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Optimization of the stocking density of mud crab, *Scylla serrata* culture in Brackishwater earthen ponds in Bangladesh

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Abstract

A study on the optimization of stocking density of mud crab, *Scylla serrata* in the grow out system in brackishwater earthen ponds (400m^2 each) was carried out for a periods of five months. Crabs (40-50g) were stocked @ 2,500, 5,000, 7,500 and 10,000 /ha under four treatments T_1, T_2, T_3 of T_4, respectively, with three replications of each. The crabs were fed with slaughtered house waste at the rate of 5.10% of the biomass. Significantly (< 0.05) higher specific growth rate (SGR) of 0.09 % day, survival rate of 66.25% were observed in T_1 followed by T_2, T_3 and T_4, but the total production of mud crab of 610 kg/ha was significantly ($p< 0.05$) higher in (7.500 nos/ha) followed by 569.64 kg/ha in T_4 (10,000 nos/has), 481.66 kg/ha in T_2 (5,000 nos/ha) and 328.48 kg/ha in T_1 (2,500 nos/ha). respectively. Considering the final weight, SGR and survival rate of mud crab, better performance of producing internationally accepted marketable size crabs (>180g) were achieved with the lower stocking density of 2,500 nos/ha though the total production was lower than the other socking densities.

Keywords: Stocking density, mud crab, Bangladesh.

1. Introduction

Among the cultivable shellfishes, mud crab *(Scylla serrata),* a decapod crustacean, is considered as one on the important seafood items for aquaculture in Southeast Asian countries due to its larger size, delicacy and grater demand (Dorairaj and Roy 1996). In Bangladesh, the mud crab, *S. serrata* occurs throughout the costal districts of Cox's Bazar. Chittagong. Noakhali, Bhola, Barisal, Patuakhali, Bagerhat, Khulna and Satkhira (Ahmed 1992). Bangladesh has been earning a significant amount of foreign exchange every year by exporting crabs to the international market

The mud crab fishery in Bangladesh still depends on wild caught from mangrove area. Generally, female crabs of 180g with mature gonad (fattening) and male crabs of 400g with hard body (full of flesh/muscle; hardening) demand for high price and export to the foreign country. Female crabs below 180g have no international market value but large numbers are caught in our country which has a very narrow local market. Female crabs are cultured for fattening and male for hardening by the coastal people.

The mud crab is yet not scientifically cultured in Bangladesh but extensively grown in ponds/ghers together with shrimps (Giasuddin and Alam 1992). The culture techniques have not been popularized among the peoples engaged in coastal aquaculture due to lack of technical knowledge. Due to high demand in the world market export of live mud crab from Bangladesh is increasing rapidly and the interest in culture of mud crab is also increasing so, effort should be made to give maximum profit from this species. Success of culture of mud crab depends on a number of factors mainly on stocking density food and feeding resume etc.

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It is important to maintain a suitable stocking density to support mud crab aquaculture development in view of this present research was undertaken to optimize the stocking density of juvenile mud crab, *S. serrata* in the grow out system in brackishwater earthen pounds.

2. Materials and Methods

An experiment on the optimization of stocking density of mud crab, *Scylla serrata* in the grow out system (earthen ponds) of Brackishwater Station, Bangladesh Fisheries Research Institute (BFRI), was carried out for a period of five months from May to September. 2005.

3. Experimental design

A stocking density of 2,500, 5,000, 7,500 and 10,000 crabs/ha was maintained as Tretment-1 Treatment-2 Treatment-3 and Tretment-4, respectively. Each treatment had three replications.

4. Pond preparation

Twelve brackishwater ponds (400m^2 each) were used for this experiment. The ponds were sun dried for one week. Lime @ 125 kg/ha was applied in the ponds after drying, when the soil pH was 7.0-7.5 Immediately after the lining, the ponds were filled up with tidal water of Kapotaksha river and organic manure (cowdung) was applied @ 750 kg/ha after seven days, After four days, inorganic fertilizers @ 25kg/ha urea and 15 kg/ha TSP were applied. Depth of water of the pond was maintained at a level of about one meter. The inside of pond embankment was encircled with bamboo splits made fence covered with nylon net, one meter apart from the edge of water. The splits were pushed into the soil up to 50cm depth to prevent escape burrowing of crabs.

