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# Mud Crab Fattening in Ponds

A.T. TRIÑO and E.M. RODRIGUEZ

Aquaculture Department  
Southeast Asian Fisheries Development Center  
Tigbauan, Iloilo  
Philippines

## Abstract

Two independent experiments on mud crab (*Scylla serrata*, Portunidae) fattening were conducted simultaneously in 150 m<sup>2</sup> ponds for 30 days: Expt. I - monosex male (286 ± 1.2 g) vs. monosex female (267 ± 0.9 g) stocked at 0.5-m<sup>-2</sup>, and Expt. II - monosex male (338 ± 3.1 g) or female (338 ± 2.8 g) vs. mixed sex (338 ± 3.4 g) stocked at 0.25-m<sup>-2</sup>. The crabs were fed daily a mixed diet of 75% brown mussel flesh and 25% fish bycatch at 10% of the crab biomass. Intermolt full male crabs weighing ≥ 400 g and roed females ≥ 350 g were partially harvested from the ponds after 20 days of culture using lift net and current method. Results of partial harvest from all treatments in both experiments showed a total yield of 51-55% of the total initial number of stocked crabs (450 crabs in Expt. I, and 338 crabs in Expt. II). From this partial harvest, crabs in Expt. I attained a mean final body weight of 496 g, a specific growth rate (SGR) of 2.75% in males and 432 g, SGR of 2.4% in females. Expt. II gave a mean final body weight of 520 g (males), 484 g (females), and 517 g (mixed sex) and SGR of 1.1, 0.73 and 0.81, respectively. Results of total harvest showed that the overall mean final body weight (372 ± 4.5 g) of monosex male crabs in Expt. I was significantly higher ( $P < 0.05$ ) than monosex females. However, specific growth rate, carapace length and width, survival, and production were not significantly different ( $P > 0.05$ ) between monosex males and females. On the other hand, growth and production of monosex crabs in Expt. II was not significantly different ( $P > 0.05$ ) from mixed sex crabs. However survival of monosex crabs (100%) was significantly higher ( $P < 0.05$ ) than mixed sex crabs (87 ± 1.88%).

## Introduction

Since undersized (< 300 g female; < 350 g male) and marketable sized but lean (≥ 300 g female; ≥ 350 g male) mud crabs *S. serrata* (Forsk.) have very low demand in the domestic market and are even rejected in the export market, they command a relatively low price. Some private operators are engaged in the fattening of these crabs for 15 to 20 days to attain the highly priced meat of the large pincers of males and the bright red roe of gravid females much sought after by consumers.

Due to limited baseline research studies, crab fattening practices vary widely in different parts of the Philippines and have been rarely documented. The only documented studies on fattening crabs were on bamboo

(DA, Region VI 1988) and net cages (Kuntiyo 1992). Crab fattening in cages is economically viable (DA, Region VI 1988) but can only accommodate a limited number of stocks. It also requires high maintenance requirements in terms of labor (Bensam 1986). Hence, crab fattening in ponds is a better alternative to accommodate a large volume of crabs at one time. The present study was conducted to determine the growth, survival and production of both undersized and lean marketable sized mud crab *S. serrata* fattened in ponds.

## Materials and Methods

Two independent experiments on mud crab (*S. serrata*) fattening were conducted simultaneously in 150 m<sup>2</sup> ponds for 30 days. In Expt. I, monosex cultures of undersized male (286 ± 1.2 g) vs undersized female (267 ± 0.9 g) were stocked at 0.5·m<sup>-2</sup>, and in Expt. II monosex cultures of lean marketable sized male (338 ± 3.1 g) or female (338 ± 2.8 g) vs mixed sex (338 ± 3.4 g) were stocked at 0.25 m<sup>-2</sup>. Treatments in Expt. I were replicated thrice while treatments in Expt. II had two replicates each due to inadequate supply of experimental animals. In both experiments, ponds were assigned in a completely randomized design.

The crabs were fed daily a mixed diet of 75% brown mussel (*Modiolus metcalfei*) flesh and 25% fish bycatch (consisting of *Leiognathus* sp) at a rate of 10% of the crab biomass daily until final harvest. The daily ration was given equally between 0730 h and 1700 h by broadcasting the feeds.

Intermolt full male crabs weighing ≥ 400 g and roed females ≥ 350 g were partially harvested from ponds after 20 days of culture using baited lift net and current method. The current method involves the draining of about 70% of the volume of water in pond at lowest tide. At incoming high tide the pond is flooded. The water current entering the pond draws crabs near or around the gate. The crabs are scooped, fat crabs are partially harvested and the rest are released in the pond.

