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OBSERVATION ON THE COMMUNITY STRUCTURE OF BROWN MUSSEL *PERNA INDICA* FROM THE INTERTIDAL ROCKY SHORES OF VIZHINJAM, SOUTHWEST COAST OF INDIA *

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ABSTRACT

The percentage occurrence by weight of the brown mussel as *Perna indica* well as the various associated organisms in the community from an intertidal rocky habitat of Vizhinjam for the various months is estimated. The associated organisms on the mussel community include, algae, sponges, sea anemones, planarians, polychaetes, sipunculids, amphipods, isopods, cirriped, crabs and gastropods. The percentage biomass of associated organisms range from 2 to 12.29 in the mussel community in various months. Cirriped form the most dominant biofouling organism on mussel. The community starts establishing on the onset of SW monsoon. A clear or distinct succession of associated organisms on the mussel was not observed in various months or season, though the biomass was found to fluctuate without any distinct trend, in various months. The population of mussel is multimodal in size. The length ranges from 2 mm to 54 mm in a population of nearly one year old. The rate of growth of mussel in the intertidal area is estimated to be 5 mm in the first few months and 4 mm per month in the latter part of the first year. The mortality rate is not estimated though assumed to be of high order judging from the presence of dead attached shells among the living ones. Some modes remain without registering any growth for a period. In the present study the estimated growth rate is only for one year since second year population could not be analysed due to total exploitation of the community from the site of collection by local people. It was observed that wherever, there is a profuse settlement of *Cellana radiata*, *Balanus amphitrite* or thick algal growth on the rocks the mussel was virtually absent or scarcely populated. However *Balanus amphitrit* could establish on mussel very successfully. The influence of pre-existing population of *Cellana radiata* and *B. triteamphi* on the settlement of brown mussel spat is not ascertained. Rocks on the lower intertidal zones have denser population of mussels than on upper ones that are subjected to more prolonged exposure at low tides.

INTRODUCTION

THE BROWN MUSSEL *Perna indica* Kuriakose and Nair (Mytilidae) is found both in the intertidal and subtidal zones from Quilon to Cape Comorin along the southwest coast of India, extending its distribution to Tiruchendur along the east coast. The details of fishery and mode of utilisation of this species are given by Hornell (1922), Jones (1950), Jones and Alagarswami (1973). Kuriakose (1973) has studied the biological aspect of this species in detail. Appukuttan and Nair (1980) have elucidated the rate of growth and biofouling of this species in culture systems at Vizhinjam Bay. Though considerable information on the biofouling organisms of our coastal waters is available in literature (Kurian, 1950 ; Balasubramanian and Nair, 1970 ; Renganathan *et al.*, 1982 ; Alagarswami and Chellam, 1976 ; Nair *et al.*, 1984), there is very little information

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available on the nature and composition of the biofouling and associated organisms on the brown mussel community on the intertidal zones of our waters. In view of this the present study was carried out during December 1986 to November 1987 on the intertidal rocks of Vizhinjam.

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Material and Method

Samples of mussels were collected from a selected area of the intertidal rocks at four week intervals. One to 3.5 kg of sample was scooped out with a sharp chissel and immediately transferred to a plastic bucket and brought to laboratory for analysis. Due to very heavy wave action collection could not be made from the site during June and July. Sand and dead shells found were removed taking care not to loose any associated organisms and the total weight is taken. All the associated organisms were carefully sorted out from the sample and fresh weight was taken each group. Samples were preserved for subsequent identification. For length frequency of mussel a subsample of 250 gm was fully counted and length taken with a dial calipper. Samples were collected from the same area of the intertidal zone. Percentage incident of various groups of associated organisms in the biomass of the community for various months is presented in Table 1 and on an annual basis in Table 2. Figure I indicates the mussel — associated organism relationship in the community structure.

