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28. BIOLOGY OF *MERETRIX CASTA* (CHEMNITZ) AND *PAPHIA MALABARICA* (CHEMNITZ) FROM MULKY ESTUARY, DAKSHINA KANNADA

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ABSTRACT

***Meretrix casta* and *Paphia malabarica* are the major species contributing to tlie clam fisheries of the iMull<y estuary. Studies on age and growth indicated that *M. casta* attains 46.6 mm and *P. malabarica* 48.1 mm in one year The von Bertalanffy growth equation is fitted for both the species. iV^ost of these clams do not survive t3 the second year. Length-weight relationship of both species and other dimensional relationships of *M. casta* are worked out. The major spawning season of *M. casta* and *P. malabarica* are Septtmbar-lVlarch and October-February rtspectlvely. In *M. casta* females are significantly dominant btyond 30 mm Itngth. This species attains first maturity at a length of 17mm-iHigh condition index in both the species coincided with paak spawning period. An analysis of rings on the shells of *M. casta* indicated that they are not useful in age determination. Various aspects of the biology of the above two species are discussed in relation to the ecological conditions of the Mulky estuary.**

INTRODUCTION

Clams are the most important estuarine moHuscan resources of Karnataka. Among them *Meretrix casta* rChemnitz) and *Paphia malabarica* (Chemnitz) contribute 88% and *A%* respectively in the Dakshina Kannada (Rao and Rao 1985).Theclamfishery of of the Mulky estuary in Dakshina Kannada was reported by Rao [1984]. Although there is some information on the resource characterstics of clams, information on t+ie biological aspect is scanty. The work on the biology of /\^. *casta* \s mainly from the estuaries of east coast (Abraham 1953, Durve **1964,** 1970 and Sreenivasan 1983). No published information is available on the biology of *Paphia malabarica.* Some aspects of the biology of these two commercially important clam species from the Mulky estuary are dealt ^®'®"

MATERIAL AND METHODS

Samples of *M casta* and *P. malabarica* **were** collected weekly during low tide from the Mulky estuary. For this purpose, the sediment containing the clams from the clam bed was i,wiiium iiy 1110 ^-la o lu passed through 1 mm mesh seive. The length of *M. casta* ranged from 5-43 mm and *P. malabarica* from 5-51 mm. The observations were made during 1979-82 on *M. casta* and 1983-84 on *P. malabarica.* Length-weight relationship and other dimensional relationships ^^^^ calculated by the least square method. ^^^ ^^-^ purpose, the linear measurements were takg^ upto 1 mm accuracy, and weight to 0.01 g precision. The differences in the distribution of males and females were tested by the Chi-square (X^) test. Three maturity stages viz, maturing (developing) mature and spent were considered. The condition index was deter-^jned as percentage of wet meat weight in the total clam weight. For this purpose after operving the clams, excess moisture from the meat was removed with a blotting paper and the meat weight recorded to an acuracy of 10 mg. The Qulland and Holt (1959) method was followed j^ gge and growth studies. Clams measuring g ^^ 4^ ^^ ^^.^ studied in detail with regard to the number of rings, length at which they were found and the period of ring formation. As there were not much variations from year to year, the data collected during different years y^ere pooled on monthly basis.

RESULTS

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Physiography and environmental conditions

Mulky estuary is formed by the confluence of Sambhavi and Pavanji rivers near Mulki

about 30 km north of Mangalore (Rao 1984). This estuary has a waterspread of about 750 ha and receives about 4000 mm rainfall annually, out of which about 85% occurs during the south-west monsoon (June-September).