The body weight, carapace length (CL) and width (CW), specific growth rate (SGR), survival, and production of crabs were calculated from the total harvest. Treatment means in Expt. I were compared using T-test and analysis of variance for Expt. II. The significance of the differences between treatment means were determined using Duncan's multiple range test. All analyses were conducted using SAS program (SAS 1988).

## Results

The proximate analysis of both foods, brown mussel and fish bycatch, showed a high protein content (Table 1). However, fat and carbohydrate contents were higher in the brown mussel. Results of partial harvest after 20 days from stocking from all treatments in both experiments showed a total yield of 51 to 55% of the total initial number of stocked (Expt. I: 450

pcs and Expt. II: 338 pcs) crabs (Tables 2 and 3). Based on this data, crabs in Expt. I attained a mean final body weight of 496 g for males and 432 g for females (Table 2). Crabs in Expt. II gave a mean final body weight of 520 g for males, 484 g for females and 517 g for mixed sex (Table 3). Results at final harvest after 30 days from stocking showed that the overall mean final body weight of male crabs in Expt. 1 was significantly higher ( $P < 0.05$ ) than that of females (Table 4). However, specific growth rate (SGR), CW, CL, survival, and production did not show significant differences ( $P > 0.05$ ) between treatments. On the other hand, table 5 shows that the growth and production of males or females and mixed sex in Expt. II were not significantly different ( $P > 0.05$ ). However, survival of monosex crabs was significantly higher ( $P < 0.05$ ) than mixed sex crabs.

Table 1. Proximate composition of fish bycatch and brown mussel. Analysis was done according to AOAC (1979)

	Composition (% dry weight)	
	Fish bycatch	Brown mussel flesh
Crude protein	66.14	61.34
Crude fat	6.91	9.54
Crude fiber	1.56	9.28
Nitrogen-free extract	1.34	10.68
Ash	21.96	9.16

Fish bycatch consisted of *Leiognathus* sp.

Table 2. Mean body weight of crabs partially harvested from ponds stocked with monosex male or female mud crabs 20 days after stocking (Expt. I)

Replicate No.	Male			Female		
	Crabs harvested (pc)	% of stock	Mean body weight (g)	Crabs harvested (pc)	% of stock	Mean body weight (g)
1	35	47	480 ± 0.3	40	53	410 ± 0.4
2	38	51	510 ± 0.5	36	48	435 ± 0.3
3	42	56	497 ± 0.8	39	52	451 ± 0.4
Mean	38	51	496	38	51	432

Table 3. Mean body weight of crabs partially harvested from ponds stocked with monosex or mixed sex mud crabs 20 days after stocking (Expt. II)

Rep. No.	Male			Female			Mixed sex		
	Crabs harvested (pc)	% of stock	Body weight (g)	Crabs harvested (pc)	% of stock	Body weight (g)	Crabs harvested (pc)	% of stock	Body weight (g)
1	16	43	510 ± 0.4	21	56	467 ± 0.3	18	48	498 ± 0.6
2	22	59	529 ± 0.5	17	45	500 ± 0.4	23	61	536 ± 0.5
Mean	19	51	520	19	51	484	21	55	517

## Discussion

The culture period of the present study is within the culture duration (15 to 30 days) being practiced in the Indo-Pacific region (Cholik and Hanafi 1992; Ladra 1992; Sivasubramian and Angell 1992; Liong 1993; Macintosh et al. 1993). Partial harvesting however, was undertaken 20 days after stocking.

Results of partial harvest from both experiments showed that about 50% of the total number of crabs stocked were ready for harvest regardless of stocking density. This suggests that crabs stocked in ponds are not fattened at the same time. Although results of the total harvest in Expt. I indicated that male crabs attained a significantly higher weight than females, this observation did not manifest in their specific growth rates. Significant differences between sexes in body weights may be attributed to large differences in the initial body weights at stocking. Results in Expt. II conform with this observation. Body weights of crabs with similar initial weights at stocking were not influenced by monosex or mixed sex culture, instead survival was more affected. The crabs raised as mixed sex group attained a survival rate significantly lower than males or females kept separately.

