HYDROGRAPHICAL PARAMETERS

3.1 Temperature
3.2 pH
3.3 Salinity
3.4 Dissolved oxygen
3.5 Alkalinity
3.6 Hardness
3.7 Total Suspended Solids
3.8 Chlorophyll

REFERENCES
A detailed study of the variations in parameters such as temperature, salinity, dissolved oxygen, pH was also carried out along with the organic matter analysis of mangrove environment. The significant changes in these chemical constituents are brought about by variations in hydrographic features associated with the SW monsoon. It has long been established that the concentrations of many components in the aquatic system are controlled by factors like salinity, pH and other major and minor ionic concentrations. Hence the study of these parameters is indeed quite relevant in the present context. The results of the present investigations are presented and discussed in the following sections.

A diurnal study was conducted to assess the changes, if any, that occurred with time or tidal levels. However, results of this study indicated that there was no significant variation of parameters with time or tide as confirmed by ANOVA (Table B.2). Therefore, sampling strategies were designed and carried out irrespective of tidal variation.

3.1 Temperature

Temperature of the environment is a major and even the deciding environmental factor in determining growth rate, metabolism, and nutritional efficiency of aquatic life. In fact, temperature will influence all biological and chemical processes in an aquatic system.

The data regarding temperature distribution for the 4 stations is given in the Table (A.1). Seasonal and diurnal variations are shown in Fig. 3.1a and 3.1b respectively.

![Figure 3.1a: Spatial and seasonal variation of temperature](image)

![Figure 3.1b: Spatial and diurnal variation of temperature](image)
Monthly data showed the maximum temperature (35°C) in the month of April'99, at Station 3 and the minimum (21°C) in October'00 at Station 1. At all the four Stations, the highest temperatures were observed during pre-monsoon and the lowest during post-monsoon. In all the seasons, except during pre-monsoon, Station R exhibited high temperature. Temperature decreased in the order, Station R > Station 3 > Station 2 > Station 1 during monsoon and post-monsoon, but during pre-monsoon, the trend was, Station 3 > Station R > Station 2 > Station 1. ANOVA showed significant variations between stations and seasons (Table B.1).

The temperature variation in the present study was predominantly diurnal with a mean value of 29.07°C. The maximum temperature (27°C) was observed at 1600hrs at Station 2 and the minimum (33°C) at 200 hrs. in the night at Station 2 itself. Therefore, the temperature variation was mostly observed at Station 2.

### 3.2 pH

pH is another important parameter which exerts definite influence on speciation of elements in water. The solubility of different constituents is dependent on pH. The pH also controls the growth of organisms regulating the activity of enzymes. In open ocean waters, pH ranges between 7.8 and 8.4. Variation in pH of coastal waters is caused by many factors. Aquatic pH generally vary from 7.0 to 7.5 in the fresher sections, to between 8.0 and 8.6 in the more saline areas. The slightly alkaline pH of seawater is due to the natural buffering from carbonate and bicarbonate dissolved in the water. During monsoon season, the fresh water discharge from the rivers lowers the pH. Photosynthesis, denitrification and sulphate reduction increase pH, whereas processes such as respiration and nitrification decrease pH (Zhang, 2000). When photosynthetic reactions take place in the aquatic system, CO$_2$ is reduced to carbohydrate. Thus the higher pH values for surface waters are caused by the enhanced photosynthetic activity occurring at the surface. Respiration and degradation/decomposition of organic material are the reactions that proceed in the opposite direction of the photosynthesis. Oxidation of organic matter leads to increase in CO$_2$ levels and to a shift of equilibrium to the lower pH. Other factors that determine the pH of the water include bacterial activity; water turbulence; chemical constituents in runoff; sewage outflows; and impacts from other anthropogenic activities.
Changes in pH can alter other aspects of the water chemistry, usually to the detriment of native species. Even small shifts can affect the solubility of some metals such as iron and copper. It has been shown that a pH of 1.5 or less was necessary to ensure that the entire metal ion remained in solution. Speciation of elements undergo considerable changes in the pH range of 7.5 to 8.5. Lowering of pH levels could trigger the resuspension of toxic metals from the sediments into the water column and this can seriously impact many aquatic species.

