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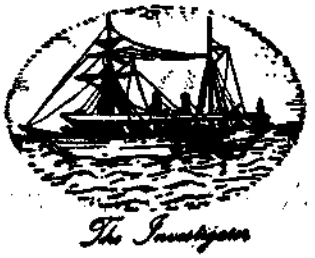

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EXPERIMENTAL CULTURE OF THE BLOOD CLAM *ANADARA GRANOSA* (LINNAEUAS) IN KAKINADA BAY

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ABSTRACT

On an experimental basis the culture of blood clam *Anadara granosa* was taken up in the Kakinada Bay. Three pens made of split bamboo screens, each measuring 100 m², were stocked with clams of 25.1, 23.4 and 24.3 mm mean size at the rate of 3,000, 7,000 and 14,000 per pen respectively in May 1979. In order to determine the optimum stocking density 6 dealwood cases were filled with mud upto 10 cm depth and were stocked with clams at the rate of 40 to 240/m². The results of these studies together with the environmental data are given in this paper.

INTRODUCTION

MEMBERS of *Anadara* Gray (Fam : Arcidae) are popularly called blood clams, ark shells and cockles—the last name because of their superficial resemblance to the European cockle *Cardium*. In a number of Southeast Asian countries *A. granosa* (Linnaeus) is fished and utilised as food. It is cultured in China, Japan, the Philippines, Thailand, Indonesia and Malaysia (Pathansali and Soong, 1958, Bardach *et al.*, 1972; Chen, 1976). Along the Indian Coast, *A. granosa* forms a fishery of some magnitude in the Kakinada Bay where an estimated 1,000 tonnes are landed annually (Narasimham, 1973). *A. granosa* was experimentally cultured in the Kakinada Bay and the results are given in this paper.

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PHYSIOGRAPHY OF THE FARM SITE

The site selected for the farm is in the Kakinada Bay and is contiguous with the natural clam bed. It is about 300 m from the shore, north of Yetimoga and is sparsely populated by the clam. The bottom is muddy with 64% clay, 25% silt and 8% made of sand and dead shells. The farm site is in the subtidal region where the minimum depth of water at the low tide is 25 cm.

Monthly average values of temperature, salinity and dissolved oxygen from May to December 1979 are given in Fig. 1. In May 1979 the temperature was 33.5°C and after a gradual fall to 28.9°C in August there was a slight increase to 30.4°C in October and it touched the lowest value, 27.8°C in December. The salinity was high in May (33.66‰) and June (34.40‰). With the onset of southwest monsoon there was gradual fall in salinity until October when it reached (22.29‰). During 1979 southwest monsoon failed and hence the high salinity in June-September. In November it went down to 13.69‰. There was a slight increase to 15.30‰ in December. The

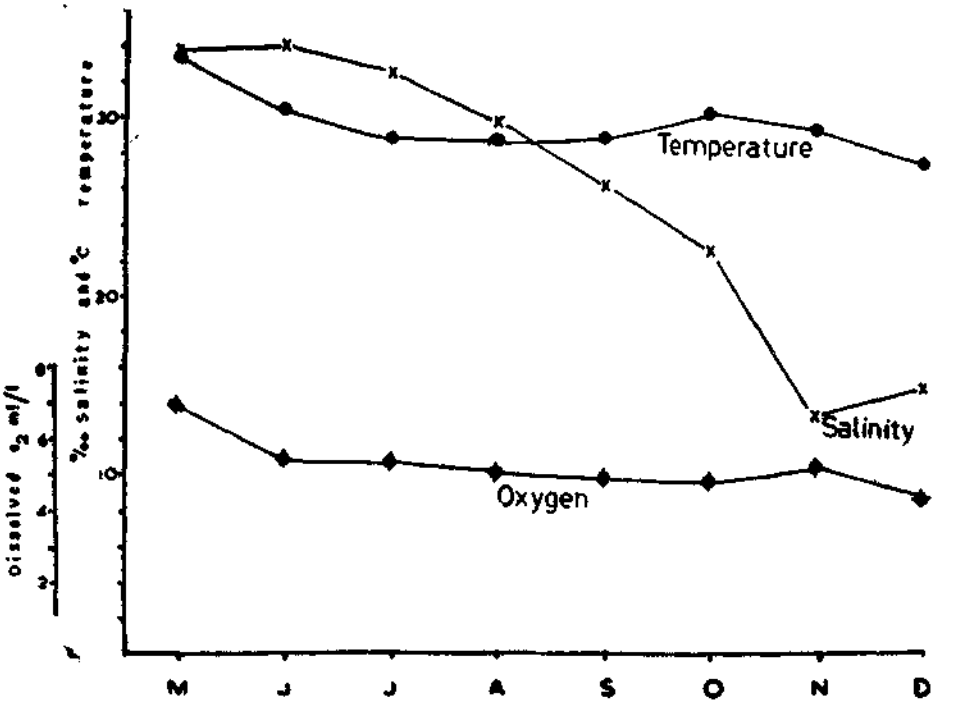

FIG. 1. Average monthly temperature, salinity and dissolved oxygen at the farm site.