The results of partial harvest could be attributed to various stages of gonad development in females (Poovachiranon 1992), and the degree of thinness or muscle content of both male and female crabs (Liong 1993) initially used in this study. Poovachiranon (1992) reported a highly significant relationship between female crab maturity index (FMI) and CW. The crab

Table 4. Growth, survival, and production of mud crabs in Experiment I

	Male	Female
Body weight (g)	372.0 ± 4.50 <sup>a</sup>	350.8 ± 5.20 <sup>b</sup>
Carapace length (cm)	8.5 ± 0.13 <sup>a</sup>	8.5 ± 0.12 <sup>a</sup>
Carapace width (cm)	12.7 ± 0.26 <sup>a</sup>	12.4 ± 0.18 <sup>a</sup>
Specific growth rate (SGR, %/day)	0.9 ± 0.04 <sup>a</sup>	0.9 ± 0.10 <sup>a</sup>
Survival (%)	87.1 ± 9.37 <sup>a</sup>	87.1 ± 8.34 <sup>a</sup>
Production (kg)	24.3 ± 22.3 <sup>a</sup>	22.9 ± 12.7 <sup>a</sup>

Values are means ±SE of three replicates. Superscripts with the same letter are not significantly different ( $P>0.05$ ).

Table 5. Growth, survival, and production of mud crabs in Experiment II

	Male	Female	Mixed sex
Body weight (g)	469.7 ± 17.5 <sup>a</sup>	419.3 ± 15.5 <sup>a</sup>	429.5 ± 15.8 <sup>a</sup>
Carapace length (cm)	8.9 ± 0.41 <sup>a</sup>	9.5 ± 0.65 <sup>a</sup>	8.9 ± 0.60 <sup>a</sup>
Carapace width (cm)	13.2 ± 0.13 <sup>a</sup>	14.0 ± 0.92 <sup>a</sup>	12.8 ± 0.13 <sup>a</sup>
SGR (%/day)	1.1 ± 0.12 <sup>a</sup>	0.7 ± 0.12 <sup>a</sup>	0.8 ± 0.12 <sup>a</sup>
Survival (%)	100.0 ± 0.00 <sup>a</sup>	100.0 ± 0.00 <sup>a</sup>	86.9 ± 1.88 <sup>b</sup>
Production (kg)	17.9 ± 44.3 <sup>a</sup>	15.9 ± 39.3 <sup>a</sup>	14.2 ± 30.4 <sup>a</sup>

Values are means ±SE of three replicates. Superscripts with the same letter are not significantly different ( $P>0.05$ ).

*S. serrata* reached sexual maturity upon attaining an FMI of  $\geq 0.88$  or a CW equivalent to  $\geq 11$  cm. Three stages of gonad maturity conditions (developing, maturing, and fully roed) were found among these groups of crabs regardless of increasing CW and FMI. Apparently, it takes time to fatten a thin crab than less thinner ones.

The stage of gonad development and degree of thinness at stocking were not determined in the present study. The data should have provided us information on the relationship of gonad development and muscle content of the crabs within the duration of culture and percentage of partial harvest.

Crabs have been fattened by some private operators using trial and error methods elsewhere in the country (Ladra 1992). A weight increment of 110 g was achieved but survival was not indicated. Cannibalism was reported as a serious problem. This was addressed in studies reported by DA, Region VI (1988) using a bamboo cage battery (with several small compartments or cubicles to accommodate a single crab per compartment or a net cage battery (Kuntiyo 1992). After 15 days, DA, Region VI (1988) reported a weight gain of 110 g with a survival of 87% while Kuntiyo (1992) showed a weight increment of 23 to 37 g and a survival of 80 to 100%, 35 days after stocking. The present study used alternative approaches to minimize loss of stocks due to cannibalism (Baliao et al. 1981, Hill et al. 1982, Cholik and Hanafi 1992, Triño et al. 1999).

Triño et al. (1999) found that a higher survival rate (98%) can be obtained at low stocking density ( $0.5 \text{ m}^{-2}$ ). This is in agreement with the present study where a survival rate of 87% in Expt. I at  $0.5 \cdot \text{m}^{-2}$  and 87 to 100% in Expt. II at  $0.25 \text{ m}^{-2}$  were obtained. Cholik and Hanafi (1992) indicated that mixed sex culture enhances cannibalism. This observation was confirmed in Expt. II. The survival of mixed sex crabs was significantly lower than the monosex groups. The presence of filamentous green algae in ponds within the duration of culture may have provided crabs with shelter, minimizing encounters between crabs, thus improving survival. The importance of aquatic macrophytes as shelters for mud crab in their natural habitat was pointed out by Hill et al. (1982). Triño and Rodriguez (SEAFDEC/AQD, unpublished report) showed that survival and growth of crabs were enhanced when marketable sized and fat crabs were harvested several times rather than at single harvest at the termination of the culture period. They found that smaller crabs grew faster and attained export quality size and conditions at total harvest. This result agrees with De Silva (1992) and Liang (1992), on the need to partially harvest crabs in a fattening culture.

