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P. B. No. 2704, E. R. G. Road, Cochin-682 031, India

25. FISHERY AND THE POPULATION DYNAMICS OF THE BLOOD CLAM *ANADARA GRANOSA* (LINNAEUS) IN THE KAKINADA BAY

K. A. Narasimham
Central Marine Fisheries Research Institute, Cochin - 682 031

ABSTRACT

The blood clam, *Anadara gtanosa* is fished throughout the year in the Kaklnada Bay by fishermen residing in 15 villages. During 1978-81. at Yatlmoga Kakinada) the blood clam catch, effort and catch per unit effort varied from 104 to 222 t, 3414 to 6295 man-days and 30.4 to 35.3 kg/man day respectively. The instantaneous rates of total (Z), natural (M) and fishing (F) mortality rates are estimated at 3.9,1.3 and 2 6 respectively- In the presently exploited population, other parameters estiinated are the age at recruitment (tr) = 0.29 yr, age at first capture [to] = 1-0 yr and the maximum age [ta] = 5.62 yr. At present the yield in weight per recruit [Yw/R] is about 9-5 g; It Increases with increase In F and it is less for greater values of tc. It is suggested that at the current level of F, maximum Yw/R value of 10 42 g is possible if tc is reduced to 0.6 yr.

INTRODUCTION

The blood clam is second in importance among a dozen species of molluscs fished in the Kakinada Bay. While a general account on these fisheries is available (Narasimham 1973) there is no information on the population dynamics of this clam. Hence the present work was taken up.

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MATERIAL AND METHODS

Out of 15 landing centres, Yetimoga was selected because of year round fishing at this centre and its proximity to the fishing ground enables the fishermen to return daily to the village with catch. Further, since the fishing ground and the fishing method are the same at all these Centres, the trends at Yetimoga can be taken as representing the catch trends at other centres. During 1978-81 weekly observations were made at this centre On each observation day, the catch of *A. granosa* and the effort expended were recorded. Men. women and children pick the clams by hand. As the clams burrow in the soft muddy substratum they are not visible to the eye and selection is not exercised when catching them. The effort was standardised in terms of man-days which is the average effort put in by a man to catch the molluscs during a single low tide The efficiency factors of a woman and child were estimated at 0.64 and 2.28 respecti- ^^.^ Q^ ^^^ observation day, a random sample ^^ ^^3 ,^g ^^ ^,3^5 ^^^ measured for length to ^^^ ^^^^^^^ ^^ 3^^ ^^,3 g^^pl^ ^^.g^, recorded ^^ ^^^ ^^g^^g, ^ ^^^^^^^ ^^^ ^^^^3, estimates ^^ ^^^^^^ gfj^^t and length frequency were obtained from the data collected on the obser- vatlondays.

The total mortality rate (Z) was estimated by the methods of Beverton and Holt (1955), Jones and van Zaiinge (1981) and Pauly (1983). The natural mortality rate (M) was estimated by the Beverton and Holt (1957) method. The regression coefficient in the length-weight relationship of *A. granosa* in the Kakinada Bay is 2.6212 (Narasimham 1985) and it was found to be significantly different from 3. Hence the yield in weight per recruit was calculated by the Beverton - Holt (1957) model as modified by Jones (1957).

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A. granosa is exploited in 46.6 sq. km area in the southern and western sides of the bay where the maximum depth is 1.8 m at low tide.

At Yetimoga, in 1978 a total of 103.9 t of blood clam were landed by expending 3414 man-days which gave an average of 30.4 kg/ man-day. The monthly catches varied from 0.9t in January to 18.0 tin September (Fig 1). Apart from September, another peak in the catches was observed in March. The catch per unit effort (c. p. u. e.) varied from 14.7 kg in January to 40.4 kg in July.