The salinity is generally high and stable during December - May (29-33%J and low during September-November [17.5-247oJ- During June-August when the flooding of the estuary is maximum, the salinity is very low [<5°/oo]- The water temperature ranged from 27.4° C to 32°C and followed the same pattern, as that of salinity [Fig. 1]. The sediment is predominantly composed of medium and fine sand [Rao and Rao 1985]. The estuary is very shallow and during low tides, major parts of the estuary are exposed. The maximum depth at low tide is 3 m. The clam beds are mostly located in the shallow areas; *P. ma/a-barica* is found in slightly deeper waters, close to the mouth of the estuary generally separated from *M. casta.*

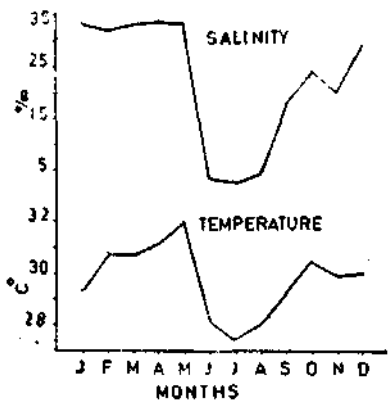

Fig. 1. Temperature and saiinity pattern of Mulky estuary. (1979-82 monthly average).

Dimensional relationships

The relationships can be described by the following equations.

M. casta:

Length-weight relationship:

logW== -3.7333+3.1478log L(r=0.9959,

The parabolic equation is

W=0.000184799 L ^'^'B

Length-height (depth) relationship;

H=-1 7775+0.8025 L (r =• 0.9882)

Length-thickness relationship:

T=-4.3286-f0.S706 L (r= 0.9842)

In the above regression equations, the correlation coefficient is close to 1, showing high degree of correlation between the parameters studied (Fig 2). The length, height, thickness (LHT) of Af, *casta* are in the ratio of 37X28 5X20.5, as compared to 37X32.25X22.75, ^.^^^ ^^^ Cornell (1917) *for Meretrix casta war o^um,* from Mangalore.

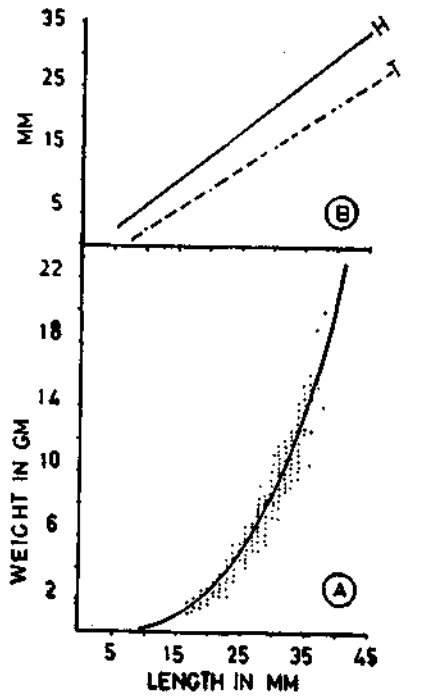

Fig. 2. Lenoth-weight (A) Thiclcnets (T) and Height (H) relationship (B) in *M. casta*

The length-weight relationship of *P.malaba-rica* may be described as

^ W^-3.9121 -h3.2640 log L (r=0.9921)

a

The parabolic equation is

W=0.000122443 L smtt

'" *P malabarica,* the weight increases at a higher rate in relation to length, when compared *to M. casta* (Fig. 3).

^^,

Generally the clams are exploited from about 20 mm length onwards. The modes could be traced only for short intervals of time, a maximum of 35 days. They could not be traced continuously over the whole length

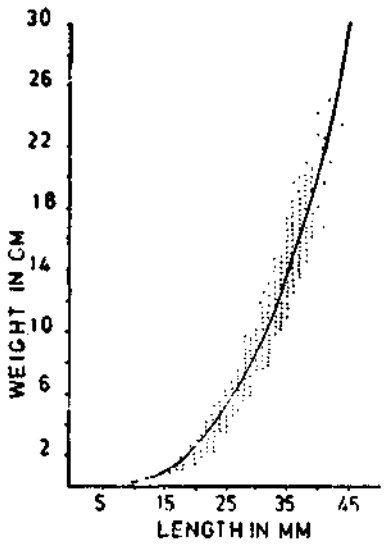

Fig. 3. Length-weight relationship in *P. malabarica*

range of *M. casta* and *P. malabarica*. The Gulland and Holt (1959) method allows age determination by the tracing of growth at short and irregular time intervals. The growth rates derived at different mean lengths are plotted to fit a regression equation by the least square method.

