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ECOLOGY OF THE CLAM BED IN THE KAKINADA BAY

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ABSTRACT

In the clam bed the monthly average water temperature varied from 24.8 to 33.5°C, salinity 14.46 to 35.53‰, dissolved oxygen 3.78 to 7.00 ml/l, pH 6.55 to 7.00, phosphate-P 1.98 to 7.08 µg at/l, nitrate-N 1.70-6.62 µg at/l, nitrite-N 0.66 to 2.94 µg at/l and silicate-Si 24.68 to 78.00 µg at/l. The monthly average organic carbon of the sediment ranged from 0.55 to 1.26%. The seasonal variations of these parameters are studied. The habitat preferences of the blood clam *Anadara granosa* are discussed in relation to some of the environmental factors.

INTRODUCTION

IN the Kakinada Bay, the blood clam *Anadara granosa* (Linnaeus) bed has a spread of 46.6 km² area (Narasimham *et al.*, 1984) and the species is collected throughout the year by fishermen residing in 15 villages. Earlier works on the ecology of the bay are related to sediments and their organic carbon (Rao, 1967), animal-sediment relationships (Radhakrishna and Ganapati, 1968) and hydrography (Ramasarma and Ganapati, 1968). In a recent communication Narasimham *et al.* (1984) dealt with the hydrography, nutrients and sediments of the bay during March-April 1983. The results of a four year study on the various environmental parameters in the clam bed are given here.

MATERIAL AND METHODS

The material was collected from the clam bed (Fig. 1) between 0700 to 0900 hr. Surface waters were collected for analyses, since at low tide the depth in the clam bed is less than 2 m and about 1/3rd of the bed is exposed. For temperature, salinity and dissolved oxygen weekly water samples were collected during 1978-81. Salinity was estimated by Mohr's titration method and dissolved oxygen by Winkler's method. The pH was recorded in the field by the Loviband Comparator disc. For the estimation of nutrients, fortnightly water samples were collected during 1982 and stored in the dark until analysed ; the following procedures outlined in Strickland and Parsons (1965) were followed. Inorganic phosphate-P was determined by the method of Murphy and Riley, nitrate-N and Silicate-Si by Mullin and Riley method and nitrite-N by Shinn's method. The analyses were carried on within the time schedules applicable to the above methods and where it was not possible the water samples were frozen at —20°C for subsequent analyses. The core sample of the sediment was collected at fortnightly intervals in 1982 with a 15 cm long and 2.5 cm diameter plastic tube and the organic carbon of the sediment was estimated by the chromic acid method as given by F.A.O. (1975).

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Results

Rainfall and seasons: During 1978-82 the annual average rainfall was 102 cm and much of it was spread during the southwest monsoon (June-September). During the northeast monsoon (October-December) intermittant rains prevail (Weather Bulletins of Metereology Dept.) January-March period is the post monsoon season which is followed by the summer (April-May).

Temperature: The monthly average temperature during the study period varied from 24.8°C to 33.5°C (Fig. 2). During 1978 the temperature was low in January at 28.8°C; it increased to touch a peak in May (32.0°C) and after a decline in July (27.3°C), a secondary peak was attained in October (29.2°C) followed by a fall to the lowest value in December 24.8°C). This bimodal oscillation, with a summer peak in May, a slight decline in July-August due to the south-west monsoon, a

