Physico-chemical characteristics of seaweed beds of the Palk Bay, southeast coast of India

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Hydrographic investigations at two different stations viz. Kattumannar and Kottaipattinam of the Palk Bay, revealed temporal variation for all the hydrographical features observed. Marked spatial variations were noticed in light penetration, dissolved oxygen and nutrient concentration. Nutrients concentration were relatively higher than that of the other parts of the Indian coast, indicating the fertile nature of this region.

Seasonal changes in seaweed characteristics are controlled directly by primary ecological factors such as light intensity, temperature and nutrients or by environmental signals (e.g. photoperiod and narrow temperature intervals). In recent times, there has been some increasing interest in the study of potential physical and chemical pollutional perturbations as these environmental parameters might exert influence on the water quality and in turn affect the metabolic rates of the algae. Hence it becomes important to determine the ecological factors that affect the growth of seaweeds. The present work was carried out in the Palk Bay waters, where luxuriant seaweed beds were identified.

Surface water samples were collected at monthly intervals from the seaweed beds of Kattumannar (station 1) and Kottaipattinam (station 2; 20 km south of station 1) areas of the Palk Bay, southeast coast of India (Fig. 1) from April 1989 to March 1991 for the estimation of various physico-chemical parameters. Temperature (atmospheric and surface) was measured using a standard centigrade thermometer. Turbidity was measured with the help of a Secchi disc and the light extinction coefficient (LEC) was calculated using Pool and Atkins formula. Salinity was estimated with the help of a Salinometer model E-2 and pH was measured using a Elico pH meter. Dissolved oxygen was estimated by the modified Winkler's method. Water samples were filtered using a millipore filtering system and analysed for dissolved inorganic phosphate, nitrate, nitrite and reactive silicate adopting the methods described by Strickland and Parsons. Four seasons that have been categorised for the study are post-monsoon (January-March), summer (April-June), premonsoon (July-September) and monsoon (October-December). The simple correlation coefficient ($r$) was employed for the statistical interpretation of data obtained from the study. Rainfall data was collected from the Nungambakkam observatory at Madras.

![Fig. 1—Map showing the study areas](image-url)
Rainfall

Annual rainfall for April 1989-March 1990 was 1418.60 mm and for April 1990-March 1991, 1755.90 mm. Monsoon season recorded maximum rainfall i.e. 70.00% during the first year and 55.50% during the second year of study, owing to the influence of the northeast monsoon.

Temperature

Atmospheric temperature varied from 25.5 to 32.7°C during the study period at both the stations (Fig. 2). The seagrasses (*Enhalus acoroides* and *Thalassia hemprichii*) and seaweed (*Gelidium edulis*) present in the study areas are obviously eurythermal as they occupy more than one zone and tolerate a wide temperature range (25.0 to 34.5°C).

Atmospheric temperature recorded during the present study period showed seasonal variations at both the stations. Station 2 recorded higher atmospheric temperature as compared to station 1. Summer (station 2) and premonsoon (station 1) seasons recorded high temperatures while the monsoon season recorded low temperatures at both the stations. But during monsoon, rainfall and cloudy sky brought down the temperature to the minimum. Surface water temperature also showed similar ranges like atmospheric temperature at both the stations and it ranged from 25.0 to 34.5°C (Fig. 2). In gen-
general, summer and premonsoon seasons recorded high water temperatures at both the stations as compared to other seasons.

Like atmospheric temperature, surface water temperature was high during the summer and premonsoon seasons at both the stations. The close similarity in the curves (Figs 2 and 3) reveals that the water temperatures of the two stations are basically influenced by the atmospheric temperature. This is further confirmed by the significant positive correlation (Tables 1 and 2) obtained between atmospheric and surface water temperatures.

**Light extinction co-efficient (k)**

Light extinction co-efficient (LEC) varied widely from 1.24 to 6.23 (Fig. 2) at both the stations. Generally, postmonsoon season exhibited higher LEC as compared to other seasons, at both the stations. Further LEC showed an increasing trend from summer to premonsoon and from monsoon to postmonsoon seasons. Station 2 recorded higher LEC than station 1. This could be attributed to the shallow nature and lesser tidal influence at station 1.