5. Stocking of crabs

Twelve Crabs (40-50g) were collected from the Sundarbans mangrove area through fishermen. These crabs were then acclimatized for about 30 minutes in plastic bucket containing ponds water because abrupt change in physico-chemical factors may cause high mortality. After acclimatization. Crabs were stocked in the ponds with the ration of Male: Female: 1:1 following the experimental design of the experiment. Crabs were stocked after three days of applying the inorganic fertilizers.

5. Feeding and management

The crabs were fed daily with slalughtered house sate @5-10% of the biomass. About 50% of water was exchanged with tidal water at every new and full moon throughout the experimental period. The depth of the water was maintained between 1 and 1.5 meter.

7. Sampling

Growth performance in respect of carapace width (CW), bodyweight (BW) of crabs and physico-chemical parameters such as water temperature, salinity. pH. Dissolved oxygen and water transparency of the water were recorded fortnightly. Water temperature was measured with a mercury thermometer, salinity with a refractometer, the value of pH with a battery operated digital pH meter and water transparency with a secchi disk.

8. Harvesting

At the end of experiment, crabs were harvested by dewatering the pond. After harvesting, final body weight, final carapace width, specific growth rate, survival rate and total production of the crab were calculated.

9. Data analysis

The experimental data was analyzed by one way ANOVA and F Value were computed. Duncan's New Multiple Range Test (DNMRT) at 5% level was also employed for further analysis of the results.

10. Results and discussion:

Water quality analysis

Mean water quality parameters in all culture ponds throughout the experimental period are shown in **Table-1.**

Table 1. Mean (SD) water parameters in different treatments during experimental period.

parameters	Treatment-1 (T1)	Treatment-2 (T2)	Treatment-3 (T3)	Treatment-4 (T4)	F-value	Level of significance
Temperature (^{0}C)	29.34 ±0.27	29.56 ±0.47	29.21± 0.39	29.76 ±0.37	0.14	ns
Salinity(ppt)	9.24 ±5.83	9.42 ±5.01	9.0 ± 65.11	9.0 ±5.21	0.067	ns
pH	8. 1 ±1.37	8.0 ±0.97	8.2 ± 0.88	8.4 ±1.12	0.056	ns
DO (mg/1)	5.53 ± 0.13	5.76 ± 0.10	5.9 ±0.11	5.31± 0.09	0.812	ns
Transparency(cm)	29.12 ±1.16	9.69 ±1.17	8.76 ±1.07	30 ±2.30	1.023	ns

'ns' represents non-significance ($p > 0.05$)

The range of water temperature was from 28-33.5^0 Cwhich is conducive to the growth of crabs. Temperature difference among the treatments was not significant (P>0.05). Cholik and Hanafi (1992) suggested that the suitable water temperature for culture of the *Scylla serrata* ranges between 5 and 30°C. Wide range of salinity (3-16ppt) was observed with its highest in late May and lowest in mid September and difference among the treatments were not significant (p>0.05). The range pf salinity 2-18ppt, was recorded by Saha *et al.* (1997). Cholik and Hanafi (1992) reported that 10-25ppt salinity is optimal for the growth of mud crab whereas Bhuiyan and Islam (1981) reported that the lower and upper lethal salinities were 10ppt and 50ppt, respectively, pH of water **Table .1** were within the suitable range (8.0-8.4) and values were not significantly different when compared using ANOVA. pH value of 8.4-8.6 was recorded by Saha *et al,*. (1997). Dissolved oxygen (DO) and water transparency (Table -1) were recorded within a range 5.31 -5.92 mg/1 and 28.76 – 35 cm. respectively. Dissolved oxygen (DO) and water transparency also did not vary significantly among the treatments. Dissolve oxygen 5.6-6.5 mg/l and transparency 3-40cm recorded by Saha *et al.* (1997) were more or less similar to the present study.

