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A CULTURE EXPERIMENT ON THE CRAB *SCYLLA SERRATA* (FORSKAL) AT TUTICORIN DURING 1975-77 TO ASSESS GROWTH AND PRODUCTION

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ABSTRACT

The green crab *Scylla serrata* is commercially the most valuable in India, with great potentialities for large-scale culture operations. In fact, experiments are being carried out in some southeast Asian countries for evolving a technique suitable for the pond culture of this burrowing and cannibalistic species. The present paper gives an account of an experiment undertaken at Veppalodai, Tuticorin during 1975-77, by rearing in individual plastic cages, for ascertaining their survival, growth and production with artificial food supplied. The results obtained from this exercise are highly encouraging with regard to survival, growth, production, etc. The present paper deals with the above work and the results obtained, along with suggestions for evolving a culture technique for pond culture of this species.

INTRODUCTION

THE GREEN CRAB *Scylla serrata* is widely distributed in the Indo-Pacific region and among the crabs occurring in the coastal waters of India, both in the seas and estuaries, it is the most highly valued species commercially. Rai (1933), Hora (1935), Chopra (1939), Jones and Sujansingani (1952), Chhapgar (1962), Thomas (1972), Datta (1973) and Rao *et al.* (1973) have dealt with the fisheries of this species in different parts of the suboontinent. In view of its euryhaline nature, capacity to live outside water for a few hours, feeding on a variety of cheap animal food such as trash fish, butcher's waste, etc. quick growth rate and increasing market demand, it is considered as one of the most suitable marine resources for coastal aquaculture operations. Realizing the potentialities for its culture, attempts are being made in the Indo-Pacific region for commercial culture and propagation of this species (Escritor, 1972; Pagcatipunan, 1972; Varikul *et al.*, 1972; Grino, 1977; Lavina, 1977). In India also, as an integral part of the mariculture programme of the Central Marine Fisheries Research Institute, an experiment was undertaken during 1975-77 in the salt pan areas at Veppalaodai near Tuticorin, for assessing growth, production and possibilities of its culture; and the results obtained in the experiment are recounted in the present paper.

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METHOD OF CULTURE

A pond measuring 22.75 × 12.25 m in area (Pl. 1 A) at the marine fish farm in the salt pan areas at Veppalodai, about 25 km north

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of Tuticorin was selected. Nair *et al.* (1975) have given an account of the salt pan areas at Veppalodai and Bensam and Marichamy (unpublished) have dealt with the lay-out of the fish farm constructed there, mode of water supply to the ponds and the general hydrobiological conditions in the farm site.

The depth of the pond ranged from 50 cm to 70 cm. As this species has the capacity to live out of water for appreciably long periods during which they are likely to move out of the culture pond by burrowing through or crossing over the earthern bunds and as they are cannibalistic in habit, it was decided to rear the crabs in individual plastic cages in the pond. The cages selected from various types available in the market were circular, 24 cm in diameter, 12 cm in height and provided with a lid each. Except at the bottom they were perforated, each perforation of 5 × 5 mm in extent along the sides and 2 × 3 to 5 × 10 mm on the lid. The interspace between perforations were about 3 to 5 mm in width. Each crab was placed inside a cage and the lid was fastened tightly to the cage through the perforations with the aid of synthetic twines at first. However, it was soon found out that a few crabs have cut the twines within a few days and managed to open the cage and make good their escape. In view of this, galvanized iron wires were used instead of synthetic twines and the crabs were not able to cut them. The culture area for each crab thus cultured worked out to be 625 sq. cm and the stocking rate was 1,60,000 caged crabs per hectare.