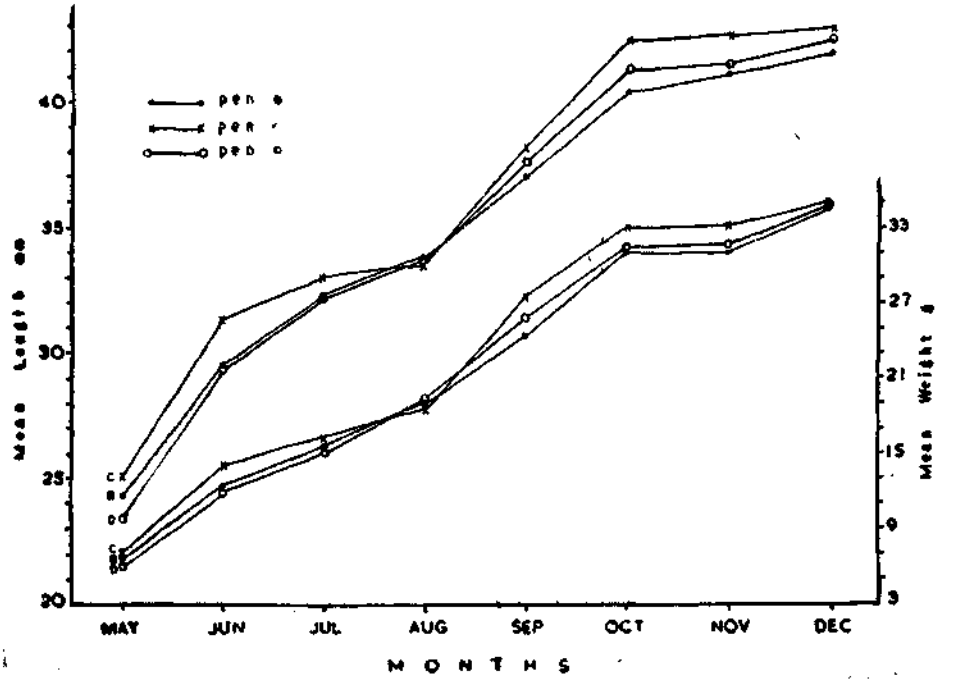

FIG. 2. Growth of *A. granosa* in length and weight in pens.

low salinity values in November and December were due to the northeast monsoon when a cyclonic storm hit the coast in the last week of November 1979. Generally the values of dissolved oxygen were high and from a high value of 7.0 ml/l in May1979 it showed a fall upto October (4.98 ml/l). In November it increased to 5.45 ml/l and touched 4.45 ml/l in December. The primary productivity was estimated by the dark and light bottle experiments conducted at fortnightly intervals during July-December (Table 1).

TABLE 1. *Average primary productivity of the waters at farm site*

Month	Gross production mg C/litre/day	Net production mg C/litre/day
July '79	0.2916	0.2144
August '79	0.3602	0.1672
September '79	0.5275	0.1544
October '79	0.3109	0.1201
November '79	0.2413	0.0886
December '79	0.4202	0.2401

CULTURE EXPERIMENTS

Clams were cultured in pens and in dealwood boxes during May 1979 to December 1979. Split bamboo screens, interlaced with hemp twine were used in constructing pens. Each screen measured 5 m long, 0.3 m high and interspaced with 6 numbers of 1 m long bamboo sticks which are driven upto 0.75 m into the mud to hold the screen vertically. Three pens, each measuring 100 m, were erected. Also an experiment on the off bottom culture in nylon mesh cages, suspended from a raft off Vakalapudi was conducted during May 1978 to October 1978.

