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Study on the Effect of Stocking Density on Brood Stock Development of Mud Crab *Scylla serrata* in Brackishwater Earthen Ponds

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Abstract: A study was undertaken to evaluate the effect of stocking density on brood stock development of mud crab (*Scylla serrate*) in brackishwater earthen ponds. Four stocking densities such as 6000/ha (T_1); 8000/ha (T_2); 10000/ha (T_3) and 12000/ha (T_4) were tested and the crabs were allowed to fed with 50% slaughterhouse + 25 percent tilapia (*Oriochromis niloticus*) + 25% soft shrimp head. In terms of survival rate (both male and female) the stocking density having 6000/ha showed the best performance. For female crab significant lower survival ($p < 0.05$) was observed for T_3 and T_4 compare to T_1 and T_2. But for final growth and carapace width, an insignificant variation was noted among the treatments. However, in case of T_1 and T_2, 2.5-3.0 percent of females were found to became berried showing significant variation with other two treatments proved that high stocking has inverse effect on brood development.

Key words: Stocking density, brood, *Scylla serrate*, carapace width, berried

Introduction

As crabs is active carnivorous crustacean and prefers live organism, so its culture cost is very high. As a result it can not gain much attention of the traditional coastal aquaculture farming of the country. However, in spite of this a considerable number of farmers culture crab in closed water earthen ponds with low investment where the return is not satisfactory. Mud crab culture in our country depends overwhelmingly on wild seed supply which is another important limiting factor that hinder this businpss to a greater extend. Though fattening of mud crab (*Scylla serrate*) has been proven profitable in many countries of the world but the collection of pre-adult crab seed are done from nature, so its timely availability and abundance is also play a role as a limiting factor for expansion of this industry (Chong, 1993). With heavy exploitation, large scale destruction of mangroves and declining quality of coastal environment the situation is very unlikely to improve in the near future. Hatchery produced crab seed have been identified as a possible solution of this problems. From the life cycle study of mud crab it is known that at certain stage of livelihood, mud crabs generally dwell near shallow mangroves water. The females after maturation may migrate to deeper sea to spawn. Berried female of *Scylla serrate* are rarely caught, as mature females apparently migrate to off shore (deeper sea) to spawn (Ong, 1964; Escriton, 1972; Hill, 1974). Consequently prior to the hatchery programs for producing crab seeds, it is necessary to provide brood female crab. Hence the present investigation was designed to develop to find out an optimum stocking density for brood stock development of *Scylla serrata.*

Materials and Methods

Pond preparation: The experiment was conducted in twelve brackishwater earthen ponds of the Brackishwater Station of Bangladesh Fisheries Research Institute at Paikgacha, Khulna from late April to late July, 1998.

After constructions of dyke and gates, the ponds were allowed for sun drying for ten days. All the ponds were fenced by bamboo slits at about 0.5 m deep in the soil to prevent escaping and burrowing of crabs. Soil samples were collected from all the ponds and chemical test of collected samples were done in the laboratory. Depending upon the soil pH, lime ($CaCO_3$) was applied in each pond at the rate of 375 kg/ha and after seven days all the ponds were partially filled with tidal water from nearby Kapotaksha river.

Stocking and feeding management: Inorganic fertilizer (Urea and TSP) were used at a rate of 40 kg/ha (Urea: TSP = 2:1). After three days of fertilization adult male and female crabs (male: female = 3:2) were stocked at a rate of 6000, 8000, 10000 and 12000/ha and the treatments were denoted as the T_1, T_2, T_3 and T_4 respectively with three replication of each. Crabs were fed with slaughterhouse waste (50%), soft portion of fresh shrimp head (25%) and tilapia (*Oriochromis niloticus*) as trash fish (25%) at the rate of 10-6 percent body weight/twice daily. After 45 days of feeding, feed composition was changed to 50 percent slaughterhouse waste and 50% tilapia (*Oriochromis niloticus*) due to the unavailability of shrimp head and applied at rate of 5% body weight twice daily (morning and evening). To keep the culture environment healthy, water was exchanged at a rate of 40-45 percent of pond volume during every new and full moon.