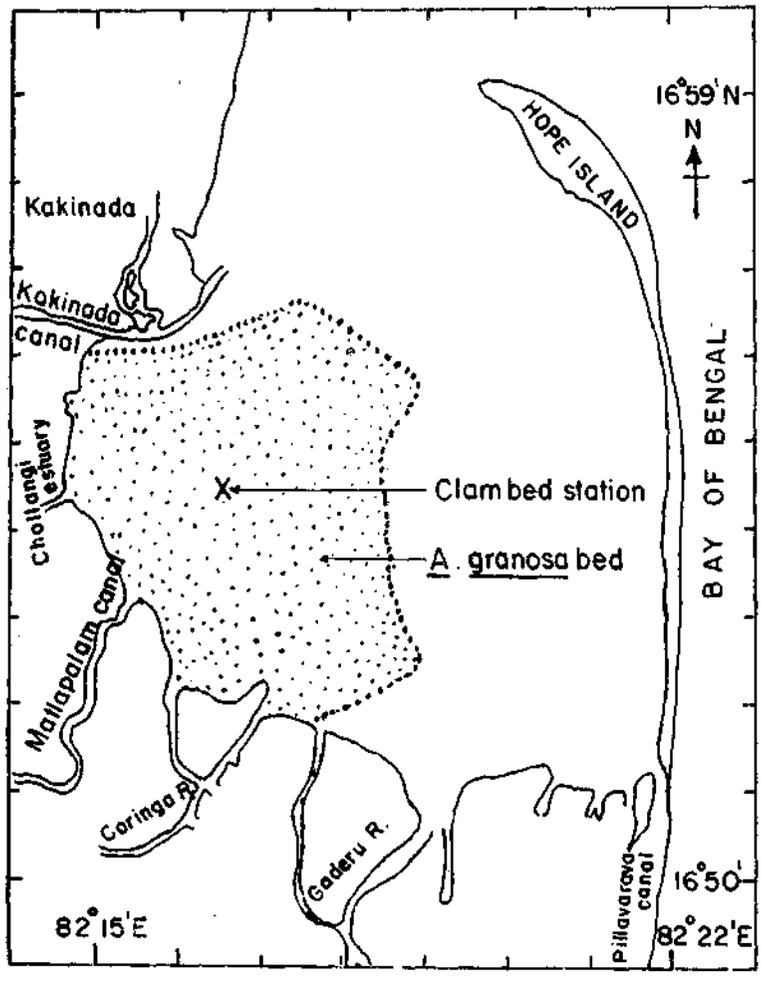

FIG. 1. Kakinada Bay showing the clam (*Anadara granosa*) bed and the sampling stations marked X

secondary peak in September/October and a notable fall in November/December which may continue during January/February due to the general cooling of the atmosphere is discernible during 1979-81. The secondary peak may be due to the early closure and delay in the commencement of the two monsoons.

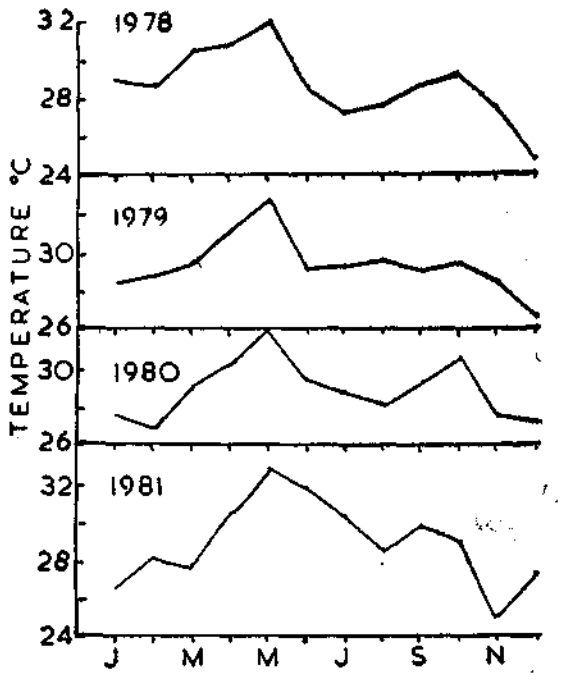

FIG. 2. Monthly average temperature of surface waters in the clam bed.

Salinity : The monthly average salinity ranged from 14.46‰ to 35.53‰ (Fig. 3). In January 1978 the salinity was low at 19.11‰ it rapidly increased in April attaining a peak in May (35.53‰) and thereafter steadily declined to 23.15‰ in December. During 1979-81, from low values in January/February, the salinity reached maximum in May/June and thereafter it declined steadily in 1979 to reach minimum in November. In 1980-81 it declined rapidly in June and thereafter showed some fluctuations. The salinity decline during the latter half of the year was due to the two monsoons and in the post-monsoon period it showed a rising trend due to the fall in freshwater in flow ; the peak in the summer is atrributed to the cessation of the freshwater discharge and evaporatien. The relatively high salinity during June-September in 1979 was due to the failure of the southwest monsoon.

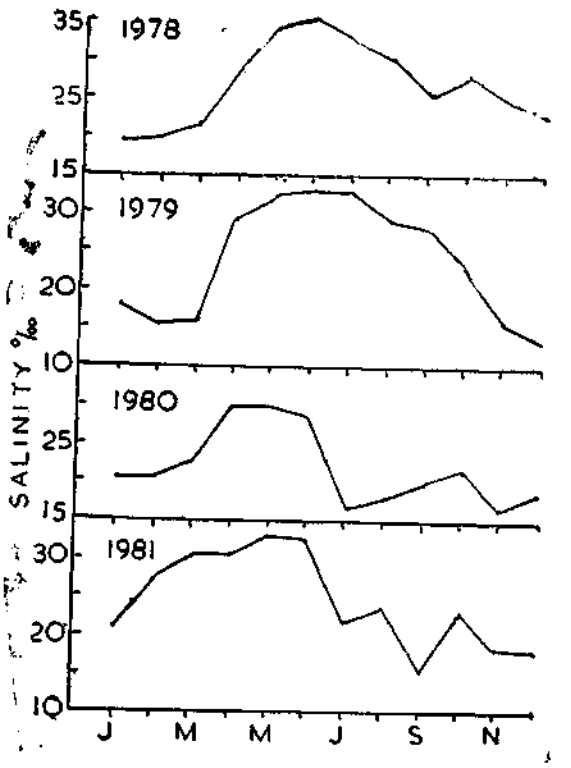

FIG. 3. Monthly average salinity of surface waters in the clam bed.

