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# ECOLOGICAL STUDIES ON THE ZONATION OF BRACHYURAN CRABS IN A VIRGIN MANGROVE ISLAND OF SUNDARBANS, INDIA

S. K. CHAKRABORTY AND A. CHOUDHURY*

*Department of Zoology and Fisheries, Vidyasagar University, Midnapore-721 102, W.B.*

ABSTRACT

Eighteen species of brachyuran crabs blonging to eleven genera and four families have been documented from the intertidal belt of Prentice Island in Sundarbans, India. Mean population density, biomass and species composition differs among different zones of the intertidal belt. Substrate characteristics, the presence and absence of mangrove vegetation, the salinity, the degree of tidal innundation and exposure are presumed to be the important factors determining the zonation of the species studied.

## INTRODUCTION

THE INTERTIDAL belt of Hoogly-Matla Estuarine complex supports the macrobenthic fauna of which a major population part is being shared by the decapod brachyuran crabs, a bioenergetically significant faunal component, of the specialised mangrove ecosystem of Sundarbans, India. They play a significant role in maintaining the steady state of the mangrove ecosystem and enhance its biological potentiality. Ecological study on this group has been increasing steadily in the recent years all over the globe (Teal, 1958 ; Warner, 1969 ; Hartnoll, 1973 ; Icely, 1976 ; Crane, 1975 ; Macintosh, 1984). Such studies in India are almost lacking, excepting the report by Altevogt (1955) and Rajendran (1972). Attempt has been made in this investigation to gain some insight on the distribution of different species of brachyuran crabs along the entire intertidal belt as there is a distinct zonation of different species reflecting their adaptation to different degrees of tidal exposure and innundation.

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## MATERIAL AND METHODS

### *Area investigated*

Prentice Island, a fractional component of virgin forest area of Sundarbans, lies between 21°40′ and 21°48′N and 88°16′ and 88°21′E (Fig. 1). The total area of the island is 12 sq. km. It is criss crossed by various creeks and channels of varying depth and width. The river Saptamukhi embraces this island on all sides and opens into Bay of Bengal. The island receives tidal flux twice daily

* Department of Marine Science, University of Calcutta, 35, Ballygunge Circular Road, Calcutta-700 019.

The tidal amplitude generally varies from 2.5 to 5.2 metres in an average in a total lunar cycle.

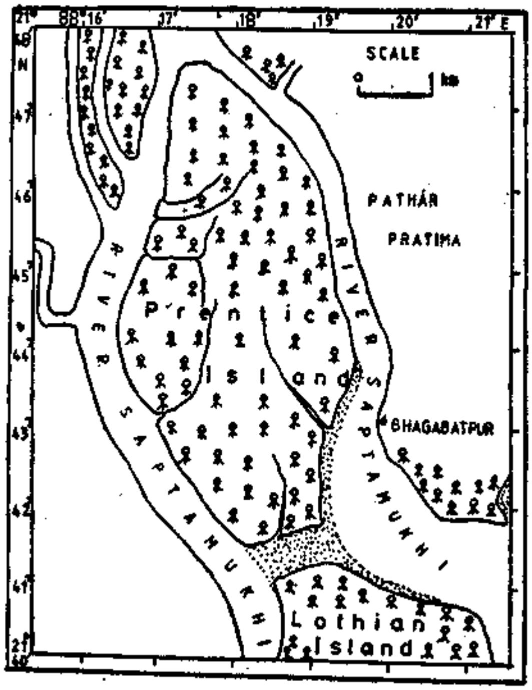


FIG. 1. Prentice Island showing station location of the study.

Prentice Island is supported by luxuriant growth of mangrove vegetations which display a good example of ecological succession pattern The edge of the forest is endowed with saline grass *Porteresia coarctata* which are followed by *Avicennia officinalis*, *A. alba*, *Acanthus ilicifolius*, *Suaeda maritima*, *Bruquiera gymnorhiza*, *Sonneratia apetala* and *Ceriops rox burghiana* (Fig. 2).

