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ON THE GROWTH OF THE BACKWATER CLAM, *MERETRIX CASTA* (CHEMNITZ) IN THE CLAM BEDS OFF COCHIN BARMOUTH

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ABSTRACT

Dense populations of *Meretrix casta* (Chemnitz) occurs in the shallow water regions on the northern side of the Cochin bar-mouth. Its rate of growth based on random samples collected from March 1971 to August 1972 was studied. The variations in the environmental parameters, particularly salinity, have a profound influence on its rate of growth. Length frequency studies of the clam shows that the growth is moderate during the pre-monsoon period, fast during the post-monsoon period and poor during the monsoon period. Depending upon the severity of the rains, the growth during the monsoon period ranges from an almost complete cessation as observed during the year 1971 to slightly perceptible increase as in 1972. Young clams show a higher rate of growth than the older ones. *Meretrix casta* has two breeding seasons, one in January and the other in October, the latter being more pronounced.

INTRODUCTION

MERETRIX CASTA is a common species of backwater clam which is widely distributed both along the east and west coasts of India. In Kerala it is present in all the estuaries although its distribution is restricted to the barmouth and its vicinity. In spite of its potential value as a cheap source of protein food and a raw material for the manufacture of lime, very little effort has been made for the proper utilization of this molluscan resource.

A perusal of the literature on clams shows that the work carried out on the Indian bivalves of the genus *Meretrix* is very limited (Hornell, 1917; 1921; Abraham, 1953; Durve, 1963, 1964; Durve and Dharmaraja, 1965; Seshappa, 1967; Silas and Alagarswami, 1967; and Durve, 1970).

M. casta being a commercially important species of bivalve, a sound knowledge of its biology and physiology particularly, in relation to the fluctuating environmental conditions is essential for its judicious exploitation. The present paper gives an account of the rate of growth of *M. casta* in the changing hydrological conditions of the Cochin Harbour area.

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MATERIAL AND METHODS

The studies on the rate of growth of *M. casta* are based on random samples collected at fortnightly intervals from the Cochin Harbour area for a period of 18 months from March 1971 to August 1972. The material was collected using a 0.05 m^2 Van veen grab and passing the bottom samples through a large sieve of mesh size 1 mm square. The age and rate of growth of *M. casta* was determined by the method of length frequency distribution. The anterio-posterior axis of the clam was measured by using a pair of verniet callipers. The length measurements were grouped in sizes with class intervals of 1 mm. The two fortnightly samples were combined for each month and the size frequencies were converted into percentage frequencies of the population. The samples of 11th and 26th October 1971, however, differed from those of other months in that they showed significant variations in the composition of size groups. Therefore, they have been represented separately in the histograms (Fig. 3) for size frequency distribution.

Water samples from the bottom for the determination of salinity were collected from the clam bed with an indigenous water sampler fabricated in the Department of Marine sciences.

Harvey's method was followed for the estimation of salinity. The bottom temperatures were noted with a bucket thermometer.

ENVIRONMENT

The Cochin Backwater is situated between latitudes 9° 28' and 10°00'N and longitudes 76° 13' and 76° 31' E. The hydrological effect exerted on the estuary by tidal flow and freshwater discharge has been discussed in detail by Qasim *et al.* (1969), Jos Anto (1971), and others.

The clams occur as dense beds off the northern side of the Cochin barmouth (Fig. 1). The clam bed has an area of approximately 2.5 Sq. km of shallow waters where the average depth is 2.7 metres. Sankaranarayanan and Qasim (1969) have reported that the hydrological conditions of this region are very much influenced by the freshwater discharge into the sea during the monsoon season. The bottom sediment in the clam bed is composed of fine sand with fragments of bivalve and

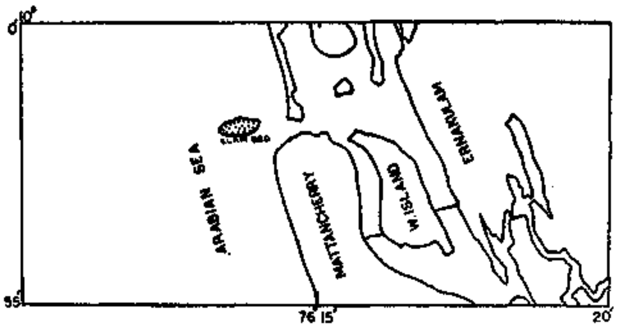

Fig. 1. Map showing the location of the clam beds.

gastropod shells. The composition of the sediment shows marked variations during the monsoon period due to the heavy deposition of silt discharged into the marine zone of the estuary by the river. The distribution of the clam is not uniform over the bed probably due to the influence of the tidal currents and deposition of silt.