Values of pH at various stations during the present investigations are given in the Table A.2. Seasonal and diurnal variations are depicted in the Fig. 3.2a and 3.2b respectively.

![Figure 3.2a: Spatial and seasonal variation of pH](image)

![Figure 3.2b: Spatial and diurnal variation of pH](image)

Monthly variation of pH was in the range 6.8 to 8.8 with an overall mean value of 7.56. pH was directly correlated to DO (Table C.1a-d) at Station 1. This may be due to increased photosynthesis at this Station. Water bodies with high alkalinity have high pH values while those with low alkalinity have low pH values. Station 2 showed a range from 6.9 to 8.8 with a mean value of 7.81, at Station 2, the pH is positively related to DO. At Station R the range was from 6.94 to 8.42 mean value being 7.64. At Station 3, the range was 6.8 to 7.93, with a mean value 7.36. At Station R a highly significant positive correlation was found between pH and hardness. The overall seasonal range showed the highest at Station 2 during premonsoon and the lowest during monsoon at Station 3 and Station R. The high correlation between pH and hardness was found during monsoon season also (Table C.2b).
In the diurnal study, pH ranged from 6.9 (at 1600hrs. at Station 1) to 8.2 (1100hrs. and 1300hrs. at Station 2). Except at 200hrs. Station 1 showed the lowest pH values. This might be due to the decomposition of organic matter in sewage overflow from the nearby-inhabited area. Diurnal data showed a direct relationship of pH with salinity and inverse relationship with POC at Station 1. pH decreases with increase of organic matter load. At Station 2 pH was determined by temperature, DO and alkalinity. Station R showed no significant correlation.

The lower pH values of mangrove areas were mainly due to the microbial degradation of organic materials such as mangrove detritus, which depletes oxygen and makes way for bacterial sulphate reduction (Berner, 1983) leading to the production of hydrogen sulphide. Samples collected from mangrove areas especially those of Stations 1 and 2 were often anoxic and had a pronounced odour of hydrogen sulphide. The reduction in pH values during postmonsoon at Stations 1 and 2 and during monsoon at Stations 3 and R was due to the effect of precipitation. Acidic mangrove deposits may be the result of several processes, including oxidation of reduced compounds (NH$_3$, H$_2$S, FeS$_2$) or the dominance of aerobic decomposition of organic matter which results in the net production of carbonic acid (Middelburg et al., 1996; Alongi et al., 1998). The activities of Rhizophora apiculata are known to lower the pH and alkalinity of sediments (Kristensen et al., 1991). Another acid-generating mechanism may be the leaching of polyphenolic acids from the standing amounts of leaf litter and slash lying on, and buried in, these water and sediments. Polyphenolic acids are a major component of pore-water dissolved organic carbon (DOC) pools (Boto et al., 1989) and DOC leaching from mangrove leaves (Benner and Hodson, 1985).

3.3 Salinity

Of all the hydrographic parameters, salinity is perhaps the most important one being an index of the amount of dissolved solids in water. Salinity varies with depth and from place to place. The principal natural processes, which lead to changes in the salinity are those, which bring about the removal or addition of freshwater. Increase in salinity is caused by evaporation and by the removal of almost pure water, as ice, during freezing. Decrease in salinity results from atmospheric precipitation, run-off from land, tidal intrusion etc.
Chapter 3

The results obtained in the present study are tabulated in the (Table A.3). Monthly data showed the maximum salinity 31.86\%o in the month of May at Station 2 and a minimum of zero in the month of August'99 at Station 3. Mean values of Stations 1, 2, 3 and R were 15.98\%o, 17.38\%o, 9.33\%o and 11.26\%o respectively. Salinity was minimum in July and October, which reflected the active periods of south west and north east monsoons respectively. High values of salinity at mangrove sites may be due to high rate of the evapotranspiration (Dittmar and Lara, 2001) which precipitates more and more salts with each incoming tide.