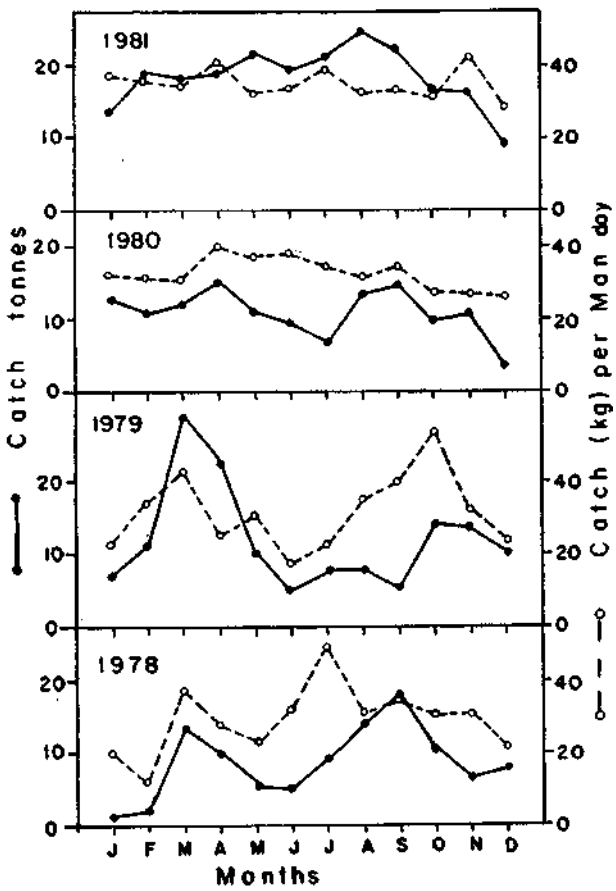

Fig 1. Monthly catches and catch rates of *A. granosa* during l978-81at Yetimoga.

In^^l979 there was an increase in the total catch (144.7 t) and effort (4715 man-days) when compared to the previous year but the c. p. u. e. at 30.7 kg hardly showed any variation. The monthly landings varied from 5.1 tin June to 29 t in March (Fig 1). The catches were considerably high in March-April and October-November. The c. p. u. e. was low at 17 kg in June and reached a maximum of 53.7 kg in October.

Compared to the previous year, in 1980, there was a slight decline both in the total catch (129.6 t) and effort (4C02 man days) while a slightly higher catch rate of 32.4 kg was recorded. The monthly catch (Fig 1) varied from 3.7 t in December to 15.2 t in April, The catches were high in April and again in August-September. The c. p. u. e. ranged from 27.2 kg in December to 39.8 kg in April.

Substantial increases in the catch (221.91), effort (62£5 man-days) and c. p. u. e. (35.3 kg) were observed in 1931. The monthly catches varied from 8.9 t in December to 24.91 in August (Fig 1). The catches were high in all the months except in December and January The c. p. u. e. fluctuated [between 29.3 kg in December and 43.9 kg in November.

The data, pooled for the 4 years, showed heavy catches in IVlarch-April, slight fall in May-July, good catches in August - September and a trough in December - January.

POPULATION DYNAMICS

The length range of the catch during the 4 years was 15.0-71.2 mm (Fig 2).

Growth parameters The parameters of the von Bertalanffy equation for growth in length in *A granosa* from the Kakinada Bay were estimated as Lcc =. 73.4 mm, K =. 0.5816 (on annual basis) and to = -0.4088 year (Narasimham 1985).

Estimation of total mortality (Z) rate

a. *Beverton and Holt method* The length at first capture (Lc) was taken as 41 mm since it was observed that this is the smallest length that is fully represented in the catches during three years (Fig 2), The mean length was calculated as 45.5 mm in 1978, 45.0 mm in 1979,45.4 mm in 1980 and 45.0 mm in 1981. From these values, Z was estimated at 3.60 in 1978, 4.13 in 1979, 3.70 in 1980 and 4.13 in 1981 (Table 1). The average for the 4 years was 3.89.

