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# Photosynthetic pigments of benthic microflora in the brackishwater pond along Nethravathi estuary, Mangalore

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## Abstract

Monthly variation of plant pigments such as chlorophyll - *a* and phaeopigments were studied for one year from Feb. 1998 to Jan. 1999 in the brackishwater impoundment of Nethravathi estuary, Mangalore. Chlorophyll - *a* values fluctuated from 0.037 mg/g sediment (Nov) to 2.10 mg/g sediment (Feb). It exhibited trimodal pattern of distribution with primary peak during February followed by December and July. Phaeopigment concentration ranged from 0.064 mg/g sediment (Nov) to 13.71 mg/g sediment (Aug). Chlorophyll - *a* values showed significant correlation with benthic phytoplankton whereas it is inversely related with sediment nitrogen and phosphorus.

Chlorophyll-*a*, the universal phtosynthetic pigment is present in almost all the plant cells. Distribution and spatial variation of benthic microflora and their photosynthetic pigments is a useful tool for the assessment of benthic renewable resources. The chlorophyll - *a* concentration of the sediment is often used to estimate the standing crop of benthic microalgae (Steele and Baird, 1968; Leach, 1970; Fenchel and Straarup, 1971 and Colijn and Dijkema, 1981). Maximum concentration of chlorophyll - *a* was always found in the top 1 cm portion of the sediment. However, reworking of sediment by wave action and activity of animals influence the distribution of benthic microalgae in the deep layers of the sediment, which contributed for the chlorophyll. The main contributors for chlorophyll - *a* in the sediment are pennate diatoms (Marshall *et al.*, 1973), many of which are capable of attaching to solid substrates that would be more likely to remain in the sediments than settled planktonic forms such as centric diatoms. Lot of information is available on pigments from the columnar waters, while the studies on sediment chlorophyll - *a* and phaeopigment distribution in the shallower water intertidal environments are few (Sivadasan and Joseph, 1995; Nayar and Gowda, 1999 and Rajesh *et al.*, 2001). Hence the present study was initiated to understand the spatial and temporal distribution of sediment chlorophyll - *a* and phaeopigments in relation to physicochemical characteristics of water and sediments in the brackishwater impoundment.

## Material and methods

The present investigation was carried out in the natural brackishwater impound-

ment along the Nethravathi estuary for a period of one year from Feb. 1998 to Jan. 1999. The pond is about 0.81 km in length with a width of about 0.3 km covering 12.7 ha of water spread area. Dense mangrove vegetation is present at the northern side of the pond. Four sampling stations were selected, among which St. 1 and 2 were along the sides of the cultivable land fringed with mangrove vegetation. St. 3 was selected at the centre of the pond which is away from mangrove vegetation and St. 4 in the area where large numbers of wood were logged by Karnataka Woods and Plywood Company. Samples were collected from the stations at monthly intervals during morning hours coinciding with the low tide. The sediment samples were collected by using a plastic corer (2.9 cm ID). From the core top 1 cm undisturbed sediment was transferred into an insulated stoppered glass tube of 50 ml capacity. To this 90% acetone was added, ground, mixed and kept overnight at low temperature under dark for pigment extraction. Subsequently, the supernatant was centrifuged at 3000 rpm for 10 minutes to get clear solution. The solution was read calorimetrically with spectronic 21 D spectrophotometer. The results were expressed as mg/g dry sediment (Lorenzen, 1967). For the estimation of phaeopigments, 2 drops of 1% HCl was added to the same supernatant solution and read spectrophotometrically. The results were expressed as mg/g dry sediment (Marshall *et al.*, 1973). Total nitrogen in the sediment was estimated by modified Kjeldhal method using selenium (De, 1962) and the results were expressed as mg/g dry sediment. For the anlysis of total phosphorus, the methods followed by Solar Zoano and Sharp (1980) was used and the results were expressed as µg/g dry sediment. The organic carbon content of the sediment was determined by the wet oxidation method (El - Wakeel and Riley, 1957) and the results were expressed in terms of percentage of total organic matter. Pipette analysis was adopted for the analysis of sediment texture (Buchanan and Kain, 1971). Temperature and pH of the sediments were measured by using thermometer and pH meter. Benthic phytoplankton analysis was done by suspending top 1 cm sediment core. Drop method was employed for counting under the microscope. The results were expressed as nos./$m^2$.