Dissolved oxygen: The monthly average values were generally high and varied from 3.78 ml/l to 7.00/ml (Fig. 4). Generally dissolved oxygen values touched a peak in February/March and again in November-December ; in other months they fluctuated.

Hydrogen ion concentration : During 1981 the pH values showed a narrow range and fluctuated between 6.55 to 7.00 indicating that the water are either slightly acidic or neutral.

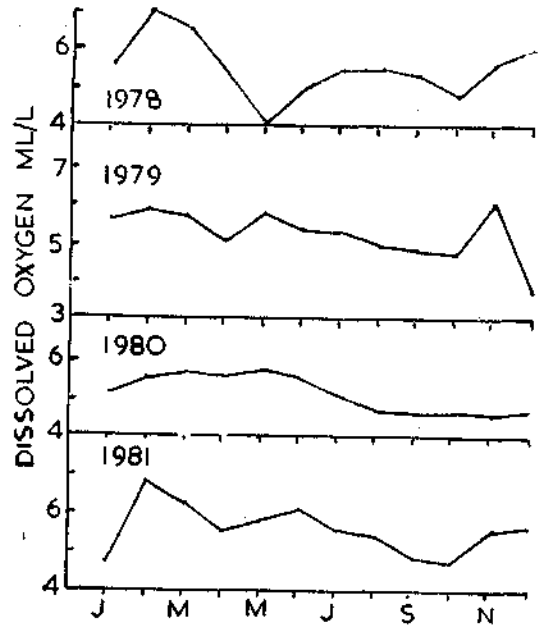

FIG. 4. Monthly average dissolved oxygen of surface waters in the clam bed.

Inorganic phosphate-P: The values varied from 1.98 μg at/l in March to 7.08 μg at/l in January (Fig. 5). They were low in the summer, picked during the two monsoons and after attaining a peak in January showed a declining trend in the following two months.

Nitrate-N: The Nitrate-N ranged from 1.70 μg at/l in May to 6.62 μg at/l in January (Fig. 5). Except for a peak in June the trend was similar to that of phosphates.

Nitrite-N: The values ranged from 0.66 μg at/l in May to 2.94 μg at/l in January (Fig. 5) and except for the peak in March, showed similar trend as nitrates.

Silicates: The values were high and varied from 24.68 μg at/l in April to 78.00 μg at/l in August (Fig. 5). A peak in August and another in February were observed.

Freshwater discharge by various rivers and canals into the bay (Fig. 1) bring sediments