11. Growth and Production

Growth performance of mud crab in respect of body weight (BW) throughout the cluttered period (May-September) is shown in **Fig.1.** Growth increment in T_2 T_3, and T_4 were more or less similar but in T_1, it was always higher than the other treatments. The higher body weight increment in T_1 might be due to the lower stocking density than other treatments. Body weight increment in all the treatments was higher during June and July. Significantly ($p<0.05$) highest carapace width (9.89 ± 0.57 cm) was found in T_1 followed by T_3 (8.96 ± 0.96 cm), T_2 (8.65 0.61cm) and T_4 (8.61± 0.61 cm), respectively Table 2. A growth of 0.04, 0.016. 0,108 and 0.017 cm per day was in T_1, T_2, T_3, and T_4, respectively. Difference in final body weight was significant ($p<0.05$) among the treatments but the difference was not significant ($P>0.05$) between T_2 and T_3. After five months of rearing, an average weight gain of 148.83, 199, 105.94 and 102.01g were recorded, at T_1, T_2, T_4 respectively **Table 2.**

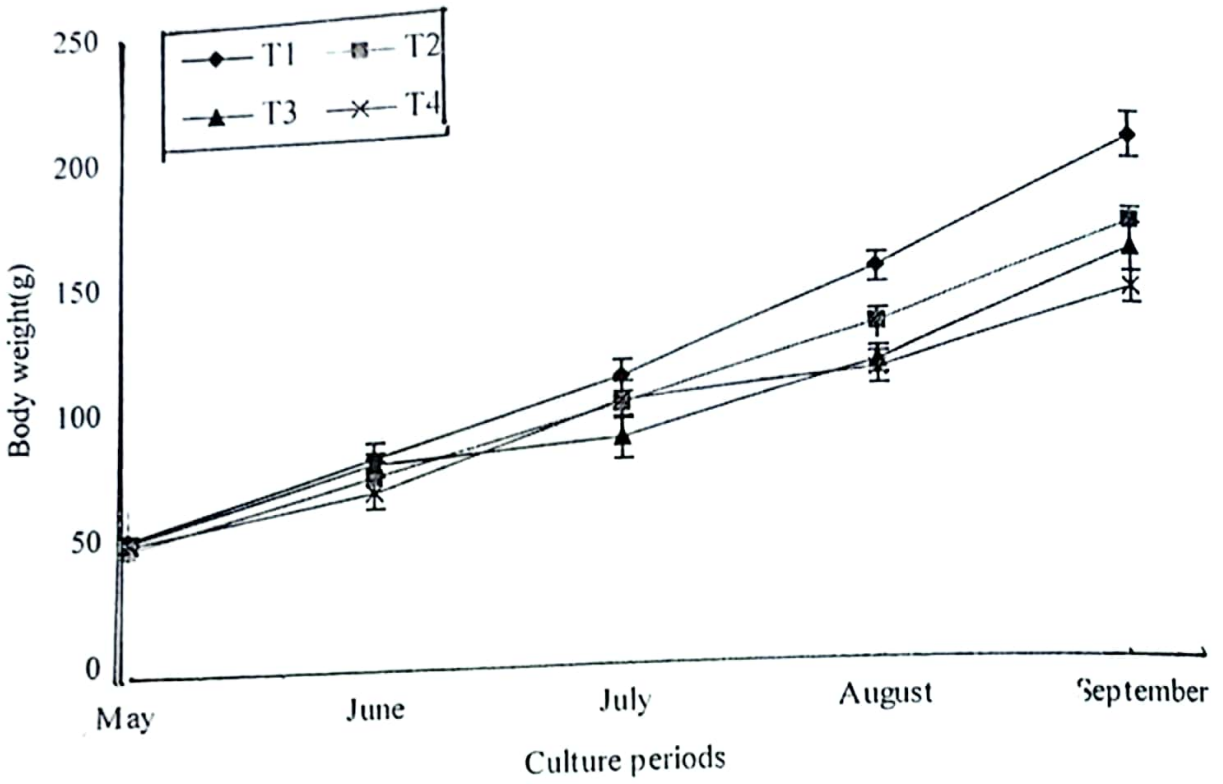

Fig.1 Growth performances of juvenile mud crabs under different stocking density over the culture period