This study suggests that pond fattening of undersized, and lean marketable sized mud crabs with partial harvest (20 days after stocking) is economically feasible. At present, *S. serrata* culture in the Philippines is still dependent upon crab juveniles caught from the wild. Hence, any commercial development in this direction needs to be considered as overexploitation of mature females and may aggravate the shortage of seed supplies from the natural habitat.

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## References

- Association of Official Analytical Chemists. 1979. Official Methods of Analysis, 14<sup>th</sup> edn. AOAC, Arlington, VA.
- Bensam, P. 1986. A culture experiment on crab, *Scylla serrata* (Forsk.) at Tuticorin during 1955-1977 to assess growth and production. In: Proceedings of the Symposium on Coastal Aquaculture, Marine Biological Association of India, Part 4:1183-1189.
- Cholik, F. and A. Hanafi. 1992. A review of the status of mud crab (*Scylla* sp.) fishery and culture in Indonesia. In: The Mud Crab (ed. C.A. Angell), pp. 13-28. Report of the Seminar on Mud Crab Culture and Trade. Bay of Bengal Programme. Madras, India.
- Department of Agriculture (DA), Region VI. 1988. Fattening mud crabs *Scylla serrata* in bamboo cages. Fish. Extension Rep., Dept. of Agriculture, BFAR, Philippines.
- De Silva, L.B.D. 1992. Results of trials of mud crab (*Scylla serrata*) fattening. In: The Mud Crab (ed. C. A. Angell), pp. 155-160. Report of the Seminar on Mud Crab Culture and Trade. Bay of Bengal Programme. Madras, India .
- Hill, B.J., M.J. Williams and P. Dutton. 1982. Distribution of juveniles, sub-adult and adult *Scylla serrata* (Crustacea: Portunidae) on tidal flats in Australia. Marine Biology 69: 117-120.
- Kuntiyo. 1992. Fattening of mud crab, *Scylla serrata* Forskal, in net cages installed in the drain canal of intensive prawn ponds fed with trash fish and prawn pellet. MS Thesis. University of the Philippines in the Visayas 60 pp.
- Ladra, D.F. 1992. Mud crab fattening practices in the Philippines. In: The Mud Crab (ed. C.A. Angell), pp.151-154. Report of the Seminar on Mud Crab Culture and Trade. Bay of Bengal Programme. Madras, India.
- Liong, P.C. 1992. The fattening and culture of mud crab (*Scylla serrata*) in Malaysia. In: The Mud Crab (ed. C.A. Angell), pp.185-190. Report of the Seminar on Mud Crab Culture and Trade. Bay of Bengal Programme. Madras, India.
- Liong, P.C. 1993. The culture and fattening of mud crabs. INFOFISH International 3/93:46-49.
- Macintosh, D.J., C. Thongkum, K. Swamy, C. Cheewasedtham, and N. Paphavisit. 1993. Broodstock management and the potential to improve the exploitation of mangrove crabs, *Scylla serrata* (Forsk.), through pond fattening in Ranong, Thailand. Aquaculture and Fisheries Management 24:261-269.
- Poovachiranon, S. 1992. Biological studies of the mud crab *Scylla serrata* (Forsk.) of the mangrove ecosystem in Andaman Sea. In: The Mud Crab (ed. C.A. Angell), pp. 41-48. Report of the Seminar on Mud Crab Culture and Trade. Bay of Bengal Programme. Madras, India.
- SAS Institute. 1988. SAS/STAT™ User's Guide, Release 6.03 edn. SAS Institute, Cary, NC.
- Sivasubramian, K. and C.A. Angell. 1992. A review of the culture, marketing and resources of the mud crab. In: The Mud Crab (ed. C.A. Angell), pp.5-12. Report of the Seminar on Mud Crab Culture and Trade. Bay of Bengal Programme. Madras, India.
- Triño, A.T., O.M. Millamena, C. Keenan. 1999. Commercial evaluation of monosex pond culture of the mud crab *Scylla* species at three stocking densities in the Philippines. Aquaculture 174:109-118.