At all the four stations salinity was maximum during premonsoon (Fig 3.3a). Station 3 showed the lowest salinity in all the three seasons. Seasonal data showed the highest salinity at Station 2 during premonsoon and the lowest was observed at Station 3 during monsoon. Overall mean value obtained was 13.38\%o. The salinity at the Station 3 was comparatively lower while that at the other two mangrove sites were more or less the similar. The lower value of salinity at this station may be due to freshwater discharge. ANOVA showed significant difference between stations and seasons (Table B.1).

![Figure 3.3a: Spatial and seasonal variation of salinity](image)

![Figure 3.3b: Spatial and diurnal variation of salinity](image)

Diurnal variation of salinity of the mangrove sites was almost parallel (Fig 3.3b). Both mangrove stations showed higher salinities compared to the Station R, with the highest being recorded at Station 2, the maximum (30.26\%o) being at 1100hrs. The lowest salinity (18.16\%o) was also found at 1100hrs. at Station R. All Stations except Station R showed only slight changes in salinity. The tidal effect was more pronounced at Station R. Effect of tide was not a significant factor at
Mangrove stations probably because of the complex network of roots, pneumatophores, creeks and channels, which restricted the free flow of water.

The mean salinity was controlled by evaporation and transpiration by mangroves. Seasonal variability of salinity was significant. During pre-monsoon salinity increased due to evaporation and low discharge of freshwater. The evaporation rate may be the highest during pre-monsoon with low or no rainfall, which explains the highest values of salinity during this period. The extreme drop in salinity to near freshwater conditions observed during monsoon at Station 3 was resulted from the considerable dilution due to the heavy influx of freshwater. Salinity was higher in May which was attributed to the combined effect of high insulation, evaporation and cessation of freshwater and/or high saline water influx due to the absence of rainfall. Lower salinity in August may be due to high freshwater influx coupled with intense rainfall during monsoon especially at Station 3. Thus, freshwater input and tidal fluctuation determine salinity distribution at Station 3, whereas monsoonal and postmonsoonal precipitation reflects the salinity variation at Station 1 and Station 2.

Salinity showed positive relationship with hardness at all stations (Table C.1a-d). This may due to the fact that Ca and Mg which contribute to hardness, contributes to salinity also. Thus, Ca and Mg behave in a conservative manner at all the four Stations. Salinity showed a direct relationship with TSS and alkalinity during premonsoon, and an inverse relation with DO during monsoon (Table C.2a-c). It is well known that the salt content of water reduces the solubility of gases and that therefore, the concentration of DO is regulated by the salinity. This implies that freshwater inputs may enhance productivity and increase levels of DO.

Diurnal correlation data (Table C.3a-c) showed a direct relationship between salinity and pH and an inverse relationship with DO at Station 1. At Station R, salinity showed an inverse relationship with temperature, which may due to increase of salt content by evaporation.

3.4 Dissolved oxygen

Dissolved oxygen (DO) plays a vital role in the aquatic environment being essential to the survival of aquatic life. Oxygen enters the water primarily through
direct diffusion at the air-water interface and through aquatic plant photosynthesis. The quantity of oxygen dissolved in water is determined by a number of factors such as temperature, salinity, partial pressure of the gas in the atmosphere, biogeochemical processes like oxidation and reduction, biochemical degradation of organic matter, respiration, photosynthesis, biological activity, currents and mixing processes etc. In fact, the maximum amount of oxygen that can be dissolved in water is only about 8.3 mg/l at standard temperature and pressure and is referred to as oxygen saturation, which is influenced by temperature, elevation (tidal level), and salinity levels.