**Results and discussion**

Chlorophyll - *a* values in the top 1 cm of the sediment fluctuated from 0.037 to 2.10 mg/g sediment (Fig. 1). Higher values were recorded during Nov, lower values during Feb. and moderate values during Dec/Jan. Generally, chlorphyll - *a* values were high in premonsoon followed by postmonsoon and monsoon season. Mangrove areas (St. 1 and 2) and wood logging area (St. 4) recorded higher values of mean chlorphyll - *a* (0.59, 0.57 and 0.69 mg/g sediment respectively), while non mangrove area (St. 3) recorded comparatively lower values (0.5 mg/g sediment). Phaeopigment concentration varied from 0.064 to 13.71 mg/g sediment

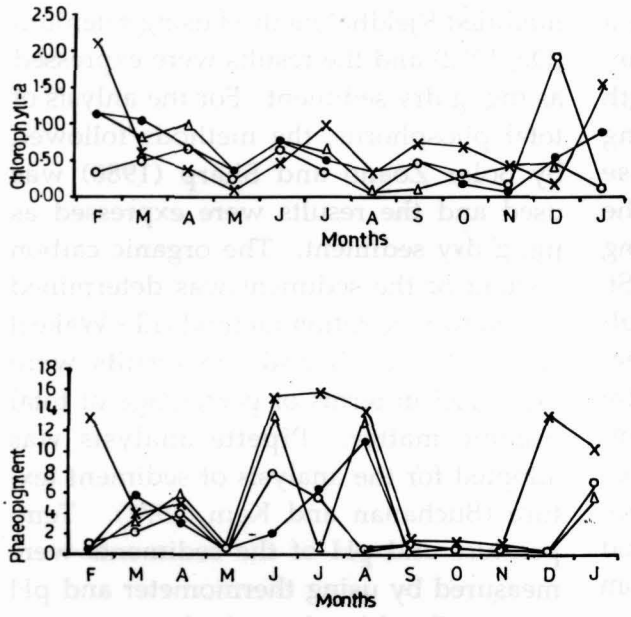


Fig. 1. *Monthly variation of sediment chlorophyll - a and phaeopigments (mg/g of soil) at different stations.*

(Fig. 1). The data exhibited primary peak in June/July and secondary peak in Jan/Feb. Lower values were observed during postmonsoon months (Sept - Nov). Spatially, the mean phaeopigment concentration was found to be more in wood logging area and mangrove areas than that of the non mangrove area (Table 1).

Higher concentration of chlorphyll - *a* observed in sediment during Feb. and Dec. were due to higher phytoplankton biomass contributed mainly by pennate diatoms. Similar observations were made by Sivadasan and Joseph (1995) in Cochin backwaters. They recorded chlorophyll - *a* values to range from 57.26 to 78.36 mg/m$^2$. The spatial

**Table 1.** *Physico-chemical characteristics (Mean value ±SE) of the sediment of study area.*

| Parameters | Stations | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Chlorphyll - *a* (mg/g sediment) | 0.59 ± 0.11 | 0.57 ± 0.10 | 0.5 0± 0.15 | 0.69 ± 0.18 |
| Phaeopigments (mg/g sediment) | 3.67 ± 1.51 | 3.08 ± 1.07 | 2.64 ± 0.86 | 7.81 ± 1.90 |
| Benthic phytoplankton (No. x $10^4$/m$^2$) | 4803 ± 769.03 | 3290 ± 436.93 | 2766 ± 714.2 | 4511 ± 896.41 |
| Nitrogen (mg/g sediment) | 0.35 ± 0.04 | 0.32 ± 0.05 | 0.20 ± 0.03 | 0.55 ± 0.1 |
| Phosphorus (µg/g sediment) | 6.21 ± 1.26 | 5.04 ± 1.42 | 4.59 ± 1.02 | 7.01 ± 1.23 |
| Organic carbon (%) | 1.87 ± 0.25 | 1.52 ± 0.23 | 1.23 ± 0.2 | 1.83 ± 0.6 |
| Sand (%) | 78.06 ± 0.89 | 76.12 ± 4.46 | 65.99 ± 3.49 | 76.26 ± 3.9 |
| Silt (%) | 18.18 ± 1.08 | 19.52 ± 4.45 | 28.73 ± 3.39 | 19.52 ± 3.64 |
| Clay (%) | 3.75 ± 0.40 | 4.36 ± 0.92 | 4.97 ± 0.97 | 4.21 ± 0.6 |