The cages with crabs inside were placed at the clayey substratum of the pond and in order to prevent the cages being moved away and displaced by wind and flow of water, they were held in position by vertical ropes which were fastened to a horizontal line fixed across the pond and attached to two poles planted at opposite sides (Pl. I B). The seeds of *S. serrata* were collected from crab holes in and around Veppalodai itself and most of the seeds obtained were without one or both of the chelipeds which were broken invariably in the process of capturing the crabs. In the beginning stages of stocking some crabs stocked with both chelipeds intact were found to have destroyed the cages partially, obviously with the aid of their chelipeds and in a few cases they have made good their escape. In order to prevent this, the movable segment of the cheliped was amputated with a pair of scissors before stocking the crabs ; and this has successfully served to prevent the crabs from damaging the cages. Before stocking, all the crabs were measured for their carapace width, length and weight. They were fed with pieces of trash fish, clam meat, sea-weeds, etc. collected at Veppalodai, by introducing the food through perforations of the cage. The crabs were watched (Plate I C) every day for moulting, particularly around new moon and full moon days when the frequency of moulting is higher than the intervening days ; and in cases of moults, the crabs were measured and weighed soon afterwards.

Mortality and Survival

In the course of July 1975 to June 1977, 165 *S. serrata* were cultured in individual plastic cages at Veppalodai. Among these, eight crabs escaped during 1976 by damaging the culture cages and breaking the synthetic twines fastening the lid with the cage. Apart from this, 49 crabs died during 1976 and 27 in 1977. Of these mortalities, 7 crabs in each year were killed as a result of pumping high saline (100-140 ‰) water by Veppalodai Salt Corporation for supplying saline water for their salt industry. During 1976, four crabs died due to infestation of amphipods, invading and consuming the internal organs. As amphipods were found to establish easy access to the culture stock placed at the pond bottom, it was decided to keep the cages partly submerged in water by lifting them off and keeping in a suspended condition. This method as well as regular examination and