Table 2. Growth parameters of mud crab (*S. serrata*) under different treatments

Parameters	Treatment-1 (T1)	Treatment-2 (T2)	Treatment-3 (T3)	Treatment-4 (T4)
Initial carapace width (cm)	6.26 ± 0.47	6. 22 ± 0.43	6.16 ± 0.25	5.93 ± 0.059
Final carapace width (cm)	9.89 ± 0.57a	8.65 ± 0.61	8.96 ± 0.96^{b}	8.61 ± 0.27^{b}
Initial wt.(g)	49.50 ± 1.32	49.67 ± 3.21	48.66 ± 3.78	48.32 ± 2.50
Final wt.(g)	198.33 f 9.12	164.67 ± 5.50^{b}	154.60 ± 9.37^{b}	138.33 ± 6.50^{b}
Weight gin(g)	148. ±12.05	119 ± 8.56	105.94 ± 7.65	102.01 ± 8.17
SGR (%)	0.92 ± 0.10a	0.80 ± 0.09^{b}	0.77 ± 0.11^{b}	0.69 ± 0.07^{b}
Zurvival (%)	66.25 ± 1.05a	58.50 ± 2.10^{a}	52.65 ± 1.15^{ab}	41.18 ± 1.1^{a}
Production (Kg/ha)	328.48 ±7.88b	481.66 ± 6.65^{b}	610 ± 4.04	569.64 ± 3.78^{b}

Figure in the same row with same superscripts are not significantly different ($p > 0.05$)

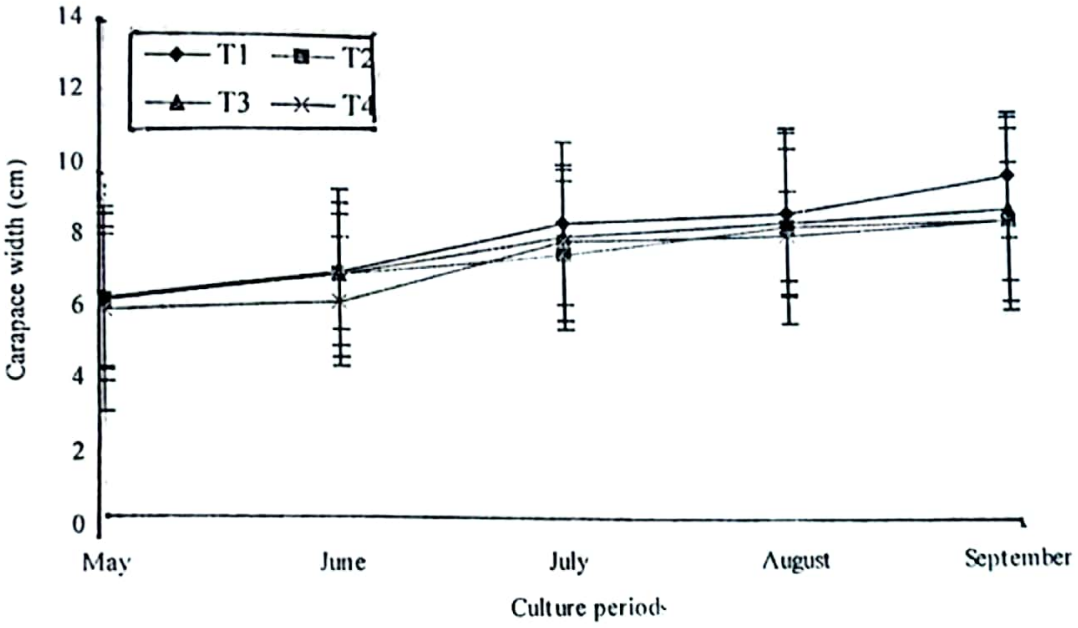

Fig. 2. Increase in carapace width of juvenile mud crabs under different stocking density over the culture period