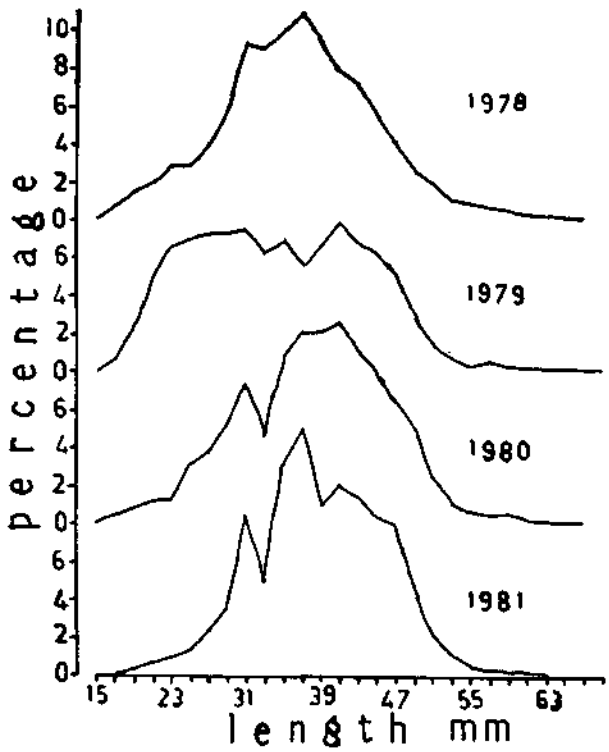

Fig 2. Annual length-frequency distribution of *A granosa* during 1978-81.

TABLE 1. Estimates of Z by different methods in A. granosa.

Year	Beverton and Holt	Jones and van Zalinge	Pauly's	Average
1978	3.60	2.99	2.95	3.18
1979	4.13	3.12	5.60	4.28
1980	3.70	2.96	3.63	3.43
1981	4.13	4.65	5.49	4.76
Average	4.89	3 43	4.42	3.91

b. *Jones and von Zalinge method* In 1978, Z was estimated at 2.99, in 1979 at 3.12, in 1980 at 2.96 and in 1981 at 4.65 (Fig. 3) with an average of 3.43.

c. *Pauly's method* During 1978-81, Z was estimated at 2.95, 5.60, 3.63 and 5.41 respectively (Fig 4) with an average of 4.02.

The Z estimates by different methods (Table 1) show that the results are comparable. The average Z for 1978-81 was estimated at 3.91.

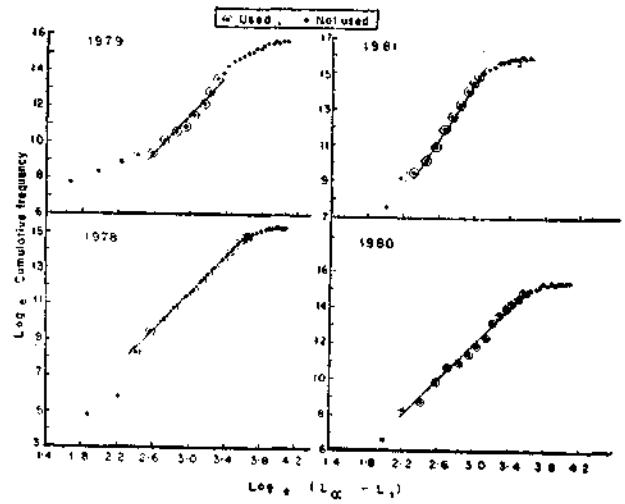

Fig 3. Estimation of Z in *A. granosa* during different years by the method of Jones and von Zalinge.

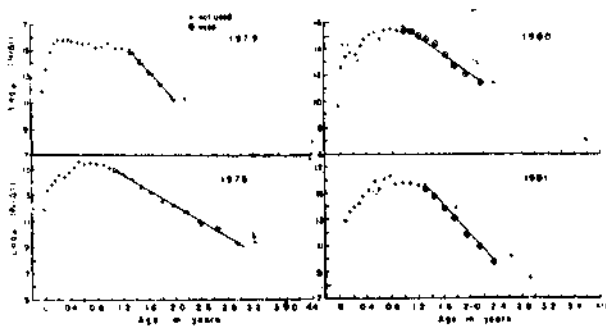

Fig 4. Estimation Z in *A. granosa* during different years by the catch curve method of Pauly.

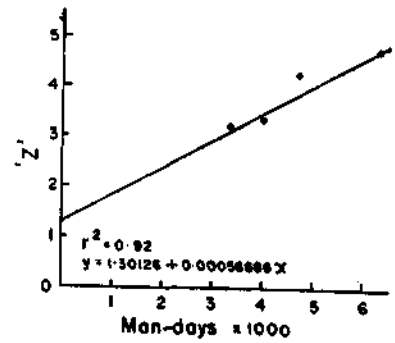

Fig 5. Plot of coefficients of total mortality in different syears against the corresponding effort in *A. granosa*.

