PROCEEDINGS OF THE SYMPOSIUM ON COASTAL AQUACULTURE

Held at Cochin

From January 12 to 18, 1980

PART 4: CULTURE OF OTHER ORGANISMS, ENVIRONMENTAL STUDIES, TRAINING, EXTENSION AND LEGAL ASPECTS

(Issued in December 1986)

MARINE BIOLOGICAL ASSOCIATION OF INDIA

POST BOX NO. 1023, COCHIN-682 031, INDIA

Price : Rs. 400.00

SYMPOSIUM SERIES 6

Abbreviation

Proc. Symp. Coastal Aquaculture, Pt. 4.

PRINTED IN INDIA BY A. D. THOMAS STEPHEN AT THE DIOCESAN PRESS, MADRAS 7 AND PUBLISHED BY E. G. SILAS ON BEHALF OF THE MARINE BIOLOGICAL ASSOCIATION OF INDIA, COCHIN-682 031

Proc. Symp. Coastal Aquaculture, 1986, 4 : 1176-1182

CULTURE OF THE MUD CRAB *SCYLLA SERRATA* (FORSKAL) IN TUTICORIN BAY

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ABSTRACT

The present paper comprises the results obtained in the experimental culture of the mud crab *Scylla serrata* in different types of cages in shallow bay of Tuticorin during 1978-79. The seeds were collected from estuarine area along creeks with its coastal mangrove swamps and impoundments and intertidal flats in and around Tuticorin. The young crabs were reared first in basket type cages made of cane splits for 2-3 months. Box type cages made of soft wooden planks, each comprising 8-10 compartments and metal framed synthetic twine mesh cages with compartment were preferred for culturing the grown up crabs. The crabs were fed with trash fish, clam meat and gutted wastes of the fish market. The growth rate of mud crabs in the existing environments appeared to be good as a good number of the stock moult frequently at an interval of 25-50 days. They were observed to reach marketable size through four—five moults in a period of 9-10 months. Eye stalk ablation accelerated the growth rate in young crabs and promoted gonadal maturation in adult crabs. Breeding behaviour of this species was observed and discussed in brief.

INTRODUCTION

THE MUD CRAB *Scylla serrata* constitutes a very important crab fishery in the whole Indo-Pacific region. Rao *et al.* (1973) evaluated the crab fishery resources of India and revealed the scope for developing the fishery into a major industry. Farming of suitable varieties of crab like *S. serrata* is an essential prerequisite for expansion as it is common to see the berried females being extensively fished in certain parts of the country and sold in markets for a high price. With increased culture activities envisaged in the overall development of the crustacean fishery, crab culture would naturally receive great attention. In addition to the increasing demand for protein food and for frozen crab meat for export it has become necessary to develop culture techniques for this neglected fishery. Available information on the biology and fishery of this edible crab have been enlisted by George and Rao (1967). Experiments to rear larval stages to juveniles have been conducted in Malaysia (Ong, 1966 a, b), India (Raja Bai Naidu, 1955), Sri Lanka and Philippines (Arriola, 1940) with varying degrees of success. Suitable techniques for application in culture field requires to be evolved. Of late, attempt has been made to culture the young ones to marketable size on moderate scale in Philippines (Escritor, 1970; Pagcatipunan, 1970), Thailand (Vanich varikul *et al.*, 1970), Sri Lanka (Raphael, 1970), India (Marichamy, 1979), Singapore and Taiwan. Taking advantage of the existence of intertidal mud flats in Tuticorin Bay and Karapad Creek with its coastal mangrove swamps and impoundments which serve as natural nursery for mud crabs, two sets of experiments relating to the culture of *S. serrata* in different types of cages were aimed at finding out the possibility of rearing young crabs to marketable size.

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The authors are grateful to Dr. E. G. silas, Director, Central Marine Fisheries Research

Institute, Cochin for his keen interest and encouragements shown in this project.