The Specific Growth Rate (SGR) of mud crab was 0.9, 0.80 0.77 and 0.69 (%/day) in T_1, T_2 and T_3. respectively. There was significant ($p<0.05$) difference among the treatments. The men survival of mud crab varied significantly ($p<0.05$) with higher men value of 66.5% in T_1 followed by 58.50 % in T, 52 .65% in T_3 and 41.8% in T_4. Chaiyakama and Parnchsuka (1977) studied the relation among the stocking, survival rate and production of mud crab and found survival rate of 57% and 36% incase of stocking density of 10,000 nos/ha and 20,000 nos/ha respectively. Raphel (1972) worked on the pond culture of mud crab in brackish water in Sri Lank and found 36% survival rate during eight months of culture period. He reported that cannibalism was the main cause for less survival Gunarto and Cholik (1990) observed increased mortality with increasing stocking density and found survival rate of 77.05%, 70% and 3.06% at stocking density of 10,000, 20,000, 30,000 and 50,000 crab/ha, respectively. Agbayani, *et al.* (1990) studied on monoculture of mud crab at different stocking densities 5000, 10000, 15,000 and 20,000/ha for 90 days. The highest mean weight, survival and relative growth

The loss of young crabs grown in ponds for a period of 3 to 8 months can be relatively high, from 40% to 60%, if the stocking rates are high. Trino *et al.* (1999) made experiment on the effects of 3 levels of stocking density (5,000, 15,000 and 30,000 nos/ha) on the growth, survival and production of mixed species of mud crabs. They obtained the highest survival at a stocking density of 5,000 nos/ha In Indonesia, Juvenile crabs (15g) were stocked in ponds at 10,000 ,20,000 and 50,000 nos/ha and fed trash, fish, snails and clams @ 3% body weight/day. After 3 months, survival was 80%, 45% and 3.9% and average weights were 146. 159 and 158g. respectively (Allan and Fielder, 2004), Mud crabs with mean body weight ranging from 5-30g, are cultured in ponds and pens in mangroves at 5,000 – 15,000 ind./ha for over 4-6 months (Quinitio 2004) Samarasinghe *et al.* (1992) made experimental culture of mud crab (*S.serrata*) with 6000 crabs/ha, at Andriesz Mariculture Ltd, from Sri Lanka. After a grow out perio15days, 44.27 % marketable crabs were recovered. Low survival was observed in this study with consequent increase in stocking density. So the same effect of stocking density

on survival rate of crab was confirmed by the present study. The lower survival rate in T_3 and T_4 could be due to the cannibalistic nature of crab. Mortality of crab due to cannibalism has been widely documented (Iversen 1986). Cannibalism is common in mud crab culture when high stocking densities (Baliao *et al.* 1981) and mixed sex culture (Cholik and Hanafi 1992) are used. Srinivasagam *et al.* (1984) observed the cannibalistic nature of crab over even the same species during and after moulting. Escritor (1972) concluded that cannibalism and the burrowing habitat of *S.serrata* should be controlled to minimize losses and to make the crab culture profitable. Survival in pond culture is generally lower as a result of cannibalism and escape (Liong 1992). The low survival is due to low salinity in the last two months of the experimental period.

The total production of mud crab of 610 Kg/ha was significantly ($p<0.05$) higher in T_3 followed by 569.64 kg/ha in T_4, 481.66 kg/ha in T_2 and 328.48 kg/ha in T_1, respectively (Table-2). Though the production was lowest in T_1 among the treatments but body weight of all the crabs gained internationally accepted which could be used further for fattening and hardening purpose. Samonte and Agbayani (1992) compared monoculture of mud crab, *S.serrata* at stocking density of 5,000, 10,000, 15,000 and 20,000 nos/ha worked out to 675kg/ha after 8 months (Dorairaj and Roy 1996). In Philippines, average survival rate of 67% and 1450 kg/h production of mud crab (average final wt. 15g) were recorded at a stocking density of 10.000 nos/ha within 130 days culture period (Allan and Fielder, 2004), Stocking density adopted varies widely and ranges from 5000 to 10000/ha in Taiwan to less than 10000/ha in the Philippenes (Chong, 1993).

12. Conclusion

The present study revealed that the higher final weight gain, specific growth rate and survival of mud crab could be obtained by culturing them with lower stocking density of 2,500 nos/ha. Considering the above view, it may be concluded that the optimum stocking density of 2,500 nos/ha might be practiced for culturing juvenile mud crab to produce internationally accepted size (>180g) crabs which can be further used for fattening and hardening purpose.