### *Techniques of study*

Field observations and collections were made during low tide. Density of the crabs were estimated by random sampling from the 10 identified transects at 75 m intervals on the eastern part of the island either by counting the number of crabs active on the substrate enclosed by the quadrate or by digging the crabs from their burrows. Samplings were undertaken during a premonsoon month (May, 1986) when the crabs are most active and showed peak population density (Chakraborty, 1984). Wet weight of the crabs were taken to get the biomass ($gm/m^2$). Temperature of the soil and air was recorded with a centigrade thermometer. Salinity, dissolved oxygen and pH of the interstitial water was recorded with standard method (Strickland and Parsons, 1968). Walkley and Blacks (1934) rapid titration method was followed to measure the organic carbon content of soil. The textural composition of soil were determined by following international pipette method, as elaborated by Banerjee and Chattopadhyay (1980).

## RESULTS

### *The environment*

Textural analysis reveals that sediment is muddy with higher percentage of silt and clay notably in mid and supra-littoral zone, whlie the percentage of sand is higher in the low littoral zone. Unlike dissolved oxygen and pH, salinity of the interstitial water increases with the distance from the shore level. Temperature within burrow of the crabs was tended to be uniform and lower than the air and soil temperature throughout the intertidal zone. Organic carbon content of the sediment was higher in the mid littoral zone, followed by supra- and lower-littoral zone (Table 2).

### *Species composition, zonation and distribution*

Seven species of benthic crabs, *viz. Scylla serrata*, *Uca dussumieri dussumieri*, *Dotilla blanfordi*, *Illyoplax gangetica*, *Macrophthalmus pectinipes*, *Metaplax crenulata*, *M. intermedia* are found to inhabit lower littoral zone (0—50 m). *Metaplax crenulata* dominates this zone due to its large size and activity.

The mid-littoral zone (50—500 m) seems to harbour maximum number of brachyuran species. The dominant representative of this zone is Sesarmid group of mangrove crabs. They include four species of which *Sesarma longipes* and *S. pictum* are very rarely noticed. The dominant species of the genus *Sesarma*, are *S. taeniolatum* and *S. chiromantes bidens* respectively. *Uca acuta acuta*, another and *M. indica* are found to extend their habitat on the supra littoral zone (Fig. 2).

*Population density and biomass*

The mean values of population densities and biomass at different zones are presented in Table 1. Distribution of the total popula-