Material and Methods

The young crab stages in the natural habitat remain as the only source of seed stock for the culture of this species. Seeds were available throughout the year and collected by using hoop nets baited with gill rackers and other gutted wastes. Width-weight a measurements and sex of the seeds were noted while stocking. Moult increments were recorded on the second day after moulting. Cages were periodically cleaned with stiff brush to avoid algal growth and colonisation of foulers. The first experiment was carried out during August 1978-December 1978 and the second during October 1978-April 1979. Crabs were cultured singly in different types of cages in order to avoid loss of stock due to cannibalism. Basket type cages made of cane splits were preferred for rearing young crabs. The grown up crabs, measuring above 110 mm (carapace width) were shifted to box type wooden cages or metal framed synthetic twine mesh cages. The basket type cages were suspended by means of coir rope tied to poles and always submerged in sea water. The other cages were placed on the racks erected in the creek. The dimensions of the cages were $2 \times 1 \times 0.3$ m and $1 \times 1 \times 0.3$ m with compartments at 0.3 m^3 each. Operation details of these cages had been already described by the senior author (1979). The pointed tip of the movable finger of the chelipeds of the seed crab was cut by using a bone cutter to minimize the possible damage to the basket. For observing the breeding behaviour of the crab five pairs of matured crabs were reared separately in big sized wooden cages. Eye ablation technique was adopted in crabs belonging to different size groups. Crabs were fed with bits of trash fish and clam meat. The left over food were removed periodically from cages.

Observations and Results

Experiments

Experiments were initially carried out at Karapad Creek (Pl. I A-C) where a good flow of tidal water existed. The depth was 1 m and during low tide the cages were partly exposed. Cleaning and feeding works were attended at this favourable time. 180 males and 160 females belonging to different size groups were collected and stocked in suitable cages during August 1978. About 52 per cent of the stock belonged to the size 7-9 cm carapace width (Table 1, Pl. 1 D). The average weight of the bulk of the stock was found in the range 65-141 gr. During early September 1978 the salt manufacturers barricaded the creek mouth preventing free flow of water in the creek in order to attend to some salt pan repair works. Consequently a change in the chemical and physical quality of water was noticed which ultimately resulted in the mortality of stock. The salient hydrological factors of the area of culture were recorded and presented in Table 2. Escritor (1970) observed a greater death rate due to high temperature at certain times of the day due to shallowness. In the present observation, due to increased salinity and temperature and stagnancy of shallow water of the creek nearly 53% of the stock perished by the end of September 1978. Subsequently, the cages were shifted to the inshore coastal water of the bay where further experiments were continued (Pl. II A). Crabs cultured in the fabricated cages were subject to mortality, particularly after moulting when the animal remained completely quiescent. Predatory fishes in the area bite the crabs through the meshes of the cage. The second experiment was carried out in the inshore water of bay with limited animals belonging to 3 distinct groups and the results are presented in Table 3.

Growth

The damaged fingers of the chela or the missing chelate legs noticed in some specimens

TABLE 1. *Details of* Scylla serrata *stocked in cages on* 9-8-1978

Carapace width cm	Male			Female			Average wt. gr.	
	No.	%	Wt. gr.	No.	%	Wt. gr.	Male	Female
3	5	2.9	40	5	3.2	39.5	8.0	8.0
4	7	3.9	92	5	3.2	65.0	13.2	13.0
5	20	11.1	620	15	9.3	445.0	31.0	29.9
6	21	11.7	1049	18	11.2	833.0	50.0	46.3
7	25	13.9	1893	20	12.5	1300.0	75.7	65.0
8	28	15.5	3083	25	15.6	2482.0	110.0	99.5
9	40	22.2	5671	40	25.0	5657.0	141.8	141.4
10	17	9.4	3745	15	9.4	3087.0	220.3	205.8
11	10	5.5	2714	12	7.5	3174.0	271.4	264.5
12	7	3.9	2398	5	3.1	3392.0	342.5	339.9
Total ..	180			160				