The competing processes of photosynthesis and respiration are the main causes of in situ changes in the concentrations of dissolved oxygen and carbon dioxide in the water. Photosynthesis by phytoplankton leads to the removal of carbon dioxide and to the liberation of oxygen. Dissolved oxygen is consumed by the respiration of plants, animals and bacteria. The ultimate factor limiting the consumption of oxygen is the supply of organic matter. Microbial degradation of the high content of organic matter in mangrove areas generally removes all oxygen from water creating anoxic conditions with a pronounced smell of hydrogen sulphide. Because the oxygen is involved both in the photosynthetic and degradation processes in nature, oxygen is not a conservative element in the natural waters.

In the present study, DO showed monthly variations at all the four stations with a maximum (9.66ml/l) in April'99 at Station 2 and a minimum (0.224ml/l) in November'00 at Station R (Table A.4). Annual mean values at each station were 2.60ml/l, 3.60ml/l, 3.96ml/l and 3.50ml/l for Stations 1, 2, 3 and R respectively with an overall mean value of 3.52ml/l was obtained. DO also showed a seasonal variation with exceptionally very high (6.35ml/l) during premonsoon at Station 2 (Fig. 3.4a). Postmonsoon showed the lowest DO values at all the four stations and the minimum was obtained at Station 2 during postmonsoon, which may be due to low primary production or high rate of decomposition. ANOVA (Table B.1) showed significant fluctuation between stations and seasons.

In a similar study by Sheeba et al. (1996) DO ranged between 2.00 and 8.75ml/l respectively for Puduvypeen and Nettoor.
DO showed a positive correlation with pH (Table C.1a-d) at Station 1 and with temperature and pH at Station 2. Increase of DO with temperature may be related to increase in light intensity, which increases the rate of photosynthesis. Also warmer temperature increases the rate of photosynthesis. During monsoon DO showed negative relationship with salinity (Table C.2b). Inverse correlation was found between salinity and DO implying that freshwater inputs may enhance productivity and increase levels of DO. The amount of dissolved oxygen depends upon salinity and indicates inverse relation with high salinity water showing low DO.

Figure 3.4a:- Spatial and seasonal variation of dissolved oxygen

In the diurnal study, DO showed variation from a minimum of 0.413ml/l (Station 3, 2100hrs and 800hrs.) to a maximum of 2.3ml/l (Station 2, 1100hrs.) with an overall mean value of 2.079 (Fig. 3.4b). In general, all the lower values were observed at night except for reference site. It may be due to the fact that at night, surplus organic matter degradation depletes most of the DO from water. During daytime, photosynthesis counterbalances respiration and organic matter degradation, whereas at night although respiration and degradation continue, photosynthesis ceases with no DO production at all which account for the low value of DO at night. Station R exhibited a lower DO range. This could be attributed to lower productivity at this site compared to mangrove sites. But after dawn, the DO altered between low and high values, in accordance with the tidal sequence. At low tide, high values of DO were observed and vice versa. During daytime, however, this tidal effect on DO could not observed, even at 1300hrs. which showed a high value, contrary to the low value expected at high tide. This
Chapter 3

may be due to the fact that this was the peak of sunlight intensity which drives the engines of photosynthesis. Also, warmer temperature at 1300hrs., helped speed up the rate of photosynthesis. Effect of wind can also cause dramatic change in DO. Oxygen concentration is much higher in air. When air and water meet, this tremendous difference in concentration causes oxygen molecules in air to dissolve into the water. More oxygen dissolves into water when wind stirs the water and enlarges the surface area for more diffusion to occur.

During daytime, there is a distinct variation between Stations 1 and 2, with very high values being observed at Station 2, which, therefore appears to be the most productive. At night also, a variation was observed, though of much lesser magnitude. The human settlement at Station 1, introduces more sewage into the mangrove system leading to depletion of the DO. At Station 2, DO values decreased from 1100hrs. to 1600hrs. This was in accordance with changes in temperature. Temperature is another physical process that affects DO concentration. Cold water can hold more and more of oxygen, than warmer water. Warmer water becomes saturated more easily with oxygen. As water becomes warmer it can hold less and less of DO.