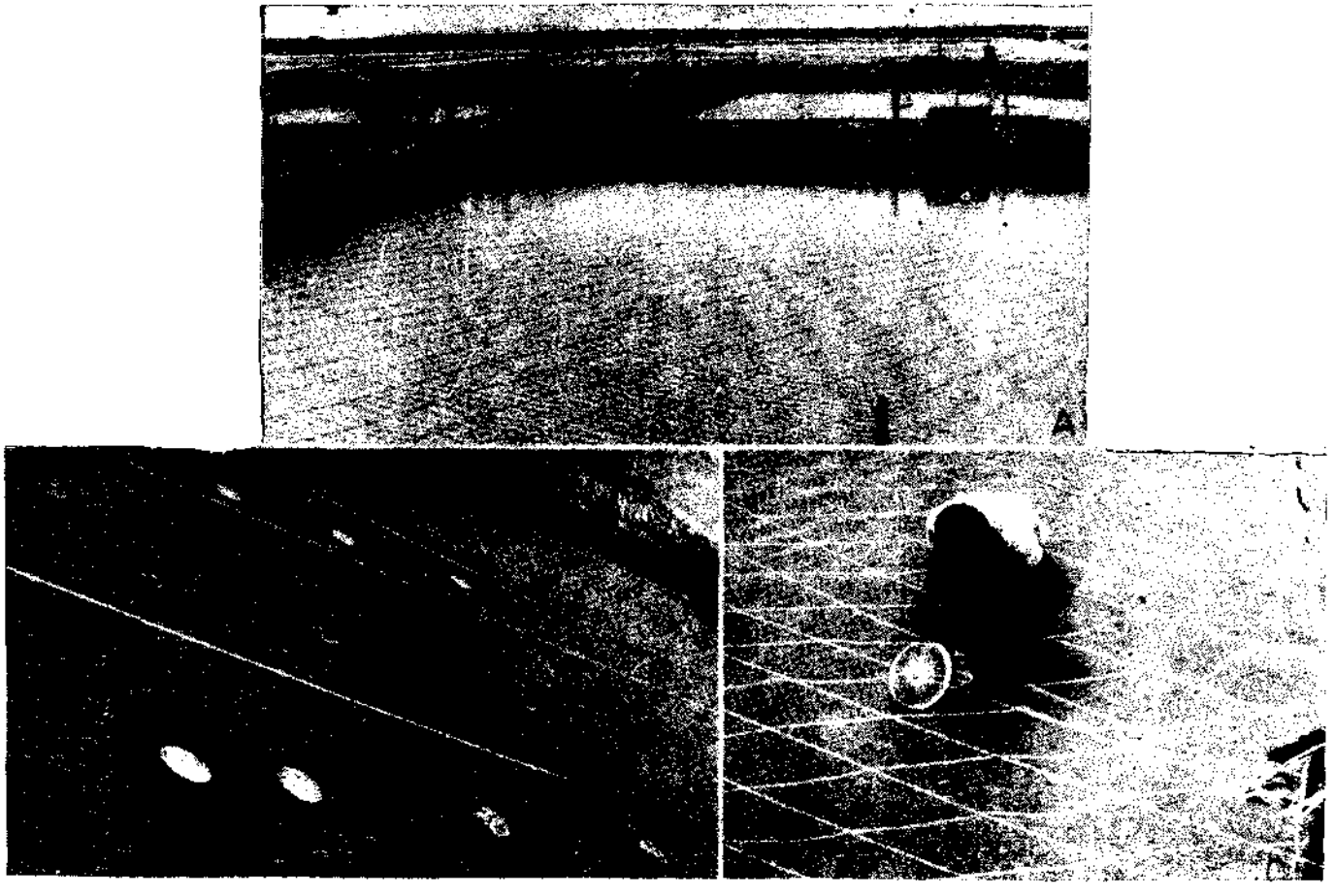

PLATE I. A. Marine fish farm at Veppalodai, Tuticorin, B. cages with *Scylla serrata* suspended in pond water and C. examination of cultured crab in the cage for moulting.

cleaning the crabs with a brush have served to reduce the mortality of the stock due to infestation of amphipods.

In addition to mortality caused by amphipods, three crabs were found to have died during 1976 due to excessive growth of certain filamentous green algae on their body, colonizing on the appendages as well as different regions including joints. From an examination of the dead crabs it appeared as though the green algal growth had arrested the growth as well as moulting of the crabs, affecting their physiology and leading to death. As in the case of amphipods causing mortality to crabs off bottom culture of the stock by suspending the cages as well as periodical cleaning and scrapping of algal growths have served to remove mortality from this factor.

Including deaths caused by amphipods and algal growth, the natural mortality suffered by the population in the course of the present experiment works out to be 38.78% and excluding the above two factors, natural mortality amounted to only 34.5% for a period of two years. It is obvious from this that the annual mortality of *S. serrata* in the present culture experiment ranges only upto a negligible proportion of 17.25% and the monthly rate is only 1.4%. As the crabs cultured in the cages were confined to a small area of only 625 sq cm, with a moving space of about 7,500 cu cm, it is obvious that the individuals were in a state of somewhat arrested condition. It is quite possible that if the crabs were afforded much more moving space for their normal activities as in pond culture, the present rate of mortality could have been reduced. Also, in their normal habits of movements here and there, the crabs could have escaped infestations of amphipods and algal growths.

Growth

The smallest crab stocked in the present experiment measured 26 mm carapace width (cw.), 18 mm carapace length (cl.) and weighed 3 gm. It was stocked in May 1977; and by July it had moulted three times and grown to 52 mm cw., 34 mm cl. and weighed 20 gm. Another crab stocked in May 1976 measuring 33 mm cw., 21 mm cl. and 6 gm in weight, lived for twelve months and in May 1977 measured 116 mm cw., 79 mm cl. and 225 gm in weight. A third crab with 37 mm cw., 23 mm cl. and 10 gm stocked in April 1976, survived for 15 months and measured 129 mm cw., 85 mm cl. and 395 gm. Crabs belonging to larger size groups cultured in the experiment have recorded much more growth. For instance, a specimen of 58 mm cw., 37 mm cl. and 30 gm stocked in March 1976 grew to 87 mm cw., 58 mm cl. and 95 gm in the course of six months; another crab of 80 mm cw., 55 mm cl. and 80 gm grew to 136 mm cw., 88 mm cl. and 320 gm by the end of twelve months; and still another crab of 102 mm cw., 72 mm cl. and 205 gm, attained 128 mm cw., 85 mm cl. and 320 gm at the end of eight months. Apart from these normal modes of growth, some quick spurts of growth were also observed in a few cases, particularly in the initial one or two months. As an example, a crab of 113 mm cw., 75 mm cl. and 200 gm weight stocked in July 1976 was found to have grown in two month's time to 131 mm cw., 87 mm cl. and 318 gm in weight.