distribution of sediment chlorophyll - *a* appears to be determined by the sediment type and depth of water above. In the present study, chlorphyll - *a* and organic carbon distribution did not show any definite trend. However, high values of chlorphyll - *a* were observed to be during premonsoon and postmonsoon seasons when sand and silt fraction of sediment was high. Davis and Mc Intyre (1983) recorded mean concentration of chlorphyll - *a* in top 1 cm sediment to be 46.2 mg/ $m^2$ in sand, 74.7 mg/$m^2$ in fine sand and 93 mg/$m^2$ in silt fraction of sediment in the estuary of Oregano. Cadee and Hegeman (1974), Calees (1979) and Colijn and Dijkema (1981) reported an increase of chlorophyll - *a* with the increase of silt in the sediment. Chlorophyll - *a* showed a direct relationship with phytoplankton biomass during the present study. The high values of chlorphyll - *a* recorded during Feb., Dec. and July coincide with higher phytoplankton biomass. Sivadasan and Joseph (1995) recorded higher chlorophyll - *a* values during July and Aug. in Cochin backwaters and they attributed it for the higher standing crop

**Table 2.** *Correlation co-efficient between pooled values of different physico-chemical characteristics of the sediment.*

| | Chl - *a* | Phaeo pigment | Benthic phyto-plankton | Nitro-gen | Phos-phorus | Organic carbon | Sand | Silt | Clay |
|---|---|---|---|---|---|---|---|---|---|
| Chl - *a* | - | 0.09 | 0.473 | - 0.7236** | -0.476 | -0.224 | 0.071 | -0.089 | 0.1123 |
| Phaeopigments | - | - | -0.3076 | -0.080 | -0.07 | -0.411 | 0.418 | -0.465 | 0.269 |
| Benthic phytoplankton | - | - | - | -0.2591 | 0.2886 | -0.106 | -0.149 | 0.235 | -0.523 |
| Nitrogen | - | - | - | - | -0.1901 | -0.308 | 0.009 | -0.012 | 0.016 |
| Phosphorus | - | - | - | - | - | -0.473 | 0.202 | -0.065 | -0.832** |
| Organic carbon | - | - | - | - | - | - | -0.183 | 0.098* | 0.508* |
| Sand | - | - | - | - | - | - | - | -0.986** | -0.084 |
| Silt | - | - | - | - | - | - | - | - | -0.0282 |
| Clay | - | - | - | - | - | - | - | - | - |

* Significant at $P_{\leq} 0.1$

** Significant at $P \leq 0.05$

of phytoplankton. From the statistical analysis it is clear the chlorophyll - *a* showed positive significant correlation (r = 0.473) with phytoplankton biomass, thus indicating that the phytoplankton biomass has direct effect on the seasonal and spaital distribution of chlorophyll - *a*. The higher phytoplankton biomass coincided with the lower concentration of nitrogen and phosphorus in the sediment. This indicates that the available nitrogen has been used by the phytoplantkon for their growth to reach maximum production and thus indicated lower values of nutrients during higher values of phytoplankton. The same could be related for higher chlorophyll - *a* in the sediment during the lower nutrient concentration. Statistically, it is further confirmed that an inverse relationship between nutrients and chlorophyll - *a* distribution. While discussing the relationship between chlorophyll - *a* and phaeo-pigments, Yentzsch (1965) remarked that prolonged dark condition tend to reduce the efficacy of chlorphyll - *a*. From the data a definite trend in distribution of phaeopigments in both time and space was not observed. However, an inverse relationship was observed between chlor-phyll - *a* and phaeopigment in the present study. Similar observations were made by Nayar and Gowda (1999) in the Talapadi lagoon, south west coast of India.

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