Diurnally DO showed a positive correlation with temperature at Station 1. DO was highly correlated to temperature, pH and chlorophyll at Station 2 (Table C.3a-c). The high positive correlation of DO with chlorophyll suggests high primary productivity at this site.

3.5 Alkalinity

Total Alkalinity is a measure of the "buffering capacity" of water, or its ability to resist a change in pH. Aquatic systems with high alkalinity have high pH values while lakes with low alkalinity have low pH values. Alkalinity influences pH which in turn will decide the aquatic life that can survive in a water body. Alkalinity is a measure of the capacity of water to neutralize acids. Higher alkalinity levels in surface waters will buffer acid rain and other acid wastes, and prevent pH changes that are harmful to aquatic life. Because the alkalinity of many surface waters is primarily a function of bicarbonates (HCO₃⁻) and carbonates (CO₃²⁻), and, in rare instances, of hydroxide (OH⁻) ions, it is usually taken as an
Hydrographical Parameters

Indication of the sums of concentration of these constituents. These ions, called buffers, are important because they slow down the rate at which the pH changes. These are bound to cations such as sodium and potassium. Bicarbonates represent the major form of alkalinity. Without a buffering system, free carbon dioxide will form large amounts of carbonic acid that may potentially decrease the night-time pH level to 4.5. During peak periods of photosynthesis, most of the free carbon dioxide will be consumed by the plants and, as a result will drive the pH levels above 10. Total alkalinity of seawater averages 116 mg/l and is greater than that of fresh water, which can have a total alkalinity of 30 to 90 mg/l, depending on the watershed and the chemical composition of water. The brackish waters of an estuary will have total alkalinity between these values. The major factors influencing the alkalinity values of oceans are weathering of rocks, anthropogenic interferences, increase in discharge of phosphate, borate, silicate, organic acids and precipitation and dissolution of biogenic CaCO₃.

In most waters, alkalinity and hardness have similar values because the carbonates and bicarbonates responsible for total alkalinity are usually in the form of calcium carbonate or magnesium carbonate. Alkalinity is often related to hardness because the main source of alkalinity is usually from CaCO₃. If CaCO₃ actually accounts for most of the alkalinity, hardness in CaCO₃ is equal to alkalinity. Since hard water contains metal carbonates (mostly CaCO₃) it is high in alkalinity. However, waters with high total alkalinity are not always hard, since the carbonates can be in the form of sodium or potassium carbonate. Conversely, unless carbonate is associated with sodium or potassium, which do not contribute to hardness, soft water usually has low alkalinity. Therefore, generally, soft water is much more susceptible to fluctuations in pH from acid rains or acid contamination. Hard water lakes are generally more productive than soft water lakes and can accept more input of salts, nutrients, and acids to their system without change than can soft water lakes.

In the present study, the highest alkalinity (4.18 mmol/l) was observed in the month of September’00 at Station 2 and lowest (0.183 mmol/l) at Station 3 in June’99 (Table A.5). Mean values of each station were 1.41 mmol/l, 1.75 mmol/l, 0.922 mmol/l and 1.27 mmol/l for Stations 1, 2, 3 and R respectively. Results of the ANOVA revealed significant differences between stations and seasons (Table B.1). Seasonal
data (Fig. 3.5a) showed a minimum value for alkalinity during pre-monsoon at all the four stations. During all the three seasons, Station 3 recorded the lowest values. The range was 1.06mmol/l (pre-monsoon, Station 3) to 2.03mmol/l (monsoon, Station 2). Increase in alkalinity during monsoon and postmonsoon is due to the input of the carbonate and bicarbonate concentrations in the water column.

At Station 1, alkalinity is found to be correlated with pH and DO as expected (Table C.1a-d). Increase in DO causes increase in pH as explained earlier which results in high alkalinity values. Seasonal correlation data revealed (Table C.2.a-c) that alkalinity showed high correlation with hardness and salinity during premonsoon. During monsoon a high positive correlation was shown with hardness. Alkaline water limits the solubility of the common cations in it and hence showed a positive correlation with total hardness.