The mode of regeneration and growth of one or both chelipeds of the crabs cultured showed variations. In some cases where both chelipeds were amputated at the time of stocking, only a single cheliped was regenerated at first. For instance, in a crab of 93 mm cw., 61.5 mm cl. and 107 gm weight, both chelipeds were absent at the time of stocking in September 1975. At the first moulting of this crab in November 1975, only the left cheliped was found to have regenerated. At the second moulting in the following March, the right cheliped was also found to have regenerated.

As the chelipeds are substantially massive, containing a large proportion of meat, regeneration and growth of the chelipeds were found to and substantially to increase in the weight of the crab concerned. In the above case for instance, with the first moulting and regeneration of the left cheliped, the weight of the crab increased from 107 to 170 gm and with the subsequent moulting accompanied by regeneration and growth of the right cheliped also, the weight of the crab reached 202 gm, thus registering a net increase of 195 gm in the course of six months.

Production

The weight groups of *S. serrata* cultured in the present experiment in 50 gm intervals, the actual weight ranges of crabs stocked in each group with the mean weight and ranges of weight increments registered along with the mean weight are presented in Table 1. From Table 1 it may be seen that, but for a few cases of variations, there are steady increments in the weights of all the crabs cultured. In many cases of lower weight groups (young crabs), there were initial increases amounting to 1.5 times (as in 51-60 gm group) and 2.7 times (as in 1–10 gm group), within a period of one month. At the end of three months of culture period, the increase in weight ranged from 2.3 times as in 51-60 gm group to 3.5 times in 1-10 gm group. As growth progressed further, the weight increments were also found to become proportionately more, thus amounting to 2.5 times in 51-60 gm group and to 11 times in 1.10 gm group in the sixth month of culture as well as to 3.5 times in the former group and 17 times in the latter group in the tenth month of culture period. In still larger groups of crabs cultured, ranging from 61-70 to 111-120 gm groups, the rates of weight increase varied from 1.2 times to 1.5 times in the first month of culture and 1.3 to 2 times in the third month. In the nineth and tenth months of culture, the weight increments amounted to 2.4 to 3.1 times. In still larger groups, production appeared to range from 1.5 to 2 times the weight at the time of stocking.

The data available from the present experiment also indicates that in groups upto 50 gm, the monthly weight increase range from 8 to 17.8 gm, with average monthly increment at 16.15 gm for 12 months of culture. In the weight groups ranging from 51 to 100 gm, the monthly weight increase varied from 12.3 to 62 gm, with mean monthly increment at 14.7 gm (Table 1). The weight group from 101 to 150 gm showed monthly increases of 3 to 28 gm with the monthly average value at 19.6 gm. Taking into account all weight groups in the present experiment, the monthly average production of each crab amounts to 16.8 gm. During the culture period in the present experiment, each crab has occupied an area of 625 sq. cm and from this it may be stated that production every month from crab culture as under the present conditions could be expected to be of the order of 2,680 kg/hectare. This would work out to be 8,040 kg/ha for a three months period of culture, 16,080 kg/ha for a six months period and 32,160 kg/ha for a twelve months period.

Remarks

From the above, it is obvious that this crab can be cultured profitably yielding quite a good return within a period of 3 to 6 months or even one year. Experiments on the culture of this species have also been carried out in a few southeast Asian countries for sometime now. Escritor (1972) gives an account of its culture in a small pond in Philippines, fenced with galvanized iron corrugated sheats. The average growth increments extending four and six months there were 17.15 mm cw. and 13.15 mm cl. and 17.69 mm cw. and 12.87 mm cl. respectively. In the present case, crabs having comparable measurements have registered almost similar

TABLE 1. *Monthly weight increments of* Scylla serrata *and the mean values (in parentheses) in the culture experiments at Tuticorin in every 50 grams weight groups during 1975-77*