M. casta

Growth rate (Y)=0.2720-0.0051 Length (X) (Fig 4A)

The intercept *a* and sloge *b* provide the values of *K* and $L\infty$ through the relationship

$K = -b = 0.0051$/day

$$L\infty = \frac{a}{k} = 53 \text{ mm}$$

Following Pauly (1983) t_o in the von Bertalanffy growth equation is derived as - 49 days. Hence the von Bertalanffy growth equation for *M. casta* may be written as

$$Lt = 53\,(1-e)^{-0.0051\,(t+49)}$$

According to the above equation *M. casta* attains a length of 36.5 mm in 6 months, 42.6 mm at the end of one year (Fig 4B). It may be mentioned here that according to Abraham (1953) *M. casta* grows to 43 mm in one year in the Adyar estuary. The largest specimen of M. *casta* in this estuary measured 43 mm in length.

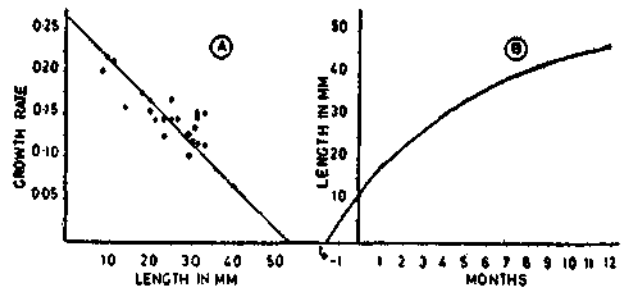

Fig. 4. (A) Regression of growth rates on length and (B) von Bertalanffy growth curve of *M. casta*

P. malabarica

In this species the regression of growth rates on length (Fig 5A) may be described as:

Growth rate (Y) = 0.2343 - 0.0039 Length (X)

The values of growth parameters derived are

$L\infty$ = 59 mm, K = 0.0039/day and t_o - 62 days

The von Bertalanffy growth equation for *P. malabarica* is written as

$$Lt = 59\,(1-e^{-0.0039\,[t+62]})$$

The estimated length of *P. malabarica* are 36.3 mm in 6 months, 43.1 mm in 9 months and 48.1 mm in one year (Fig 5B). The largest specimen of *P. malabarica* recorded in the collections is 51 mm.

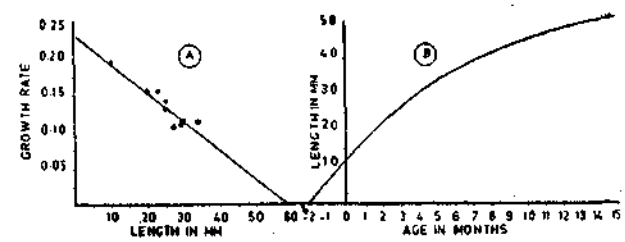

Fig. 5. (A) Regression of growth rates on length and (B) von Bertalanffy growth curve of *P. malabarica*

Maturity and spawning

M. casta: Developing and mature clams were noticed from 15-19 mm group onwards, which may be considered as size at first maturity (17 mm). According to Abraham (1953) the size at first maturity was 11 mm. Mature *M.*

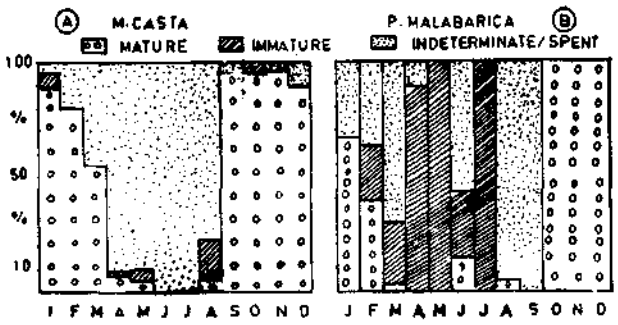

Fig. 6. Dtstribution of mature (A) *M. casta* and (B) *P. malabarica* in the Mulky estuary.