RESULTS

Temperature

The seasonal variations in the bottom temperature over the clam bed during the whole period of observation is shown in Fig. 2, from which it may be seen that the temperature reaches the maximum in April. With the onset of south west monsoon either by the middle of May or by the beginning of June the temperature gradually falls. As the intensity of the monsoon increases, the temperature shows a progressive decrease until it reaches the minimum in July. This is followed by a gradual increase till November. In December and January which are the months of north east monsoon, a slight decline in temperature is noticed. From February onwards the temperature again shows a steady increase till April when the maximum value is attained.

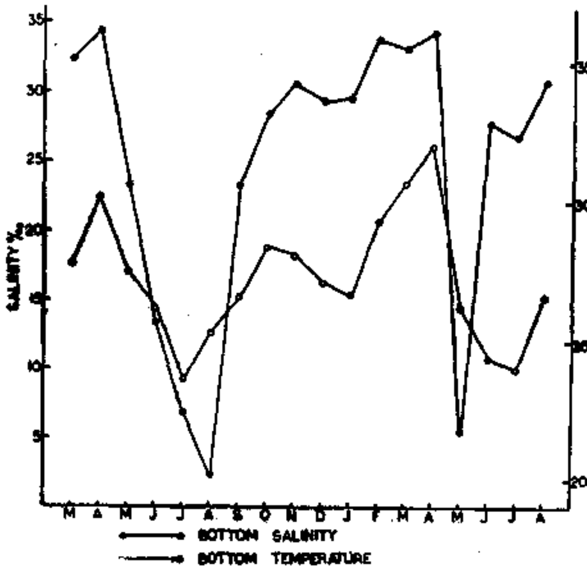

Fig. 2. Graph showing the distribution of bottom temperature and bottom salinity of the waters over the clam beds.

Salinity

The distribution of bottom salinity over the clam beds is represented in Fig.2. It may be seen from the figure that the seasonal variation of bottom salinity displays a trend similar to that of bottom temperature. The salinity reaches the maximum of 34.33‰ in April. With the onset of south west monsoon, the salinity gradually falls and reaches the minimum value of 2.30‰ in August. During September a sudden rise in bottom salinity is observed and this is followed by a gradual increase till April except during November and December. This slight decline in bottom salinity observed during November and December, could be attributed to the effect of the north east monsoon.

Breeding season

Different authors have given different periods as the breeding time of *M. casta*. Hornell (1922) found that *M. casta* spawns twice in a year during April - May and again in September. Panikkar and Aiyar (1939) hold that *M. casta* breeds discontinuously throughout the year and it is often influenced by rains. According to Abraham (1953) the peak period of spawning activity of *M. casta* is July and August. This is followed by another spawning period in October and November and a third one in the summer months beginning with March and ending with April.

Durve (1964) found that *M. casta* is a continuous breeder in the Mandapam fish farm with a break for a few months in the late summer.

The first sample collected in March 1971 for the present study consisted of clams ranging in length from 14 - 29 mm with a modal value of 18.5 mm. Abraham (1953) has shown that *M. casta* is about 2 months old when it has a shell length of 15 mm. He has observed that subsequent growth during the third month is 7.5 mm. Assuming that *M. casta* in the Cochin Harbour area follows the same rate of growth, it can be reasonably supposed that the 18.5 mm group represented in the first collection is more than 2 months old and that spawning must have taken place some time in the middle of January. The sample collected on 11th October 1971 was dominated by young clams of modal value 4.5 mm. By 26th October this shifted to 7.5 mm. This new year class is presumably the product of spawning some time in October. Thus the present observations on the rate of growth of *M. casta* in the clam beds off Cochin barmouth shows that it has two breeding periods, one in January and the other in October.

