10].

In the present study disrupts normal functioning of the ecosystem, causing a variety of problems such as a lack of oxygen in the water, needed for fish and shellfish to survive. During the rainy season, the increased flow of freshwater results in the appearance of freshwater species. However, the majority of dry season species cannot survive in these low salinities and migrate to higher salinity areas offshore. Salinity is extremely important from the standpoint of monitoring water quality. The purpose of this study has been to determine the effect of drainage system and type of land use on the load of mineral nutrient compounds derived from soil environment and present in water ecosystems. As water originating from rain and snow is the main medium shaping soil processes and transport of minerals, particular attention has been paid to variations in atmospheric precipitation during the analyzed time period. Increased human activities over the recent past are imposing a greater stress on these ecosystems, resulting on changing their water quality and loss of biodiversity. In the present study tidal and diurnal variations in a large spectrum of physico- chemical fraction was irrigates for this coastal environment.

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