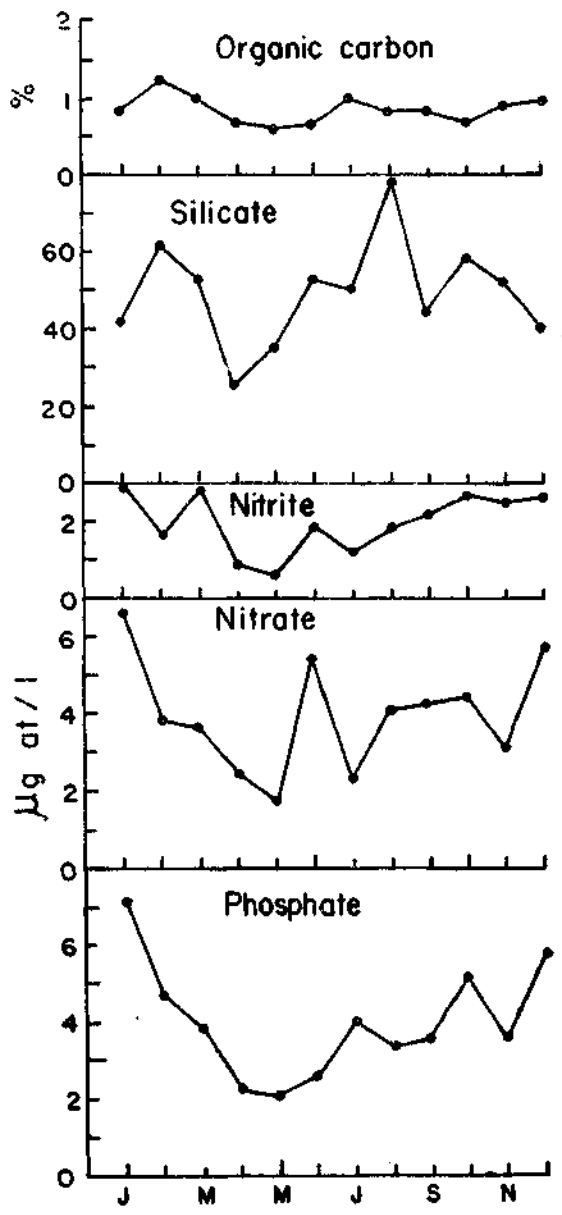

FIG. 5. Monthly average nutrients of surface waters and organic carbon of the sediment in the clam bed in 1982.

which seem to influence the nutrients to a large extent. Thus from a low in summer an increasing trend in the values of phosphates, nitrates and nitrites is discernible during the two monsoons. In the post-monsoon period

a peak was attained in January and thereafter the values declined. Nitrates may be enriched by the decomposition of organic wastes also. However, the silicates were generally high except in the summer. The low values of the nutrients during summer may be due to biological utilisation.

Organic carbon : The organic carbon values of the sediment were generally high and ranged from 0.55% in May to 1.26% in February (Fig. 5). There was a peak in February-March and another in July. The organic carbon may be derived from primary production within the ecosystem (autochthonous source) and also by terrestrial biota (allochthonous source) by transport into the bay.

Discussion

Ramasarma and Ganapati (1968) observed that in the Kakinada Bay the water temperature varied from 23.0°C to 34.0°C and salinity from 5.88‰ to 34.22‰ during different months. Their observations on the seasonal pattern and extent of varaition of teperature and salinity are generally in agreement with the present study except for the low salinity of 5.88‰ recorded by them in October 1961 at a station close to the land (at this time there was heavy local rainfall). During March-April 1983, in the squares comprising the clam bed, the average temperature, salinity and dissolved oxygen were 31.1°C, 32.36‰ and 5.24 ml/l respectively (Narasimham *et al.*, 1984); these values compare favourably with those obtained during March-April in this study. It is well known that salinity is an important factor limiting the distribution of invertebrates in estuarine environment (Gray, 1974). Pathansali (1966) stated that a salinity of 14‰ to 30‰ is within the range tolerated by *A. grynosa* in Malyasia. Chen (1984) mentioned that in Taiwan, this species is found in mudflats where the water salinity is 15‰ to 25‰. In the present study the monthly average salinity in the clam bed varied from 14.46‰ to 35.53‰ and it shows that this species can live under marine conditions also. However, high salinities (beyond 30‰) prevailed for only 2-4 months during different years and *A. grynosa* can be considered as essentially a estuarine species. In Africa, *A. senilis* was observed to tolerate a salinity range of 10‰ to 28‰ (Yoloye, 1976).

Narasimham *et al.* (1984) observed that in March-April 1983, in the region of the clam bed, the average values of phosphate, nitrate-N, nitrite-N and silicate-Si were at 2.17, 2.26, 0.68 and 37.9 μg at/l respectively. In this study slightly higher values were obtained for the former three parameters while the value of silicate-Si is comparable in both the studies for the corresponding months. Nair *et al.* (1983) observed that in the Ashtamudi estuary along the Kerala coast, the phosphates, nitrates and nitrites were low during the pre-monsoon period, increased during the monsoon and reached highest values (nitrite declined slightly but still high) in the post-monsoon. They attributed these seasonal variations to the river discharge leading to transportation of sediments. In the present study similar trend was observed.

Rao (1967) studied the organic carbon of the sediments of the clam bed area in the Kakinada bay during February-March 1957 and obtained values of 0.8 to >1%. Narasimham *et al.* (1984) recorded an average organic carbon value of 0.79% in the clam bed during March-April 1983. These values compare favourably with those obtained in the present study for the corresponding months.

The distribution of *A. granosa* in the clam bed region of the bay in relation to the particle size of the sediments was studied by Radhakrishna and Ganapati (1968) and Narasimham *et al.* (1984). These studies showed that *A. granosa* is generally abundant in areas where more than 50% of the sediment particles are

< 0.125 mm. The topography of the clam bed in the Kakinada bay suggests that *A. granosa* prefers shallow waters (<2 m depth) which are sheltered from strong wave action. In the west African lagoons, *A. senilis* was also stated to inhabit shallow (< 5 m depth) clam waters, sheltered from wave action (Yoloye, 1976).

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