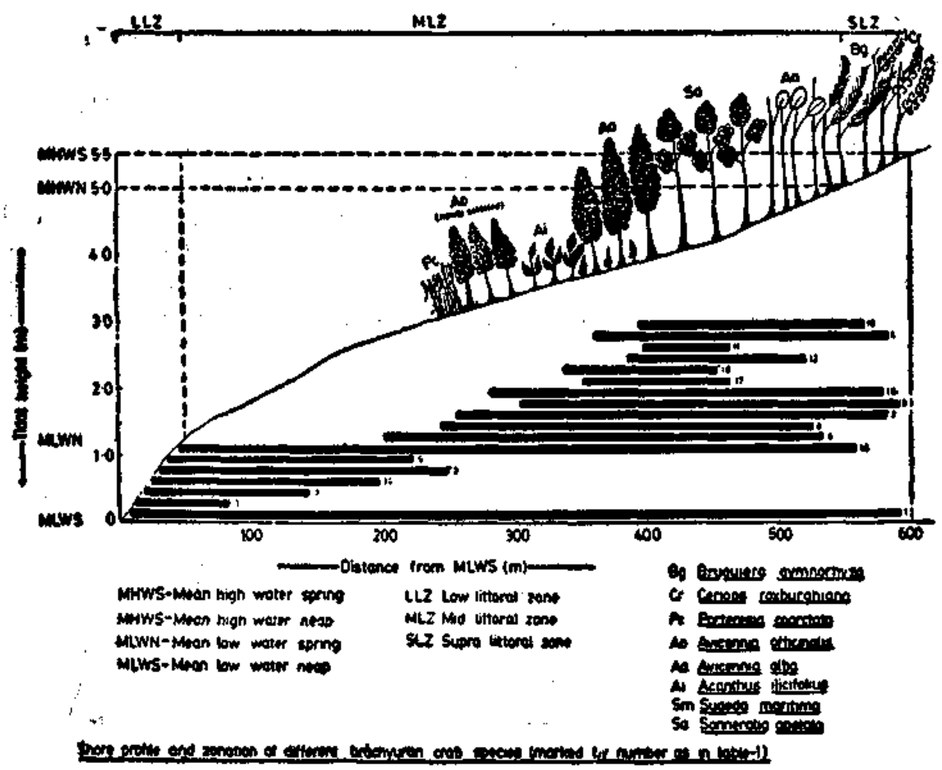


FIG. 2. Shore profile and zonation of different crab species (marked by number as in Table 1).

dominant mangrove crab species, because of their higher abundance and surface activity, is also encountered in this zone. The other species of mangrove crabs recorded from this zone are *Dotillopsis brevitarsis*, *Uca triangularis bengali*, *Euricarcinus grandidieri*, *Metaplax intermedia*, *M. indica*, *Metapograpsu-messor*, *Metapograpsus maculatus*.

Some of the mid-littoral crabs *viz.*, *S. taeniolatum*, *S. chiromantes bidens*, *U. acuta acuta*, *U. triangularis bengali*, *M. intermedia* tion indicated that population density was higher in the lower zones of the intertidal belt, showing a general decrease towards high water level. But the biomass value was lowest in lower level and highest in upper level due to the occurrence of smaller sized and larger sized crabs in the two zones respectively.

## DISCUSSION

Seasonal oscillation of different hydrological parameters (Choudhury *et al.*, 1984),

TABLE 1. *Size (breadth), density (No./m²) and biomass (gm/m²) in parenthesis of different species of crabs in different zones*

| Species | Average size of adult (mm) | Average density and biomass at distances from shoreline | | | |
|---|---|---|---|---|---|
| | | 0-50 (m) | 50-250 (m) | 250-550 (m) | 550-600 (m) |
| **Family : Portunidae** | | | | | |
| *Scylla serrata* .. | 90 | 0.2 (1.1) | 0.07 (0.4) | 0.03 (0.2) | 0.1 (0.4) |
| **Family : Ocypodidae** | | | | | |
| *Uca dussumieri dussumieri* .. | 16 | 0.6 (1.3) | 0.67 (1.55) | — | — |
| *U. acuta acuta* .. | 10 | — | 1.35 (0.97) | 14.7 (19.63) | 5.6 (8.1) |
| *U. triangularis bengali* .. | 8 | — | — | 8.9 (11.53) | 2.8 (1.6) |
| *Dotilla blanfordi* .. | 3 | 27.6 (2.3) | 11.75 (2.4) | — | — |
| *Dotillopsis brevitarsis* .. | 7 | — | 4.47 (2.12) | 3.7 (3.93) | — |
| *Illyoplax gangeticus* .. | 3 | 59.2 (3.7) | 24.45 (1.42) | — | — |
| **Family : Xanthidae** | | | | | |
| *Euricarcinus grandidieri* .. | 18 | — | 0.65 (1.3) | 3.3 (6.86) | — |
| **Family : Grapsidae** | | | | | |
| *Sesarma taeniolatum* .. | 42 | — | — | 2.3 (16.26) | 1.4 (1.32) |
| *S. chiromantes bidens* .. | 26 | — | 0.3 (0.7) | 2.75 (5.93) | 0.9 (3.3) |
| *S. longipes* .. | 38 | — | — | 0.03 (0.2) | — |
| *S. pictum* .. | 8 | — | — | 0.86 (0.78) | — |
| *Macrophthalmus pectinipes* .. | 22 | 1.2 (3.1) | 0.1 (0.32) | — | — |
| *Metaplax crenulata* .. | 36 | 2.2 (7.8) | 0.92 (4.4) | — | — |
| *M. intermedia* .. | 8 | 0.6 (0.3) | 11.35 (6.05) | 14.6 (8.0) | 6.3 (4.4) |
| *M. indica* .. | 15 | — | — | 1.6 (2.4) | 0.7 (1.1) |
| *Metapograpsus messor* .. | 7 | — | — | 1.2 (0.96) | — |
| *M. maculatus* .. | 8 | — | — | 0.96 (0.73) | — |
| Total .. | | 91.6 (19.6) | 56.08 (21.63) | 54.93 (77.41) | 17.8 (32.2) |