**Salinity**

Salinity showed more or less similar ranges from 19.50 to 39.40% (Fig. 3) at both the stations. Premonsoon season recorded high salinity as compared to other seasons. Low salinity was observed during the monsoon and postmonsoon seasons at both the stations. Decrease in salinity during the monsoon and postmonsoon seasons was due to precipitation.
at the study area. Salinity showed a significant positive correlation with surface water temperature, inorganic phosphate concentration and negative correlation with dissolved oxygen (Tables 1 and 2).

**pH (Hydrogen-ion concentration)**

There was a narrow range of fluctuation (7.80 to 8.92) in pH of the water during the study period at both the stations (Fig. 3). pH remained alkaline throughout the study period at both the stations. Monsoon season recorded low pH while summer and premonsoon seasons recorded high pH. Station 2 recorded relatively higher pH than station 1. High pH recorded in the present study could be due to the removal of CO₂ by photosynthesis, while low pH, due to the dilution of seawater by freshwater flow during the monsoon season. Simple correlation coefficient (Tables 1 and 2) for pH showed positive significance with surface water temperature and light extinction co-efficient and negative significance with atmospheric and surface water temperatures.

**Dissolved oxygen**

Dissolved oxygen (DO) concentration fluctuated widely at both the stations and it ranged from 3.19 to 7.97 ml l⁻¹ (Fig. 3). DO concentration was high during the postmonsoon season which was due to the photosynthetic activity of phytoplankton and renewal of water consequent to monsoon rains and freshwater discharge.

Low DO concentration recorded during the summer season might be due to the shallow nature of the study areas with the biological oxidation of detritus and respiration of bottom communities along with slow diffusion of dissolved gases. DO concentration showed high positive significance with light extinction co-efficient and pH and negative significance with surface water temperature (Tables 1 and 2).

Availability of nutrients is one of the primary factors regulating the growth, reproduction and bio-chemistry of seaweeds. In semitropical and tropical regions, availability of inorganic nutrients has been implicated as the most important factor limiting seaweed productivity. Nutrient cycles in seaweed beds are complex, since the plants are able to utilize either the sediment or the water column for a nutrient source.

**Dissolved inorganic phosphate**

Dissolved inorganic phosphate concentration varied from 0.06 to 8.16 μM at both the stations (Fig. 4). Bimodal peaks were observed for inorganic phosphate distribution during the pre- and postmonsoon seasons at station 1 and during the premonsoon and monsoon seasons at station 2. High concentration of inorganic phosphate observed during the monsoon and postmonsoon seasons were due to the monsoonal flow of fresh water and land run-off. This was followed by a sudden decrease during the summer season, probably due to the utilization by the macro (seaweeds) and microphytobenthic communities.

**Dissolved inorganic nitrate**

Nitrate concentration varied from 0.03 to 31.25 μM (Fig. 4) at both the stations. It showed the major peak during the summer (station 1) and postmonsoon (station 2) seasons. This could be attributed to higher activity of oxidation of ammoniacal form of nitrogen to nitrite and subsequently to nitrate during the summer season and enrichment of terrigenous deposits with lot of nutrients as land run-off during the monsoon and subsequent postmonsoon season. Station 2 recorded more concentration of nitrate as compared to station 1.

**Dissolved inorganic nitrite**

Nitrite concentration showed a distinct difference in its seasonal distribution at the two stations and it varied from 0.02 to 20.58 μM (Fig. 4). Pre-(station 1) and postmonsoon (station 2) seasons recorded low concentration whereas premonsoon (station 2) and monsoon (station 1) seasons recorded high concentration of nitrite as compared to other seasons. This difference in seasonal variation of nitrite concentration could be attributed to the variations in phytoplankton excretion, oxidation of ammonia and reduction of nitrate of which the latter is reported to be dominant, in addition to the bacterial decomposition of planktonic detritovores.

**Dissolved inorganic silicate**

Silicate concentration varied from 0.18 to 30.52 μM (Fig. 4) at both the stations. It registered a primary peak during the postmonsoon season and a
secondary peak during the premonsoon. High silicate concentration was due to the addition of silica material by land run-off caused by flooding during the monsoon and subsequent postmonsoon seasons. During the summer season, reactive silicate concentration was low due to the sizeable reduction in the freshwater input and greater utilization of this nutrient by the abundantly occurring phytoplankton for their biological activity.

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References