![Figure 3.5a: Spatial and seasonal variation of alkalinity](image1)

![Figure 3.5b: Spatial and diurnal variation of alkalinity](image2)

In the diurnal study, alkalinity ranged from a minimum of 0.354 mmol/l (Station R, 1000hrs.) to a maximum of 5.67mmol/l (Station R, 2100hrs.) with a mean value of 1.16 mmol/l (Fig. 3.5b). Thus, both the maximum and minimum were obtained for the reference site and hence a much variation was observed at Station R. Three higher values were observed in the diurnal study, three of them were in the reference site. For all other time, the reference site showed comparatively lower values. Station 1 and 2 showed almost similar variation, but Station R varied frequently with distinct ups and downs.
3.6 Hardness

Calcium and magnesium ions defines the extent of hardness. A low CaCO$_3$ hardness value is a reliable indication that the calcium concentration is low. However, high hardness does not necessarily reflect a high calcium concentration.

In Subarnarekha river, east coast of India, total hardness ranged between 40-100 ppm during premonsoon and between 90-200 ppm during postmonsoon period (Senapati and Sahu, 1996).

In the present study, total hardness was a maximum (7.1mg/l) in April’00 at Station 1 and a minimum (0.209mg/l) at Station 3 in October’00 (Table 3.6). Mean values for the four stations were 3.41mg/l, 3.41mg/l, 2.21mg/l and 2.72mg/l at Stations 1, 2, 3 and R respectively. For all Stations, the monsoon period showed the lowest values (Fig. 3.6a). Station 2 during premonsoon showed the maximum value and Station 3 during monsoon showed the minimum. The variation between stations and seasons was confirmed by ANOVA also (Table B.1).

![Figure 3.6a: Spatial and seasonal variation of hardness](image)

**Figure 3.6a:** Spatial and seasonal variation of hardness

Total hardness in the diurnal study showed a maximum of 6.76mg/l at 1000hrs. at Station 2 and minimum, 1.36mg/l at 1300hrs. at Station R with an overall mean value of 4.36mg/l (Fig. 3.6a). Mean values for each station were 4.19mg/l, 5.12mg/l, and 3.76mg/l at Station 1, Station 2 and Station R respectively.
Chapter 3

3.7 Total Suspended Solids (TSS)

The greater the amount of total suspended solids in water, the more turbid it would appear. The major source of total suspended solids in the mangrove waters is from mangrove litter decomposition products, phytoplankton, clays, silts from shoreline erosion, resuspended bottom sediments and allochthonous organic detritus from adjacent water bodies and/or wastewater discharges. Dredging operations, channelisation, increased flow rates, monsoonal floods, tidal activity, benthic activity etc. may also stir up bottom sediments and increase the cloudiness of the water. High concentrations of particulate matter can modify light penetration, cause shallow bays to fill in faster and smother benthic habitats—impacting both organisms and eggs. As particles of silt, clay and other organic materials settle to bottom, they can suffocate newly hatched larvae and potentially interfere with their feeding activities. If light penetration is reduced significantly, macrophyte growth may be decreased. Reduced photosynthesis can also result in a lower daytime release of oxygen into the water. Particulates also provide attachment site for heavy metals such as cadmium, mercury, and lead and many toxic organic contaminants such as PCBs, PAHs and many pesticides. The amount of suspended solids in the Mahanadi estuary, east coast of India were found to be the highest (136-151mg/l) during monsoon and the lowest (54-64mg/l) during premonsoon (Das et al., 1997). The amount of suspended solid in the water mass decreased from ebb tide to flood tide at all the three seasons. The difference was significant in the postmonsoon indicating turbid water discharge during ebb tide. The highest value was observed during low tide of monsoon indicating the maximum flow of turbid water from the upstream of the river (Das et al., 1997). The suspended particulate matter in Talapady lagoon, (India) near mangrove area showed mean values in the range 3.8 – 744.3mg/l (Nayar et al., 2000).