Pen culture

The details of stocking of *A. granosa* in pens designated C, D and B are given in Table 2. The growth in mean length and mean weight of the clams in the three pens showed the same pattern (Fig. 2). The clams grew to 40.6 to 42.7 mm mean length and 31.1 to 33.0 g mean weight by October (Table 2). By December, they attained a mean length of 42.3 to 43.4 mm and a mean weight of 34.6 to 35.8 g. In spite of varying stocking densities, the growth in different pens was similar. The average growth during the culture experiment was 2.6 to 2.8 mm/month. It was fast in June-July and September-October and slow in August and November-December periods (Fig. 2). While the slow growth in August could not be related to the environmental parameters studied, that in November and December coincided with reduced salinity (Fig. 1). Similar retardation of growth during the period of low salinity was observed by Rao (1952) and Rao *et al.* (1962) in the bivalves studied by them.

Production

The clams were harvested by hand-picking at low tide on 23rd and 24th October 1979 (harvest 1, Table 2). Pen C with a stocking density of 3,000 clams, gave a production of 89.35 kg/100 m^2 with a survival rate of 90.3%. A production of 183.2 kg/100 m^2 was obtained in pen D, stocked with 7,000 clams and the survival was 84.0%. Pen B was stocked with 14,000 clams and the yield obtained was 385.3 kg/100 m^2 with a survival of 88.6%. Obviously the disparity in the survival rate in the pens is narrow and pen B with maximum stocking density gave the highest yield.

All clams harvested in October were restocked on the same dates in the respective pens to study their further survival and production at the end of the North-east monsoon. The clams were finally harvested on 20-21 December 1979 (harvest 2, Table 2). For the 7 month period the production in pen C was 84 kg with a survival of 79.5/, in pen D 167 kg with a survival of 66.7% and in pen B 357 kg against a survival of 73.8%. It may be seen that the extension of the culture period by 2 months

resulted in lower survival and production. In the last week of November 1979 a severe cyclonic storm hit the Andhra Coast and the bamboo screens of the farm, already weakened due to submersion for 6 months were damaged and had to be replaced.

The results show that culture of *A. granosa* for a 5 month period during May-October is advantageous when compared with the extended culture upto December.

Biology of cultured clams

The index of condition (% meat weight in total weight) was studied in the cultured clams and also from the natural bed for comparison. In September the average index of condition of clams in the pens varied from 22.2 to 24.0 and in the natural bed a comparable value of 23.1 was noticed (Table 3). In October-December the index for the cultured clams was invariably higher when compared with the condition obtained in the wild population.

TABLE 2. *Stocking and harvesting particulars of* A. granosa

Stocking	Pen C	Pen D	Pen B
Area of pen (sq. m)	.. 100	100	100
Date	.. 24.5.79	21 & 24.5.79	23 & 24.5.79
Numbers stocked	.. 3000	7000	14000
Size range in mm (mean)	.. 19-29 (25.1)	19-29 (23.4)	19-29 (24.3)
Total weight kg	.. 21	43.5	94
Mean weight (gm)	.. 7.0	6.2	6.7
Harvest 1			
Date	.. 24.10.79	24.10.79	23.10.79
Size range in mm (mean)	.. 36-52 (42.7)	34-50 (41.5)	34-49 (40.6)
Mean weight (gm)	.. 32.97	31.14	31.06
Estimated numbers	.. 2710	5883	12406
Survival rate (%)	.. 90.3	84.0	88.6
Production for 5 months (kg/100 m^2)	.. 89.35	183.2	385.3
Harvest II			
Date	.. 21.10.79	21.10.79	20.12.79
Size range in mm (mean)	.. 35-53 (43.4)	35-51 (42.8)	33-52 (42.3)
Mean weight (gm)	.. 35.20	35.79	34.57
Estimated numbers	.. 2386	4666	10327
Survival rate (%)	.. 79.5	66.7	73.8
Production for 7 months (kg/100 m^2)	.. 84	167	357

TABLE 3. *Average index of condition (meat wt. as % of total weight) in clams from the farm area and natural bed*

Month	Pen C	Pen D	Pen B	Natural bed
September '79	22.2	24.0	22.5	23.1
October '79	21.1	20.6	20.1	17.5
November '79	19.0	18.7	19.7	16.0
December '79	16.6	17.2	16.6	15.0

During September-October over 88% of clams from pens were in active stage of gametogenesis and none in spawning condition. By November spawning commenced in 30% of clams and by December, 65% were in spawning condition. In September a vast majority (98%) of clams from the natural bed were in resting stage with considerable phagocytic activity. In October 80% were in active stage. In November 18% and in December 80% were in spawning condition. The reproductive cycle in both the cultured and wild clams showed the same general sequence of events with considerable spawning activity in November-December period.