Length frequency distribution

The length frequency distribution of *M. casta* observed during a period of 18 months from 1-3-1971 to 22-8-1972 is represented in Fig. 3. The histograms

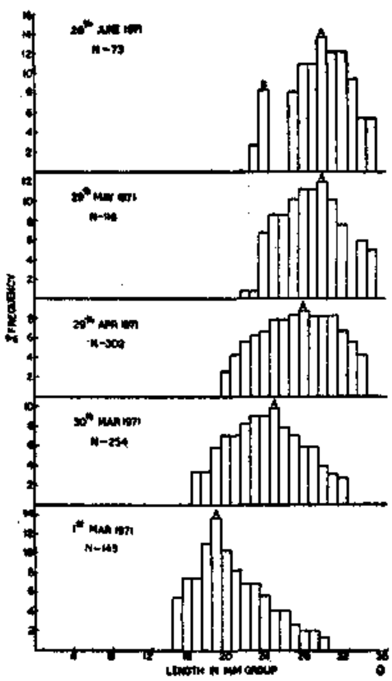

Fig. 3 a. Histograms representing length frequency distribution in population samples of the clam, *Meretrix casta* collected from the clam beds off Cochin barmouth. N- stands for the number of individuals obtained per sample.

for 1-3-1971 shows that clams of length 17 -19 mm contribute to the bulk of the samples, with mode A at 18.5 mm forming the predominant group.

By 30-3-1971, mode A shifted to 24.5 mm, showing an increase of 6 mm within 30 days. But it may be noted that clams ranging in length from 21-23 mm also form a significant part of the samples.

In April 1971, the modal value shifted from 24.5 mm to 27.5 mm, thereby registering an increase of 3 mm in length.

In May 1971, the bulk of the collection was formed by clams ranging in length from 26 - 28 mm. Mode A shifted from 27.5 - 29.5 mm showing an increase of 2.0 mm.

The collection of June 1971 are represented by two modes, namely A at 29.5 mm and B at 23.5 mm. The histograms for July is unimodal, there being no group other than A at 29.5 mm to offer any significant contribution to the populations. In August 1971, the collection is dominated by the very same mode A which, however, remains stationary. The histograms for September 1971 shows that mode A has shifted from 29.5 mm to 33.5 mm recording a growth of 4 mm in one month. The collection taken in October 1971, was dominated by

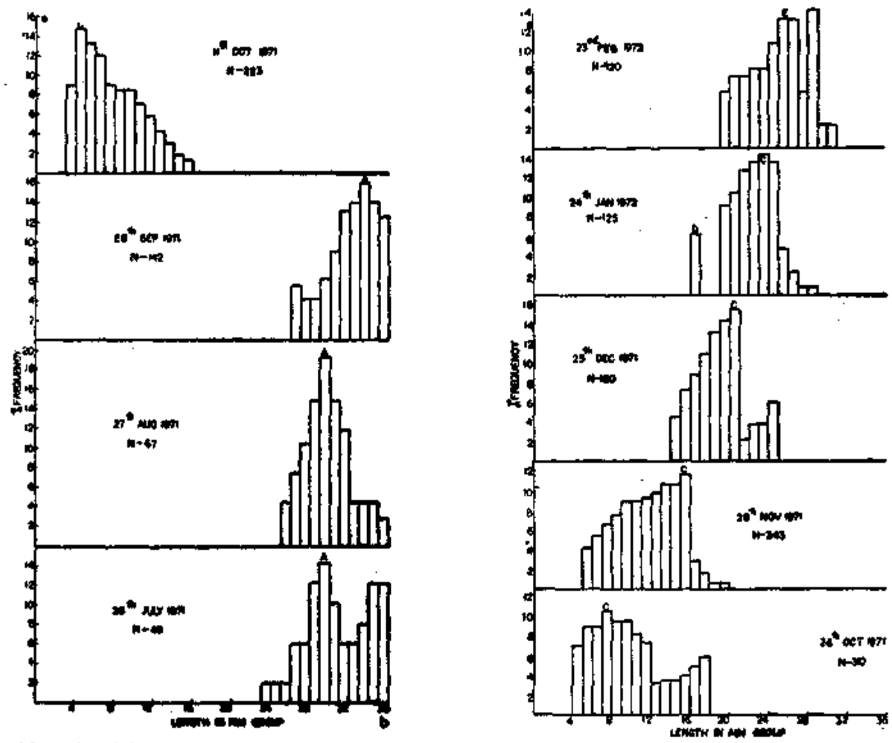

Fig. 3 b and c. Histograms representing length frequency distribution in population samples of clam *Meretrix casta* collected from the clam beds off Cochin barmouth. N-stands for the number of individuals obtained per sample.