Observations

Community structure : The surface of the shell, the byssus thread and the interspaces of mussels provide substratum and living space for both parabions and cryptobions in the community. A few of the associated animals are errant forms such as polychaetes, copepods, crabs and gastropods. The cirriped *Balanus amphitrite*, sponges and anemones form the sedentary forms. Algae are found growing on bysses or on the sides of shells. Copepods and tiny polychaetes were also found on the accumulated sand and dead shells among the living mussel. The brown mussel community starts gaining foothold on the intertidal rocks of Vizhinjam on the onset of SW monsoon, but observations were virtually impossible due to very heavy breakers during this time. The gross feature of the community is established in about two months *i.e.* by August. It is observed that very little qualitative difference occur in the structure of the associated organisms in different months of the year. The fouling and associated organisms get recruited to the community both by larval settlement as in *Balanus* or by migration of adults and subadults as in large gastropods and perhaps polychaetes. However, a clear and distinct succession of the organisms is not observed, though fluctuation in the biomass of different associated organisms in relation to mussel is observed (Table 1) in different months as well as the biomass of fouling and other associates in the community (Fig. 1).

Composition of the associated organisms — a qualitative analysis : The following are the various groups of animals and plants found associated on brown mussel community at Vizhinjam.

Algae : *Ulva fasciata*, *U. lactuca*, *Chaetomorpha antennina* and *Gracilaria cortica* are found attached on the sides of bivalves or on the byssus. The premonsoon months have a relative profusion of algae on mussel community.

Sponges: The initial encrusting stages of *Calyspongia fibrosa* was observed in April and May.

Polychaetes: The species noted was *Perinereis* sp. The heteronereid stage also found. Polychaetes are found throughout the year crawling among the interspanes of the living and dead mussels.

Amphipods and Isopods: The talitroid *Parhyale hawaiensis* is the most common amphipod found. They occupy the byssus threads. The gammarid *Elasmopus spinydactylus*, *E. rapax*, *E. pectenicrus* and *Maera quadrimana* were also seen in large numbers. The isopod *Cirrolana bovina* is also found.

Crabs: At least representatives of five families of juvenile crabs are found associated. The most common was *Glabropilumnus dispar* and *G. sodalis* (Xanthidae). *Pachygrapsus minutus* (Grapsidae). *Manaethius monoceros* (Majidae) and *Pinnotheres ridgewayi* (Pinnotheridae), and some members of the family porcellanidae were also recorded. December, February and March showed a relative paucity of crabs in the mussel community.

Cirriped: *Balanus amphitrite* forms the most dominant fouling organism on mussels. Generally it gets attached to the sides of the brown mussel.

Other molluscs: A few gastropods are found among the mussels which include *Trochus* sp., *Nerita* sp., *Pyrene zebra*, *Drupa* sp., *Littorina* spp. and *Cellana radiata*. Among the Polyplacophora, *Ischinochiton* sp. was also found.

TABLE 1. *Incidence in % of various associated organisms in the community structure of* Perna indica *during various months in the biomass of the mussel community*

Name	Dec.	Jan.	Feb.	Mar.	Apr.	May	Aug.	Sep.	Oct.	Nov.
Algae ..	0.15	0.185	0.09	0.06	0.08	0.89	1.04	0.134	0.02	0.01
Sponges ..	—	—	—	—	0.04	0.08	—	—	—	—
Sea anemones ..	0.17	0.08	—	0.28	0.04	0.03	0.12	0.002	0.06	0.03
Planarians ..	—	—	0.003	0.02	—	—	0.126	0.54	0.375	0.39
Polychaetes ..	0.62	0.37	0.04	0.14	0.09	0.05	0.82	0.67	0.54	0.32
Sipunculids ..	0.08	0.008	0.004	0.01	—	0.003	0.017	0.02	0.01	0.017
Amphipods and Isopods	0.01	0.04	—	0.05	—	0.008	0.07	0.04	0.06	0.05
Crabs ..	—	0.01	—	—	0.03	0.02	0.01	0.001	0.03	0.04
Cirriped ..	—	1.10	0.35	5.70	—	1.35	8.26	1.80	11.00	4.82
Gastropods ..	1.32	0.185	1.68	0.28	6.69	0.48	0.06	0.02	0.09	0.17
Fish larvae ..	—	—	—	0.027	—	—	—	—	—	

There was no sampling for June and July due to very storng wave action.