Group (Weight in Grams)	Minimum and Maximum weight increments recorded and the mean values (in parentheses) in grams after each month of culture																
	At Stocking	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th
1— 50	6-46.4 (26.2)	16.1-72.2 (44)	25.6-85.3 (54)	20.8-99.6 (61.7)	46.6-110.2 (71.5)	36.5-126.2 (79.9)	68.6-126 (95)	75-122 (103.6)	87.8-135 (110)	133 (133)	103.3-185 (142)	134-138 (136.6)	140-322 (220)	150-255 (206)	277.5 (277.5)	203 (203)	395 (395)
51—100	56.1-96.2 (75.9)	84.4-146.5 (115.4)	100.5-152 (127.8)	111.5-162 (135)	125-190 (158)	153.3-168.7 (161.2)	135 (135)	147-190 (180)	164.2-211 (175)	145-205 (145)	197-288 (237)	200-270 (238.6)	192-282 (224)	242-280 (261)	203-307 (238.3)	—	—
101—150	106-146.5 (127.1)	146-217 (180)	139-209 (175.8)	175-235 (203.5)	175-285 (229)	174.5-269 (232)	202-275 (245)	135-235 (185)	195-235 (204)	—	300.8 (300.8)	257 (257)	—	280-300 (290)	283 (283)	—	—
151—200	154-198.2 (177.1)	242-262 (252)	209-318 (263.5)	220 (220)	230-258 (239.3)	368 (368)	—	235 (235)	—	—	—	—	—	—	—	—	—
251—300	255-270 (262)	260 (260)	—	—	—	390 (390)	—	—	—	—	—	440 (440)	—	—	—	—	—

growth increments, ranging from 8 to 17 mm cw. and 6 to 12 mm c.l. and 15 to 20 mm cw. and 8 to 15 mm cl. in four and six months respectively. As a matter of fact, individual increments in sizes and weight did not appear to depend upon the passage of time alone Escritor (1972) records poor recovery rates in his experiment on culture of *S. serrata* and attributes them to difficulties in harvesting as well as to the boring, crawling and cannibalistic habits of the species. In a preliminary experiment on the culture of *S. serrata* in Thailand, Varikul *et al.* (1972) have obtained a production rate of 264 to 403 kg/ha for a culture period of 45 to 60 days and Grino (1977) reports a production of 200 crabs/ha/year in the milkfish ponds of Java. When compared with these figures, the present estimated production appears to be highly encouraging. Grino (1977) gives an account of the culture practices for *S. serrata* in Western Visyas in Philippines. The culture period there lasts for four to five months and the ponds are subjected to preparations for the growth of *lab-lab* and zooplankton on which the juvenile crabs subsist. As *lab-lab* thins out, supplementary food is given to the culture stock in the form of trash fish, etc.

One of the major problems encountered by culturists of *S. serrata* is their cannibalistic nature. A way of minimising cannibalism is the provision of adequate quantities of food for the stock. Also, in order to prevent one crab attacking another, the last segment of the cheliped may be amputated periodically or alternatively, the last two segments of the chelipeds may be immobilized by fastening with a metal wire. Another problem faced in the culture of this species is its burrowing habits and escape from culture ponds. In order to overcome this difficulty, it is advisable to erect corrugated iron sheets or asbestos sheets all along the sides of the culture ponds with sufficiently deep penetration into the pond bottom for preventing the crabs from burrowing through. Also, sufficiently tall asbestos or iron sheets would serve to prevent the crabs from crossing over.

Regarding the availability of seeds of *S. serrata*, adequate information is not available on the seed resources centres, seasons of collection, etc. It is obvious that in order to realise a successful culture industry for this crab it is imperative to locate its seed resources centres, as early as possible. Also attempts at artificial propagation of this highly euryhaline species could be made for providing a continuous supply of its seeds as is done elsewhere (Escritor, 1972; Lavina, 1977). By ensuring such essential prerequisites for the culture and propagation of this species, it appears quite possible to realise a production rate of upto 32,160 kg/ha/year, as estimted in the present experiment at Tuticorin.

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