TABLE 2. *Hydrology of the crab culture area*

Place	Month	Surface temperature (°C)	Oxygen (ml/L)	Salinity (‰)	pH
Karapad Creek	June 78	25.7	4.1	36.14	8.00
	July 78	26.5	4.6	36.86	8.10
	Aug. 78	26.5	4.4	36.61	8.15
	Sept. 78	27.5	4.5	41.67	8.20
	Oct. 78	25.5	4.7	39.90	7.95
	Nov. 78	25.0	4.0	36.86	8.00
	Dec. 78	25.5	4.5	31.56	8.05
Tuticorin Bay	Sept. 78	26.0	4.5	36.52	8.15
	Oct. 78	26.1	5.9	36.98	8.00
	Nov. 78	23.5	3.4	31.00	8.10
	Dec. 78	25.0	5.0	27.89	8.05
	Jan. 79	25.2	4.7	31.56	7.95
	Feb. 79	26.2	4.9	33.95	8.00
	March 79	27.0	5.0	34.52	8.15
	April 79	28.8	4.5	34.08	8.00

Time of observation : 0900 hrs.

TABLE 3. *Details of* Scylla serrata *cultured in Tuticorin Bay from* 4 *October* 1978 *to* 3 *April* 1979 (6 *months*)

Size groups mm	Stock				Size groups mm	Harvest			
	Nos.	Average cw mm	Total wt. gr.	Average wt. gr.		Nos.	Average cw mm	Total wt. gr.	Average wt. gr.
51-59	20	55.3	498.0	24.9	118-129	18	122.0	5941	330.1
61-69	20	64.7	960.0	48.0	135-146	17	138.8	8792	517.2
72-79	20	75.1	1423.0	71.2	137-149	17	143.5	11069	651.1