Percentage composition of associated organisms

The percentage occurrence of different associated organisms within the mussel community for the various months is presented in Table 1. The range is as follows based on samples analysed. Algae 0.01 to 1.04; sponges 0.04 to 0.08; Sea anemones 0.002 to 0.28; planarians 0.003 to 0.39; polychaetes

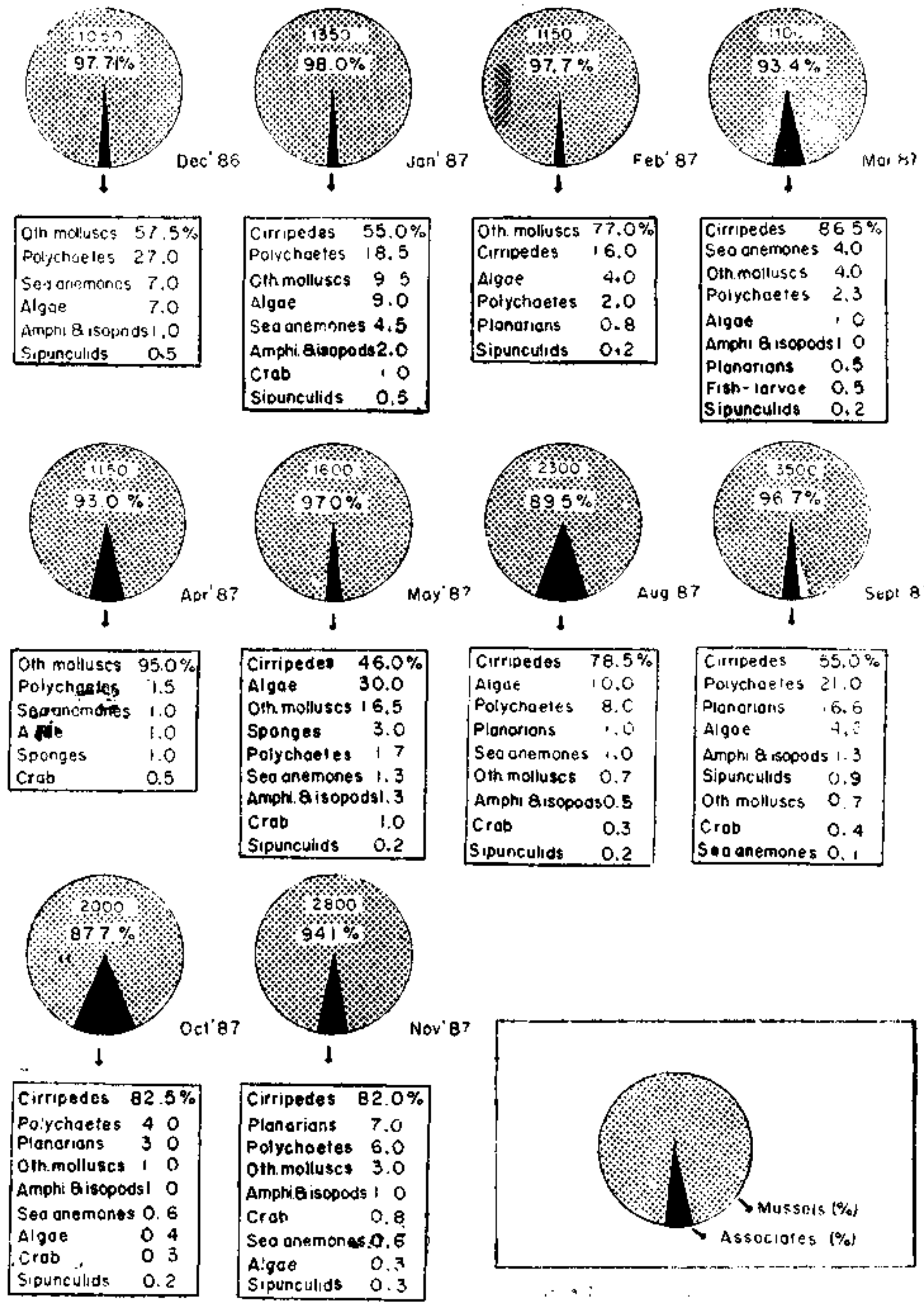

Fig. 1. Percentage composition of various components of brown mussel community from the intertidal rocks of Vizhinjam. The figures on the upper part of the circle indicate the weight of sample in gm. The data in boxes indicate the percentage of different groups in the biomass of associated organism indicated in the circle.