13. References

1. Agbayani, F. R., D. D. Balia, P. B. Samonte, R. E. Tumaliuan, and R. D. Caturao, (1990) Economic feasibility analysis of the monoculture of mud crab (*Scylla serrata* (Forskal).*Aquaculture*, **91** (3-4): 223-231.

2. Ahmed, M.K., (1992) *Mud Crab A potential aqua-resources of Bangladesh.* In: The Mud crab- a report on the seminar convened in Surt Thani, Thailand, 5-8 November (1991) BOBP/REP, **51:** 95-102.

3. Allan, G and D. Fielder, (2004) Mud Crab aquaculture in Australia and Southeast Asia. ACIR working paper No 54.56 pp.

4. Baliao, D.D., E. M. Rodriguez, and D.D. Gerochi, (1981) Culture of mud crab *Scylla serrata* (Forskal) at different stocking densities in brackishwater ponds. Quarterly Research Report SEAFDEC Aquaculture Department, **5(1)**: 10-14.

5. Baliao, D. D, M. A. De Los Santosand and N.N. Franco, (1999) Pen culture of mud crab in mngroves. Aquaculture extension maul, No.**29,** March (1999). 10p

6. Bhuiyan, A.L and M.J. Islam (1981) Tolerance and distribution of *Scylla serrata* in response to salinity of Karnfully river estuary, *Bngl. J. Agric* **6:** 7-15.

7. Chaiyakam, k. and P. Parnchsuk., (1977) Experiments on rearing of mud crab, *Scylla serrata* in brackishwater pond and cement pond. Annual Report Songkhla Fisheries Station, Department of fisheries. 72-89.

8. Chong, L.P. (1993) The culture and fattening of mud crabs. Inofish *Internationl* **3/93:** 46-49.

9. Cholik, F and A. Hanafi. (1992) A review of the status of the mud *crab (Scylla serrata)* fishery and culture *in Indonesia. In:* The mud crab a report of the seminar convened in Surat Thani, Thailan, Novemer 5-8, (1991) BOBP/PER, **51**: 13-27.

10. Cowan, L., (1984) Crab forming in Japan, Taiwan and the Phillipines. Quensland Deprtment of primary industries, Brisbane, QLD. Australia information series Q 84009. 43-61 pp.

11. Dorairaj, K and S.D. Roy, (1996) Mud crab culture in the Andamans. *In:* Fisheries-A multibillion dollar industry (eds. B. Krishnamoorthi, K. N. Jrishnamoorthi, P.T Menakshisundaram, K. N. Nayar)-proceedings of the seminar held at Madras, India, August 17-19, 1995; Aquaculture Foundation of India: Madras (India), 36pp

12. Escritor, G.L., (1972) *Observation on the culture of mud crab, Scylla serrat. In:* Coastal aquaculture in the Indo-Pacific region (ed. T.V.R. Pillay). West Bfleet, Fishing News (Books) 355-361 pp

13. Gunarto, P and F. Cholik, (1990) Effect of stocking densities on mangrove crab (*Scylla serrata*) in ponds. Coastal aqua Res. J. Rica, Manors, Indonesia **12** (2): 55-61.

14. Giasuddin, M & M.F Alam, (1992) *The mud crab (Scylla serrata)* fishery and its bio economics in Bangladesh in: The mud crab-report on the seminar convened in Surat Thani, Thailand, 5-8 November 1991. BOBP/REP,**51**: 29-40.

15. Iversen, E.S., (1986) Farming in the edge of the sea. Fishing news Books, UK,301 pp.

16. Liong, P.C., (1992) the fattening and culture of the mud crab (*Scylla serrata*) in Malaysia. In: the mud crab- a report on the seminar convened in Surat Thani, Thailand, 5-9 November (1991) BOBP/REP, **51:** 185-190.

17. Quinitio, E.T., (2004) Mud crab hatchery and grow-out status in the Philippines In: Mud crab aquaculture in Australia and Southeast Asia (eds. G. Allan and D. Fielder). Proceedings of the ACIAR crab aquaculture scoping study and workshop 28-29 April (2003) Bribie Island, Australia. 56 pp.