Survive rate 89.7% gained wt. 22.9 kg

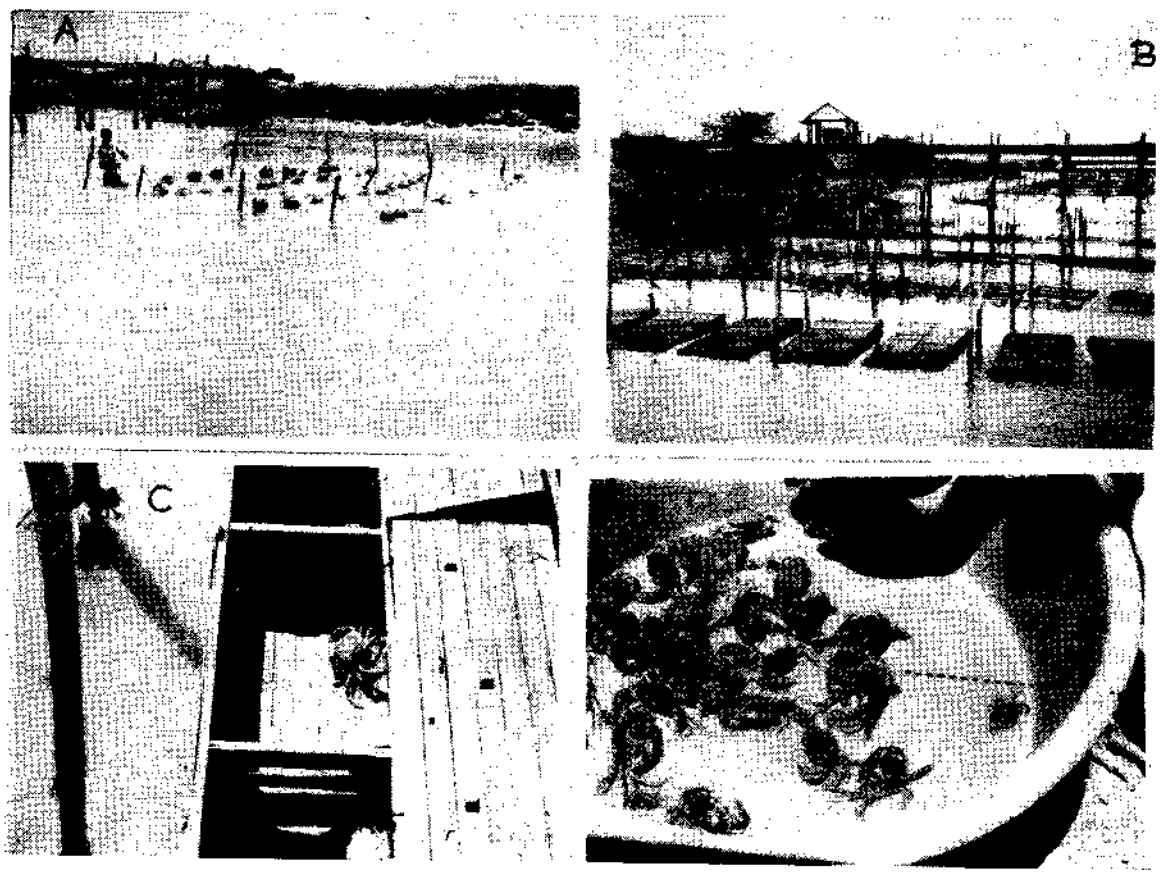

PLATE I. A. Young crabs cultured in baskets; B. Grown up crabs cultured in box type wooden cages; C. Crabs in compartments with lids open showing the feeding holes also and D. Part of seeds collected from the wild.