young clams and is represented in the histogram as mode C at 4.5 mm. By 26-10-1971, this mode has shifted to 7.5 mm thereby showing a rapid growth of 3 mm within a period of 15 days. In the histogram for November 1971, mode

C at 15.5 mm persists as the prominent group. By 25-12-1971, mode C has shifted from 15.5 mm to 20.5 mm thereby registering an increase of 5 mm in length. The histograms for January 1972 showed two distinct modes namely C at 23.5 mm and a new mode D at 16.5 mm, the latter presumably being the product of late spawning in 1971. The samples of February 1972 were dominated by two modes, namely C at 28.5 mm and a new mode E at 25.5 to 26.5 mm of which the latter contributed the bulk.

The histograms for March 1972 was characterised by the presence of mode C at 30.5 mm and a new mode F at 21.5 mm and 22.5 mm. Mode C of the previous month has shifted to 31.5 mm. The histograms of subsequent months from May 1972 to August 1972 were all represented by mode C at 33.5 mm, 33.5 mm, 34.5 mm and 35.5 mm respectively.

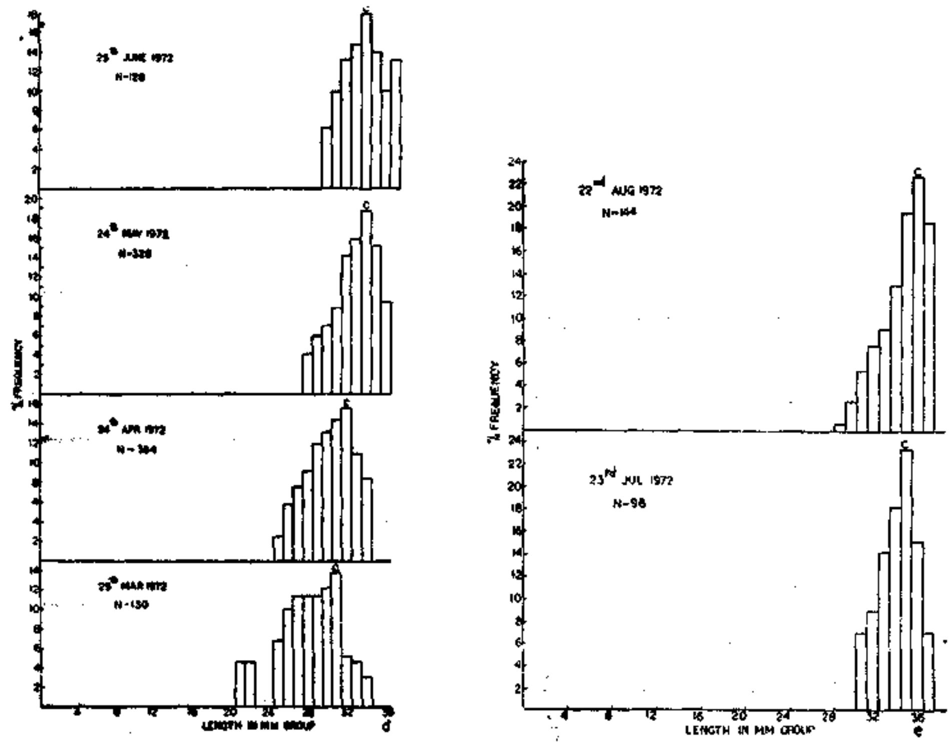

Fig. 3 d and e. Histograms representing length frequency distribution in population samples of the clam *Meretrix casta* collected from the clam beds off Cochin barmouth. N-stands for the number of individuals obtained per sample.