Box culture

Six wooden boxes, each measuring 0.25 m^2, were filled with mud obtained from the clam bed, upto 10 cm depth and stocked with clams on 23.5.1979. The clams were stocked in multiples of 10, the first box having 10 and the last box 60 clams. The clams varied in size from 19-25 mm with the mean length in different boxes varying from 21.6 to 22.4 mm and mean weight 5.0 to 6.5 g. Each box was covered with nylon netting (1 cm mesh), nailed with 1 m long bamboo sticks on 4 sides and these were driven into the mud close to the pens. Every month, during the last week, all the clams were measured and total weight obtained from each box; also the mud in the box was changed. In boxes 2, 3 and 6 a total of 34 clams died during the 7 month experiment period and on a number of occasions crabs were found in these boxes.

By October the clams had grown to a mean length of 39.5 to 40.7 mm (mean weight 25.5 to 28.7 g) and by December they attained a mean length of 41.0 to 42.4 mm (mean weight 27.7 to 30.2 g) in different boxes. The mean length of the clams from all boxes was within 1 standard deviation on either side of the mean of any particular box in a given month indicating that the growth of the clams in different boxes, stocked with varying densities, is not significantly different. The average growth for the experiment period worked to 2.7 to 3.0 mm/month which compares favourably with the 2.6 to 2.8 mm/month observed in the pens. The clams had grown fast during June-July and September-October period and growth was slow in August and November-December period, a condition identical to the one observed in the pens.

Off bottom culture

A total of 56 cages with nylon yarn meshes around 0.5 m diameter metal rings were suspended in tiers from a raft moored in 5 m depth off Vakalapudi light house (10 km north of the pen site). Stocking was done during March-May 1978 and the density per cage (area 0.2 m^2) varied from 9-396 clams. Observations showed near cessation of growth and very heavy mortality, varying from 70.7 to 100% and the experiment was abandoned in October 1978. The condition of the clams was also poor compared to the condition of natural bed population. However, 19 clams of mean length 25.5 mm stocked in a metal box filled with mud upto 10 cm depth and suspended in a cage from the same raft showed a growth of 2 mm/month. This experiment indicated that *A. granosa* does not thrive when suspended in the water column in metal ring cages without muddy substratum.

Remarks

There is scope for blood clam culture in the Kakinada Bay where there are extensive mud flats spread over several hundred hectares. *A. granosa* thrives and grows rapidly in intertidal flats of soft mud containing upto 90% silt and very few shellfish grow in such an environment. The present study has clearly demonstrated that a very high production of the blood clams per unit area can be obtained by simple transplantation of seed clams to sparsely populated areas which are suitable for growth. As *A. granosa* is cultured elsewhere without any enclosures, the pens can be dispensed, once the culture is undertaken in large areas. The growth rate in the pen is faster, compared to that obtained in Malaysia (Narasimham, 1968) or Taiwan. This would help to harvest the clams much earlier, thus reducing the culture period and production cost. Growth of *A. granosa* in dealwood boxes at densities of 40 to 240/m^2 did not reveal any significant difference in the growth. In Malayasia a final density of 300 to 600/m^2 is achieved after thinning. There is need to determine the stocking density for obtaining optimum growth and production in the Kakinada Bay.

References

Bardach, J. E., J. H. Ryther and W. O. McLarney 1972. *Aquaculture*. John Wiley and Sons, Inc ; 868 pp.

Chen, T. P. 1976. *Aquaculture practices in Taiwan*. Page Bras (Norwick) Ltd. 162 pp.

Narasimham, K. A. 1968. Studies on some aspects of biology and fishery of the cockle *Anadara granosa* (Linnaeus) from Kakinada Bay. *Proc. Symp. Mollusca*. Marine Biological Association of India, **2** : 407-417.

——— 1973. On the Molluscan fisheries of the Kakinada Bay. *Indian J. Fish.*, **20** (1) : 209-214.

Pathansali, D. and M. K. Soong 1958. Some aspects of cockle (*Anadara granosa* L.) culture in Malaysia. *Proc. Indo-Pacific Fish. Coun.*, **8** (2) : 26-31.

Rao, K. V. 1952. Studies on the growth of *Katelysia opima* (Gmelin). *Ibid.*, Sec. II : 94-102.

———, K. A. Narasimham and K. Alagaraswami 1962. A preliminary account of the biology and fishery of the Razor-shell *Solen kempi* Preston from Ratnagiri in Maharastra State. *Indian J. Fish.*, **9** (2) : 542-579.