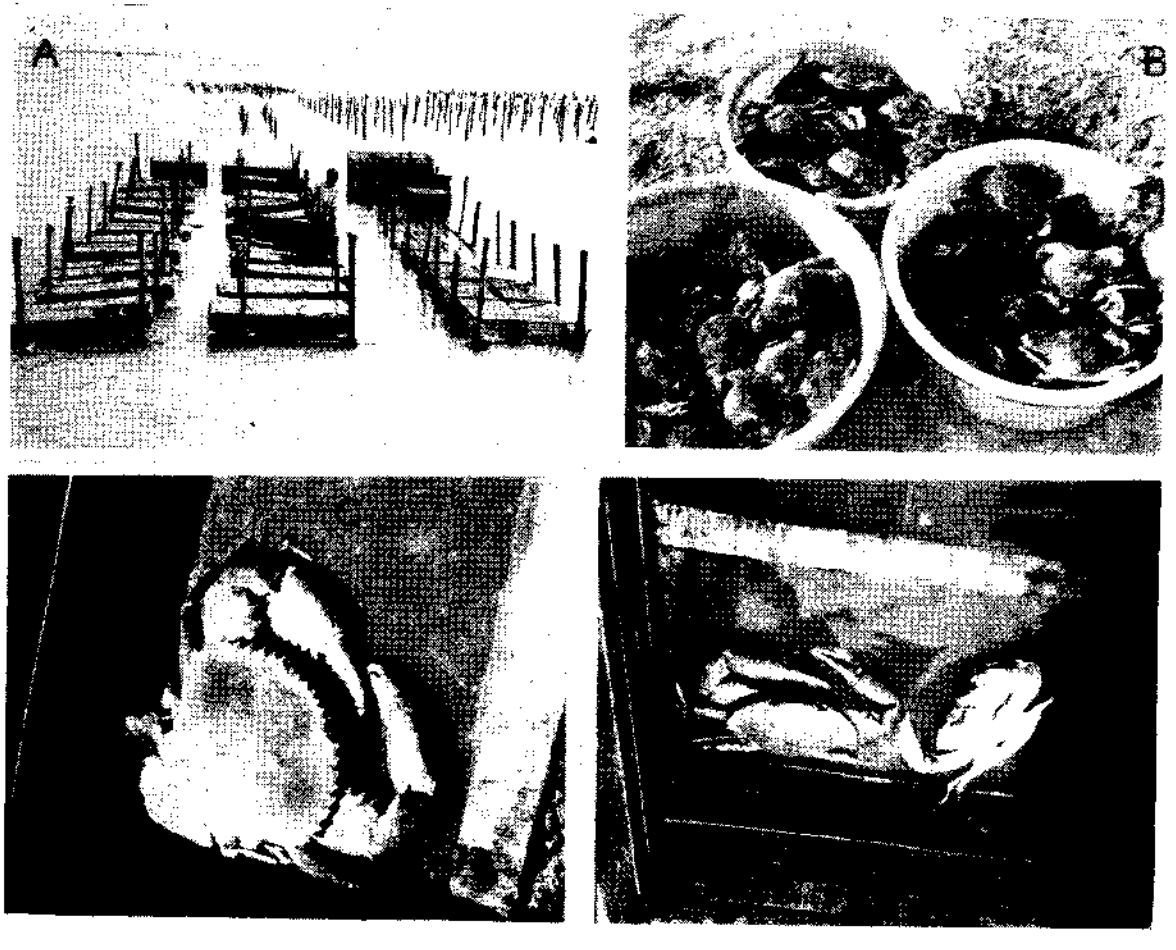

PLATE II : A. Box type wooden and fabricated cages in the bay ; B. Harvested crabs ; C. Crabs during mating and D. The pair separated. Female still lying on her back.

at the time of stocking regenerated in the subsequent moulting. Growth occurred normally when the shell was cast. Further increase in carapace width appeared to cease after the fourth or fifth day of moulting till the next moult. Moult increment and moult frequency were noted for every individual of the stock in growth study. In the process of moulting a split developed between the epimera and the inturned edge of the carapace along the pleural groove. The split gradually enlarged until the carapace was freed from the abdominal part of the exoskeleton. Thereafter with the muscular action the abdomen and the walking legs freed individually. Chelae were the last of the appendages to be withdrawn from the old exoskeleton. The actual period of moulting lasted for 30-40 m and most of the moult during night.

The young crabs measured less than 100 mm cw exhibited a stimulus to eye ablation and resulting in two frequent moulting ranging from 10-15 days. The moult increment in such crabs varied from 7 to 10 mm. Crustacean eye stalks contain the centres for distribution of gonad and moult inhibiting as well as accelerating harmones. Eye stalk ablation technique was also followed to induce precocius maturation of the ovary and subsequent spawning in captivity. Two female crabs at the size 104, 115 mm were selected for this observation. Only one eye was ablated. After an interval of 30 days they died. When dissected, the ovary was in fully matured condition having bright orange-red colour. A female berried crab collected in the size 125 mm cw was also put under this observation. On the fourth day, the animal released undeveloped eggs instead of attaching to pleopods. In the technique of eye ablation, a thick burning incense stick was used to puncture the eye ball.

The monthly average growth increment in size and weight of the crab of different size groups were plotted in Fig. 1. Individuals of the same size showed a difference in moult frequency and moult increment (Table 4). It can be observed from Fig. 1 that the rate of growth in size steadily increased and the maximum of 11.6-13.3 mm per month was obtained in the case of harvested male crabs measured under 10.0 - 12.9 cm carapace width. Females grouped under 10.0 - 13.9 cm cw exhibited a slightly low rate of growth ranging from 11.2 to 12.6 mm/p.m. In both the sexes the rate of growth in size remained minimized after reaching 14 cm cw. However, increment weight of the animal was steady and adult crab gained more weight as they grow.