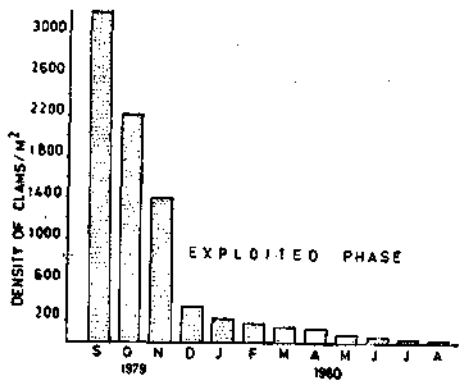

Fig. 7. Changes in the density of clam population in the clam bed *M. (casta)* during course of 12 months.

casta were observed from August to May. Majority of the specimens were in mature condition during September - March period, which may be considered as the spawning season (Fig 6A). Indeterminate clams were available almost througout the year. Although mature clams were available from September to March in appreciable numbers, seed clams were available during September - December and April-May periods only, indicating that major spat settlement takes place only during these two periods. The clams that settle during September-December period contribute to the fishery (Fig 7), whereas those that settle during April - May are subjected to heavy natural mortality during the monsoon.

P. malabarica : Mature gonads were observed in clams measuring 20 mm onwards. Mature *P. malabarica* were abundant from October to February, which can be considered as the spawning season (Fig 6B). Mature specimen were also observed during March, June and August in few numbers. Unlike in *M casta*, immature specimens were available in considerable numbers from April to July. Thus the spawning season of *P. malabarica* is short, when compared to *M casta*.

Sex ratio

The sexes of *M. casta* were almost equally distributed (Table 1) except in August when

TABLE 1. *Sex ratio and Chi-square (X^2) values of M. casta (1979-82 pooled) and P. malabarica 1983-84 pooled)*

	M. casta				*P. malubarica*			
MONTH	Males	Females	Total	Chisquare	Males	Females	Total	Chisquare
Jan	100	98	198	0.02	26	24	50	0.08
Feb	88	72	160	1.60	32	16	48	5.33*
Mar	73	54	127	2.84	19	10	29	2.79
Apr	6	10	16	1.00	35	32	67	0.13
May	13	15	28	1.14	29	21	50	1.28
Jun	1	4	5	1.80	64	11	75	37.45*
Jul	—	—	—	—	62	13	75	32.00*
Aug	56	27	83	10.13*	4	—	4	4.00*
Sep	92	101	193	0.42	—	—	—	—
Oct	76	79	155	0.05	10	15	25	1.67
Nov	54	62	116	0.55	9	16	25	1.96
Dec	51	49	100	0.04	10	15	25	1.00

* Significant at 5 °/₀₀

there was a significant male dominance. In other months the X^2 values showed no significant deviation from the expected male to female ratio of 1:1. In *P. malabarica* there was male dominance during February, June, July and August months (Table 1) which is significant. The sex ratio in relation to length showed that at 30 mm and beyond, females out-numbered males in *M. casta*.

Condition Index

The condition index of *M. casta* ranged from 8.4 in May to 16.0 in September (Fig 8A). There was a trough during April–June, when most of the clams were in spent or indeterminate condition. The index was high during September-December. Coinciding with spawning activity. The pea crab (*Pinnotheres* sp) infestation was at its peak (65 to 100%) during April-June (Fig 8A), indicating that high pea crab infestation may also be a probable reason for the low condition index obtained in *M. casta*. In *P. malabarica*, the condition index (Fig 8B) ranged from 11.8 in May to 14.3 in February. It began to increase in October through February, coinciding with the major spawning period. Then it showed a decline till May. Again there was a small peak in the index in June, which coincides with a minor spawning.