Estimation of M andF The regression of the annual average Z (Table 1) against the corresponding effort for the 4 years (Fig 5) is described by the equation

Y^ 1.30126 +0.000566859 X

where Y - Z, X = effort in man-days and M = 1.30126 or 1.3.

Yield per recruit in weight The value of Woo ..,«„ «^»:.v,«*«j *iinc u*r- l j.u was estimated at 119.5 g by taking Leo and the length-weight relationship of the species The smallest length in the catch was 1 5 mm and this was taken as length at recruitment (Lr) whose age (tr)' was estimated as 0.29 yr. The length at first capture was 41 mm and the age at first capture '(to) was estimated as 1 yr. The largest clam in the catch measured 71.2 mm and the maximum age (ta) was estimated as 5.62 years.

The yield in weight per recruit (Yw/R) against F, keeping M constant at 1.3 and considering three values of tc at 0.75, 1.00 and 1.25 years, show (Fig 6 A) t at Yw/R increases with increased F, without showing a fall. It is also observed that Yw/R is less for greater values of tc- Under the current values of F and tc (2.6 and 1.0 year respeciively) the yield per recruit is about 9.5 g and the same is about 10^3 g v.ith the same t. and with F at 5.1^ It IS thus clear that any increase in F (i. e. fishing etfort) would give only marginal increase in the yield which may not be remunerative, though the same does not affect the stock adversely.

Yie d in weight per recruit against toby , . . . ,^ , "^""P'^^ ^ '"^ ^ "°"'^'"* ^' '^^ """'«"» '«^«' ^ ^ ° ^ ' '^^'^ ^ ^^ ^^'^ maximum yield of 10.42 g is obtained vvhen tc is 0.6 yr. Hence reduction of tc from the present one year to 0 6 year would give maximum yield under the current fishing mortality rate,

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Broom (1983) estimated the average instantaneous rate of total mortality (Z) as 1.88 j„ ^^^ ^aj^^^^, ^^^ two artificially seeded populations of *A. granosa* in Malaysia. The two components of this mortality were not estimated ^y him. This value is considerably lower than j^^^ ^glue of 3.9 obtained in this study.

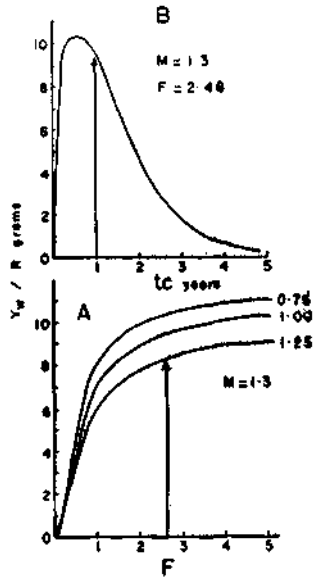

Fig 6. Yield per recruit (Y„/R) of *A. granosa.* **A. As a function of Fishing mortality rate (F;. Numerals** are the values of age in years at first capture. Vertical line represents the current F. B. As a function of age **at first capture. Vertical line** repiesents the current tc.

It was shown that at present the age at first capture is one year (Lc = 41 mm) and a reduction to 06 yr (Lc = 32.6 mm) would give maximum yield per recruit. The length at first maturity in/4. firz-anosa is 20 mm in males and 24 mm in females (Narasimham 1985). Therefore reduction of tc from one year to 0.6 yr would ensure that the clams would spawn at least once before they are fully recruited to the fishery and hence there will not be any problem of recruitment overfishing at some higher level of etfort.

The total stock of *A. granosa* in the clam bed in the Kakinada Bay during March-April 1983 was estimated at about 6000 t (Narasimham *et. at.* 1984) and the actual landings at 2000/ year (Silas *et. al.* 1982). This suggests that there is considerable scope to step up production collecting the clams by hand (which [jp^j^g ^^e catching efficiency) and the low market demand for the clam meat insulate against over fishing. However, any change in the pattern of fishing such as the introduction ^f *dtedge* or Other mechanical gear is likely to affect the stock adversely.

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