Monthly data of the present study showed a variation from 88.41mg/l (Station R, May’00) to 6379mg/l (Station 2, August’99) (Table 3.7). The high value at Station 2 in August’99 was due to low water content at that time due to barriers built to prevent the loss of prawn seeds.

Very high seasonal mean value was observed at Station 2 during monsoon while the lowest was observed at Station R during postmonsoon (Fig. 3.7a). TSS
Hydrographical Parameters

showed the widest temporal fluctuation with a major peak during the monsoon months, when huge quantities of suspended particles were brought in by land runoff and also by resuspension of sedimentary particles, facilitated by the winnowing activity of the monsoon floods.

TSS showed a positive correlation with POC at all the Stations except at Station 3 (Table C.1a-d). This may be due to high tidal activity at Station 3 which flushes out TSS as readily as it forms and/or resuspension of sediment particles from the bottom. At Station 1, Station 2 and Station R, TSS was enriched with organic carbon as shown by the positive relationship between the two.

![Figure 3.7a: Spatial and seasonal variation of total suspended solids](image)

![Figure 3.7b: Spatial and diurnal variation of total suspended solids](image)

TSS in the diurnal study varied from 9.4mg/l (Station R, 2300hrs.) to 89.33mg/l (Station 2, 1300hrs.) showing a mean value of 39.93mg/l (Fig. 3.7b). Diurnal correlation data (Table C.3a-c) showed that at Station 2 and Station R, TSS was highly enriched with POC. Absence of correlation of TSS with POC at Station 1 may be because the former was composed of large fraction some other particles like resuspended sedimentary particles, clay minerals etc.

### 3.8 Chlorophyll

Chlorophyll is the green pigment in aquatic plants (algae / phytoplankton) that allows them to create energy from light – to photosynthesize. Chlorophyll is a measure of all green pigments whether they are active (alive) or inactive (dead). Chlorophyll ‘a’ is a measure of the portion of the pigment that is still active; that is,
the portion that is still actively respiring and photosynthesising. Sunlight, temperature, nutrients and wind all affect algae numbers and therefore chlorophyll a concentration. During the premonsoon season when water begins to warm, the days are sunnier, and nutrients are plentiful, the "bloom" of algae may occur. During monsoon, and postmonsoon, when temperature and sunlight decrease, algae concentrations will decrease as well. Similarly, during day time chlorophyll 'a' concentration would increase as phytoplankton growth increases and a decrease in concentration would occur at night.

A notable feature of this component is that at Station 1, chlorophyll values were very much higher than that at the other two Stations and oscillated between 3.99μg/l (1000hrs.) and 11.09μg/l (2100hrs.) with a mean value of 6.79μg/l (Fig 3.8).

![Figure 3.8: Spatial and diurnal variation of chlorophyll](image)

The very high chlorophyll concentration at Station 1 indicate high primary productivity at this Station. Compared to Station 1, the values were negligible at Station 2 and Station R and ranged between a minimum of 0.087μg/l (200hrs.) and a maximum of 0.687μg/l (1600hrs.) with a mean value of 0.297μg/l at Station 2 and between 0.044μg/l (400hrs.) and 0.693μg/l (1100hrs) at Station R (average 0.221μg/l). The lowest of all chlorophyll concentration was observed at Station R at 400hrs. The overall mean value was 2.44μg/l. ANOVA showed significant difference between Stations, but not with time (Table B.2).

Correlation coefficients (Table C.3a-c) showed that Chlorophyll was very much related to POC at Station 1 and Station 2 suggesting that the organic matter at
Hydrographical Parameters

Stations was formed mainly from the primary productivity. At Station 2, chlorophyll showed direct relationship with temperature, which may be due to the dependence of primary productivity on light intensity, as light intensity increases during day time with increase of temperature. At Station R, chlorophyll is related only to temperature and not to POC which may be due to the fact that organic matter at this Station come from other sources like sewage, anthropogenic inputs etc.

REFERENCES