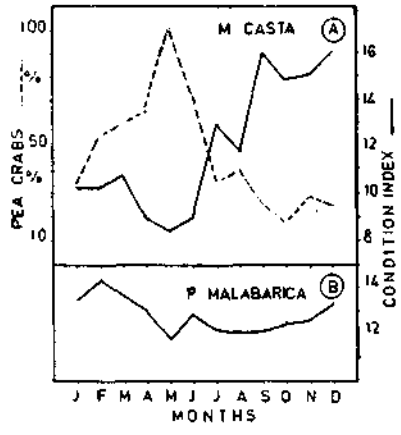

Fig 8. (A) Condition Index and infestation of Pea-crabs in *M. casta* (B) condition index in *P. malabarica*

Rings on shell

Rings varying in number from 1 to 4 occurred on the shells of *M. casta*. These rings are generally in the form of thin grooves in the antero-posterior direction. The rings are variously termed as disturbance rings (Orton 1927), growth rings (Rao 1951) etc. The smallest clam in which ring was observed measured 9 mm in length. Single ring was found at a length range of 9-32 mm (mean 20.7 mm). The second ring occurred at lengths 15-36 mm (mean 27.8 mm), third ring at lengths of 24-41 mm (mean 34.0 mm) and the fourth ring at lengths of 32.41 mm (mean 36 2 mm). (Fig 9)

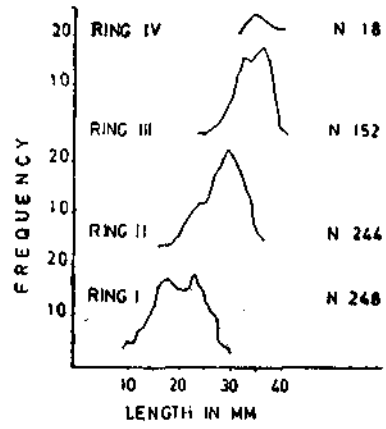

Fig 9. Distribution of rings on the shells of *M. casta* (n = number measured)

It was also observed that the ring formation was not confined to any particular month or season. Also these rings could not be related to any particular age units. They appear to indicate some physiological changes in the clam, like reproductive activity. It is of interest to note that the mean length for the formation of first ring is closer to the size at first maturity.

DISCUSSION

According to Hornell (1917) *Meretrix casta* found in the estuaries of west coast are similar to those occurring on the west coast of Malay Peninsula. On both these coasts the rainy season is prolonged and rainfall is heavy compared to the east coast of India. West coast *M. casta* have shown morphometric adaptations such as the more pointed out line of the posterior angle of the shell etc. They have been elevated to a species viz., *Meretrix ovum* (Hanley). However, Hornell (1917) opined that the differences between the east coast

and the west coast specimens of *M. casta* are insufficient to warrant separation as a distinct species, but advocated to consider it as a variety, namely *Meretrix casta* var *ovum* (Hanley). The length, height and depth (LHD) proportions given by Hornell (1917) and those obtained in this study show that, in the present case the body is more linear and streamlined. Hence the growth in length may be rapid.

According to Rao and Rao (1960) *M. casta,* measuring 17 mm and 24 mm, transplanted in a fish farm in the iVlulky estuary, reached 32mm, and 36 mm respectively in 4 months. These growth rates are almost similar to the results obtained in this study. The growth rates obtained in the present study in *M. casta* are faster than those given by Abraham (1953), Durve (1970) and Sreenivasan (1983). Such disparity in the growth rates may be due to the differences in the envitonmental conditions.

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