DISCUSSION

From the account given above, it may be seen that mode A obtained in the first collection of March 1971, is probably the product of spawning during January 1971. It has attained an average length of 18.5 mm by first March and then grows at the rates of 6 mm, 3 mm, 2 mm in the subsequent months to a length of 29.5 mm at the end of the third month. This shows that the growth is faster during the early period, a phenomenon which is well known for clams (Newcombe, 1935). The higher rate of growth during the post-monsoon period may be attributed to the high salinity conditions of the environment. Salinity is an important factor which influences the rate of filtration of clams and thereby indirectly their rate of growth also. It has been pointed out by Durve (1963) that the rate of filtration of *M. casta* is not much effected by variation in salinity within a range of 25-56‰. It has been aready stated that over the clam beds under investigation, the salinity during March and April 1971 was 32.39‰ and 34.33‰ respectively, the variation being too negligible to cause any appreciable change in the rate of filtration. In May, however, the salinity declined to 23.3‰ (Fig. 2). According to Durve (1963) a drop in salinity below 23‰ will affect the rate of filtration of *M. casta.* The slow rate of growth of mode A during May would therefore be attributed to this drop in salinity.

During the subsequent months, growth of the clam virtually ceases, as illustrated by mode A, which remains constant at 29.5 mm till the end of August 1971. It may be noted that these are the months of South West monsoon when the salinity shows a steep decline up to 2.3‰. The cessation of growth during this period is evidently due to the low salinity conditions of the environment. The sudden shifting of mode A from 29.5 mm to 33.5 mm in September 1971, when the salinity is on the increase lends support to the view that low salinity has a drastic effect on the growth of the clams. Other factors, such as spawning and scarcity of food, due to hyposaline and rough weather conditions as observed by Durve (1970) could also be ancilliary causes for the inhibition of growth during the monsoon period.

Mode C at 4.5 mm which appeared in the collection of 11-10-1971 has fairly good representation in almost all the histograms of the succeeding months till August 1972 and therefore is of much help in tracing the rate of growth from its earliest stage upto a length of 36.5 mm.

By 26-10-1971, this mode has shifted to 7.5 mm showing an increase of 3 mm in 15 days. Assuming that the rate of growth of the clams before they attained a length of 4 mm is faster than the above rate, it may be presumed that during the first months of their life, the average growth will be approximately 7 to 8 mm. In November 1971, this mode has shifted to 15.5 mm, registering an increase of 8 mm indicating that the growth during the second month is also of the same order. Then they grow at the average increments of 5 mm, 3 mm and 5 mm in the subsequent months till February 1972. In the histogram of March 1972, the mode C is represented at 30.5 mm and again it appears in the next month at 31.5 mm showing that the rate of growth of the second brood during the 6th and 7th months is only 2 and 1 mm respectively. In May 1972, it registered a growth of 2 mm and remains constant in June. The cessation of growth during June 1972 is obviously due to the decline of salinity brought about by unusual heavy rains which occurred during the close of May and lasted till the middle of June. It may be noted in this connection that although the salinity for May has been shown to be 5.5‰ it does not mean that it was uniformly low during the whole of this month. In fact, the value relates to the salinity condition at the close of the month when there was an interim dilution of the waters over the clam bed due to the unusual down pour referred to above. This low salinity prevailed till the latter half of June, when the rains stopped and the normal marine condition was established. Hence, the actual effect of low salinity was stronger during June than during the previous months. This accounts for the cessation of growth during June. There was a slight shifting of mode C by 1 mm during July and August, thereby showing that unlike mode A which was constant during these months, this mode showed some degree of progress, although its magnitude was low. This intra-seasonal variations in the rates of the growth of clams observed during the identical periods in two consecutive years of study is evidently due to the inconsistency in the outbreak of the South West monsoon which in 1972 occurred too late to bring about any marked change in the salinity conditions during June to August.

It has already been stated that *M. casta* has probably two breeding seasons, one in January and the other in October. Assuming that, mode A belongs to the early brood of January 1971 and mode C, the second brood of October 1971, it follows that the first year class of *M. casta* in the clam beds off Cochin barmouth attains a length of 33.5 mm in 9 months and the second year-class attains a length of 35.4 mm in 11 months.

Another interesting observation that was made during the course of the investigation was the presence of deeply impressed disturbance rings on the shells of *M. casta.* Since these rings were observed in specimens collected immediately after the monsoon, it may be presumed that they are the result of interrupted growth during this period. Similar growth check have been observed on the shells of *Katelysia opima* by Rao (1952) and on *Donax cuneatus* by Nayar (1955). Orton (1952) has also observed such disturbance rings on the shells of living Molluscs. These rings, therefore could be used as an aid for determining the age of the different year classes.

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