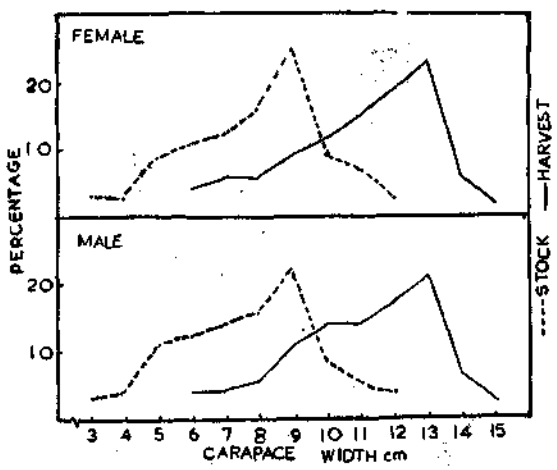

Fig. 1. Length frequency distribution of *Scylla serrata* cultured in cages.

In Fig. 2 the length frequency distribution of cultured crabs both at stock and harvest has been depicted. The peak size group observed at 9 cm progressed to 13cm thus indicating an overall growth of 4 cm in 4 months. The average weight of this group of crab varied from 450 - 460 g. Males exhibited greater increase in weight than the other sex because of the fleshy chelae.

Production

The area utilized to carry out the present experiment in cages was 200 m^2. Out of 340

TABLE 4. *Growth particulars of* Scylla serrata *harvested on* 5-12-78

Sex	Carapace width cm	No. of crabs	%	Increase in carapace width mm min.	max.	Total wt. gr.	Average wt. gr.	Increaee in weight gr. Min.	Max.
Male (72)	6	3	4.2	7.8	9.1	151	50.3	9.9	12.7
	7	3	4.2	9.1	10.4	279	93.0	20.8	22.4
	8	4	5.5	9.6	11.2	474	118.5	22.4	29.9
	9	8	11.0	9.9	11.2	1226	153.3	29.6	33.3
	10	10	13.9	10.4	12.7	2409	240.9	47.6	62.4
	11	10	13.9	12.2	14.3	2833	283.3	52.0	71.5
	12	12	16.8	11.2	13.0	4649	387.4	61.8	91.8
	13	15	21.8	8.3	11.4	6862	457.5	58.2	101.4
	14	5	6 .9	6.5	8.6	2894	578.8	61.9	106.1
	15	2	2.8	6.0	7.3	1545	772.5	103.4	104.0
Female (53)	6	2	3.8	8.6	9.3	95	47.5	10.4	—
	7	3	5.7	8.8	10.4	254	84.7	15.8	20.8
	8	3	5.7	8.8	10.9	338	112.7	21.6	25.2
	9	5	9.4	10.1	10.9	739	148.0	28.9	32.8
	10	6	11.4	11.2	12.2	1426	237.7	33.5	56.9
	11	8	15.0	12.1	13.3	2203	275.4	56.4	60.3
	12	10	18.8	11.4	13.3	3832	383.2	67.1	97.2
	13	12	22.6	10.9	11.4	5424	452.0	70.2	95.7
	14	3	5.7	9.4	9.6	1680	556.0	93.9	98.0
	15	1	1.9	8.3	—	715	715.0	101.8	—

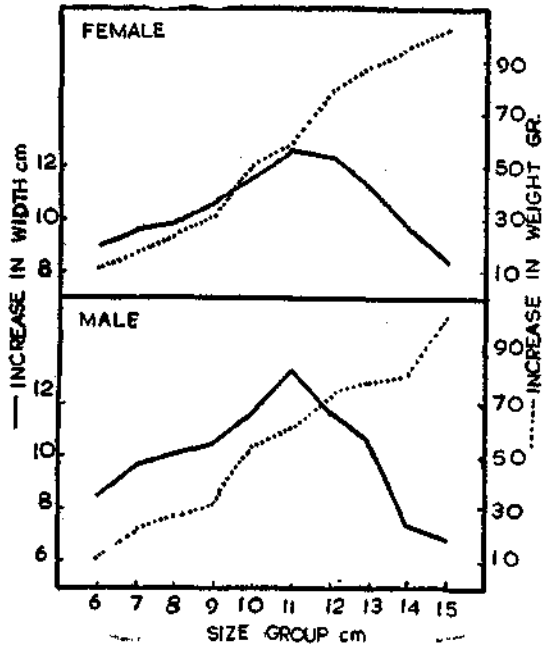

Fig. 2. Average growth increment of *Scylla serrata* in different size groups.