0.04 to 0.82 ; sipunculids 0.003 to 0.08 ; amphipods and isopods 0.008 to 0.07 ; cirriped 0.35 to 11.0 ; crabs 0.001 to 0.04 ; and gastropods and polyplacophora (other molluscs) 0.02 to 6.69. In March a few larval fish were also found which could have caught entangled at high tides.

The percentage of associated organisms in the community range from 2.00 to 12.29 in different months (Fig. 1). On an yearly basis algae to the brown mussel community is 4.9% by weight.

Length frequency of brown mussel : The length frequency distribution of brown mussels from the intertidal zone is presented in Fig. 2. The population is multimodal. The length range from 2 to 54 mm in one year old population. Since the population from the site of collection get exploited by the local people by May, a second year population from the same site could not be studied for length frequency distribution and growth estimation.

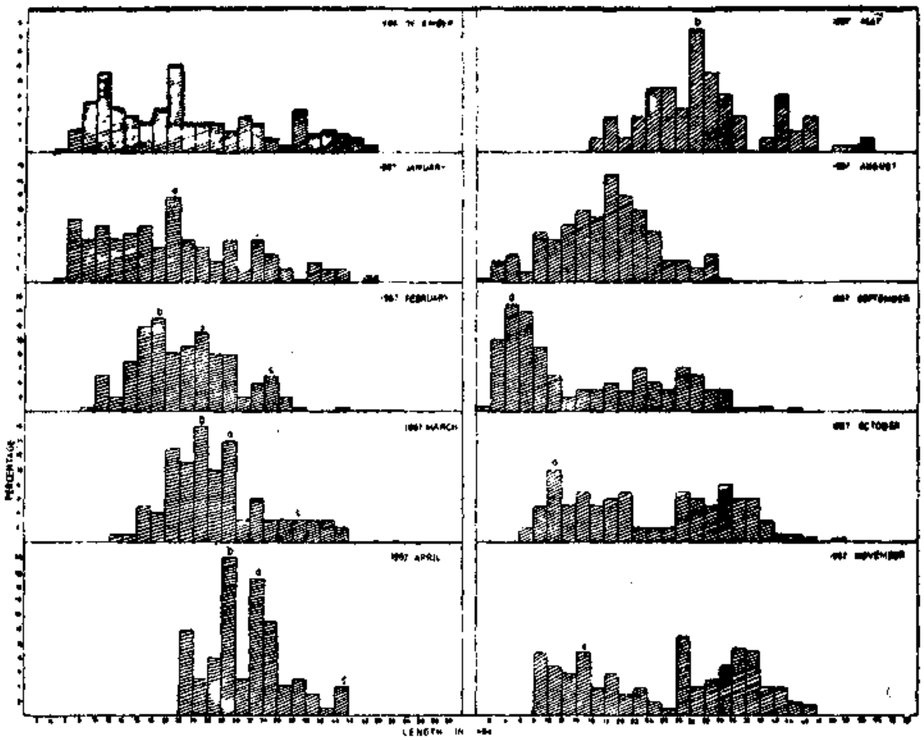

Fig. 2 Length frequency and modal progression of *Perna indica* from the intertidal zone of Vizhinjam.

the cirriped *B. amphitrite* forms the largest component among the associates constituting 68.27% by weight. Other molluscs including gastropods and polyplacophora form 12.48% (Table 2). Polychaetes formed 7.49% and planarians 3.89%. The rest is composed of minor elements. The percentage contribution of