different degrees of tidal amplitude and rate of siltation render complex environment for the macrobenthic fauna of this estuarine mangrove island. It can be inferred that different species of crabs display distinct zonation in response to their different degrees of adptation, although *Metaplax intermedia* is well noticed throughout the intertidal zone.

The crabs which are the inhabitant of low littoral zone and lower part of the mid littoral zone, do not experience problems of water shortage, *i.e.* desiccation as their habitat is covered by every high tide of the fortnightly lunar cycle. The crabs inhabiting the low littoral zone feed intensively throughout the period of exposure, as this zone remains under water during each high tide and also in the neap tide. But the crabs inhabiting the upper mid-littoral zone and supra-littoral zone are subjected to more prolong exposure. They must make periodic visits to the burrows to cool and to replenish body water lost by exposure and evaporation. The frequency of burrow visits by fiddler crabs increases as the shore becomes drier and hotter during the summer period in particular (Macintosh, 1984) the intertidal slope, is the rate of oxygen consumption. Reduction in the number and volume of the gills of the series of crabs was noticed as the habitat changed from sea to land (Pearse, 1929). The reduction in the number and volume of gills is accompanied by an increased oxygen consumption. The gills of *Uca* and *Sesarma* are reduced in size in comparison to many less terrestrially adapted crabs (Gray, 1957 ; Veerannan, 1974), suggesting that aerial breathing contributes significantly to the total oxygen consumption.

TABLE 2. *Ecological parameters in different zones*

| Zones | Salinity (‰) | Dissolved Oxygen (ml/L) | pH | Temperature (°C) | | | Organic Carbon | Texture of soil | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Air | Soil | Burrow | (%) | Sand (%) | Silt (%) | Clay (%) |
| Low littoral zone .. | 27.2 | 3.8 | 8.2 | 32 | 32.5 | 30.0 | 0.48 | 28.52 | 59.04 | 12.08 |
| Mid littoral zone .. | 27.4 | 3.4 | 8.0 | 30 | 29.5 | 29.0 | 0.92 | 12.26 | 73.69 | 15.05 |
| Supra littoral zone .. | 28.2 | 3.1 | 7.8 | 31 | 30.0 | 29.0 | 0.69 | 14.74 | 75.30 | 9.96 |

Among the several factors influencing the distribution and abundance of *Uca* spp., the most important are the substratum, salinity and competition in the biotic system (Teal, 1958). Fluctuating temperature and salinity variation increases and water availability decreases with shore level as the moderating influence of tides diminishes. Moreover, owing to the solar evaporation and rainfall, salinity fluctuation inside the crabs' burrows of the upper portion of the intertidal zone is supposed to be much greater. The osmoregularity of the crabs might be an important factor, regulating the distribution pattern. As the temperature within the burrow of crabs does not fluctuate in relation to the temperature of air and soil, the temperature is not supposed to play a great role in the zonation of crabs (Chakraborty, 1984).

Ayers (1938) experimentally showed that one of the important physiological ability which plays a major role in the distribution along



Occurrence of larger crabs on the upper shore may be explained by the increase of tolerance against desiccation and gradual expansion of living area (Kikuchi *et al.*, 1981).

The higher biomass of brachyuran fauna as recorded around upper part of intertidal belt coroborrates with the observations of Swennen (1982). Zonation of the biomass can be caused by difference in predation pressure, food supply and habitability of the substratum (Swennen, 1982). Besides, the pattern of distribution of individual species seems to be dictated by the tides during the fortnightly lunar cycle, because the extent of periodical innundation and exposure, and desiccation must exert prejudicial impact on theexistence of benthic fauna in those severely stressed habitats.

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