crabs stocked, only 72 males and 53 females were recovered after a period of four months and these together weighed 40 kg (Pl. II B). This increment was from the initial stock of seeds weighing 15.36 kg. Among the harvested crabs the total gain in weight was 160.6%. The rate of survival was accounted to be 36.8 per cent. At this rate, the production potential per hectare worked out to 2000 kg in 4 months. An increase in the yield was obtained in the second experiment when the cages were placed in a submerged level where better environmental conditions prevailed. The depth of the ground was 2-3 m. The survival rate improved to 86.7% and in a period of six months the weight of the crabs increased from 2.9 kg to 25.8 kg.

Mating behaviour : A series of observations on the mating behaviour of mature crabs in the size 100-130 mm cw were made. The act of copulation was seen and photographed (Plate II C-D). Once attracted to a female the male showed on attraction to food and re-

mained continuously with the female. Pairing was found to occur for period ranging 3 days before the moult and for a further period of 1-2 days after moult. During the premating embrce, the male climbed over and clasped the female by his chelipeds and the anterior pair of walking legs. The pair separated on the verge of precopulatory moult. After the copulatory moult of the partner the male gently turned the female over her back using the chelae. The female unfolds her abdomen, co-operating in this behaviour actively to held the male into position. These observations suggest that moulting and increase in size would continue in both sexes including those which have attained maturity. The mated females were reared in the same environment for oögenesis and ovulation to take place, since the berried females are normally found in sea and not in brackishwater. Two of these mated female crabs in the size 101 and 110 mm died after 50 days, but none had become egg bearing and no development of the gonads was seen to have taken place when the crabs were later dissected. It can be stated that in *S. serrata* mating can take place without subsequent egg carrying. Edwards (1966 b) found similar features in *Cancer pagurus*. Ong (1966 b) observed such condition in crabs at size 116.9 mm and explained that copulation may occur in female *Scylla* before the stage of full sexual maturity. The present findings also confirmed that the individuals of a species generally do not mature at the same age or size.

Discussion

The influence of salinity on growth of crab was studied to some extent by earlier workers. According to Ong (1966 b) the intermoult period was shorter for immature crabs reared in water of reduced salinities. Alice (1979) found that at 26 ppt lesser moults occurred with increment in weight and more moults at 30 ppt with lesser overall weight increments. In the area of present experiments the salinity was higher than 33 ppt except the north east monsoon period when it fluctuated from 27 to 31 ppt and an overall weight increment was well noticed. The percentage moult increments were greater for young crabs and decreased in the later stages. The time interval between consecutive moults was greater with adult crabs. Ong (1966 b) observed a higher rate of average moult increment *i.e.*, 10.7-14.6 mm with the crabs of mean carapace width ranging from 70-100 mm and in the crabs measured above this size the growth rate was reduced. Escritor (1970) recorded an average growth increment of 17.2-17.6 mm cw with the crabs stocked in the size 79-97 mm. However, in the present study a fast rate of moult increment (11.2-13.3) was found in slightly big sized crabs belonging to 10-16 cm. Vanich varikul *et al.* (1970) observed a difference in the rate of survival and gain in total weight of the crabs by reducing the period of culture from 60-45 days. Escritor (1970) did not notice any difference in the growth increment in the crabs cultured with intensive feeding and shorter rearing period to that of the longer rearing without supplementary feeding. In the present observation the aim was to obtain crabs of high quality and large size and hence the period of culture was extended to gain weight in the harvested crabs to a maximum of 160 per cent. Although the magnitude of the rearing experiment was low, the results of the observations envisage the scope for an extensive culture in this area. With the increasing attention shown in different Southeast Asian countries, mass culture of crabs would become in near future as practicable as the culture of other decapods, like prawns.

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