Rate of growth

Kuriakose (1973) has already estimated the rate of growth of brown mussel from the natural habitat of Vizhinjam and Appukuttan and Nair (1980) have estimated the growth rate on cultured systems from Vizhinjam. The present estimation from intertidal zone is only for one year old population since second year, population was not available due to reasons already stated. A few modes as shown in Fig. 2 could betraced for a reasonable time. Mode A, with an initial length of 21 mm in January is traced to 33 mm by April with an average monthly growth rate of 4 mm. Mode B, starting with 19 mm in February attained 31 mm by May with an average monthly growth of 4 mm. Mode C with an initial length of 33 mm in January reached 45 mm in April, again registering an average monthly growth of 4 mm. Mode D represents initial settlement with a length of 5 mm in September and attained 15 mm by November showing a monthly growth rate of 5 mm. The multimodal nature of the population is mainly due to continual settlement of the spat and retarded growth of some specimens due to various ecological parameters. The largest size we found in our samples is 54 mm and that might be the maximum size attained by the mussels on intertidal rocks at Vizhinjam. The present data indicates that the mussel may attain an average monthly growth rate of 5 mm for the first six months on settlement and then show a retardation to 4 mm per month during the second half of the first year.

TABLE 2. *Contribution of various groups towards the biomass of associated organisms in the brown mussel community on the intertidal rocks of Vizhinjam out of* 18,000 *gm of mussel sampled* (*Ref. Fig.* 1 *for monthwise data*)

Name	Weight in gm	%
Algae	51.24	4.90
Sponges	1.80	0.17
Sea anemones	12.40	1.20
Planarians	40.59	3.89
Polychaetes	78.12	7.49
Sipunculids	2.63	0.25
Amphipods and Isopods	7.40	0.71
Crabs	3.34	0.32
Cirriped	711.42	68.27
Other molluscs	132.75	12.74
Fish larvae	0.30	0·03
Total	1042 00	

Settlement of mussel spat on intertidal rocks

Settlement of spat of brown mussel on the upper littoral rocks starts with the onset of SW monsoon. Heavy winds and consequent high waves may bring spat to the upper littoral rocks and constant splashing of waves may favour their settlement. The lower littoral rocks have a relatively more profuse and denser settlement of mussels than the upper littoral rocks. Field observation has clearly indicated that some sort of relationship exists between the initial spat settlement and presence of fouling organisms on substratum. It was observed that wher ever there was heavy concentration of *Balanus amphitrite* and *Cellana radiata* on certain rock mussels were absent or very sparcely populated. This situation was also observed among algal patches. However *B. amphitrite* was the most dominant fouling organism on mussels. Whether a profuse early existing growth of cirriped and other organisms such as *Cellana* prevent settlement of spat of brown mussel on rocks or not has yet to be systematically studied.

Discussion

Ricketts and Calvin (1962) have stated that there is an orderly progression in the mussel beds by a replacement of one group by another leading finally to a stable condition in the community structure. The early settlers generate conditions suitable for subsequent ones. The settlement of spat of brown mussel at Vizhinjam starts by June and may continue upto February (Kuriakose, 1973). The present samples are only from August *i.e.* more or less two months after the initial settlement. The composition of the associated organisms does not indicate any sort of succession for various months at Vizhinjam. We could not assess the situation in the first two months of settlement as samples could not be collected due to weather conditions. However, it must be said that a more or less steady state in the composition of the associated organisms on the mussel community is reached within two or three months after initial establishment of the mussels on the intertidal rocks at Vizhinjam.

The present estimated growth rate of brown mussel, shows slight variation from earlier estimates from different habitats. Kuriakose (1973) obtained a monthly growth rate of 6 mm for the first year and 4.77 mm per month for the second year. Appukuttan and Nair (1980) obtained a monthly growth rate of 3.5 mm for cultured brown mussels on ropes in the protected waters of Vizhinjam Bay and 5 mm per month for cultured mussels outside the Bay in open water. However, the mussels from the intertidal rocks registered only a monthly growth rate of 5 mm in the early stage and 4 mm subsequently for the first year population. This is slightly less than what Kuriakose (1973) has estimated from natural habitats at Vizhinjam. Estimate of 3.5 mm on ropes from Vizhinjam Bay by Appukuttan and Nair (1980) more or less agree on the present growth rate from intertidal areas. All these data indicate that environmental parameters and crowding as well as availability of food may be the factors that influence the rate of growth of brown mussel and the growth rate is liable to variation in different habitats. The intertidal zone is subjected to extremes of environmental parameters and stress (Dayton, 1971 ; Paine, 1966) such as exposure, temperature and salinity. As in the case of many other mytilids the brown mussel has also successfully adapted to these extreme conditions of intertidal zone.

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