Sampling: Growth study was done in respect of carapace width and body weight of crab fortnightly. Physico-chemical parameters of water such as water temperature, water transparency, pH, dissolved oxygen, salinity etc., were monitored in every week.

Harvesting: All crabs were harvested by completely drain out of the pond water. Comparison of treatments means was carry out using one way analysis of variance (ANOVA) and Duncun's Multiple Range Test (DMRT) $p < 0.05$.

Results

Among the water quality parameters water temperature was found to range from 28-33°C during the culture period without any significant variation among the treatments. Wide range of salinity (6-18 ppt) was noted during the experimental period with its highest in late May and lowest in late July. A suitable pH and dissolved oxygen range of 7.9-8.6 and 5.6-6.5 ppm were noted without any significant variation among the treatments. The average water transparency for all the treatments found to range between 35-45 cm. The growth responses and survival rate of crabs at different treatments are presented in Table 1 and 2 respectively. Though a significant high initial carapace width of crab for T_2 was recorded but in case of final carapace width no significant variation was observed for male crab. For female crab, no significant variation in carapace widthwasrecorded both for initial and final stage. The maximum carapace width attained by male and female was 12.52 and 10.84 cm in T_3 and T_4

Table 1: Initial and final carapace width, weight and survival rate of male crab during the experimental period

Parameters	Treatments			
	T_1	T_2	T_3	T_4
Initial carapace width (cm)	11.91[b]	12.06[a]	11.89[b]	11.82[b]
Final carapace width (cm)	12.03[a]	12.30[a]	12.52[a]	12.19[a]
Initial weight (g)	474.17[b]	483.75[a]	470.50[c]	464.17[d]
Final weight (g)	498.64[a]	513.20[a]	506.33[a]	497.88[a]
Survival rates (%)	93.33[a]	66.25[b]	64.00[b]	67.50[b]

Figure in the same row with same superscripts are not significantly different

Table 2: Initial and final carapace width, weight, survival rate and maturation of female crab during the experimental period

Parameters	Treatments			
	T_1	T_2	T_3	T_4
Initial carapace width (cm)	10.50[a]	10.58[a]	10.72[a]	10.50[a]
Final carapace width (cm)	10.78[a]	10.82[a]	10.61[a]	10.84[a]
Initial weight (g)	205.00[c]	212.17[b]	223.83[a]	207.23[c]
Final weight (g)	257.02[a]	243.34[a]	236.98[a]	245.78[a]
Survival rates (%)	45.55[a]	45.00[a]	29.33[b]	24.77[b]
Berried female (%)	3.00[a]	2.50[a]	2.10[b]	2.00[b]

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

respectively. Maximum weight attained by the male crabs is 513.2o g in T_2 without showing any significant variation among the treatment but for female the maximum weight was for the crab of T_1 (257.02 g) where the variation among the treatments was not significant.

Among the four stocking densities the significant higher survival rates both for male and female crabs (male, 93.33% and female 45.55%) were found in T_1 (6000/ha). Insignificant variation was observed in survival rate of male crabs among all the treatments ($T_2=66.25\%$, $T_3=64.00\%$, $T_4=67.50\%$) I. e. for T_2, T_3 and T_4 no impact on survival rate due to gradual increase in stocking rate was observed. But for female crabs a negative co-relation was noted where the survival rate was found to decrease with gradual increase in stocking densities ($T_2=45.00\%$, $T_3=29.33\%$, $T_4=24.77\%$). Berried female was estimated as 3, 2.5, 2.1 and 2 percent for T_1, T_2, T_3 and T_4 respectively.

Discussion

Physico-chemical parameters of water play a very important role on the growth, survivability and maturation of mud crab. Preferably in high temperature above 25°C and in salinity below 17 ppt. considerable mortality on crab zoae generally occur (Hill, 1974). Hence, in natural environmental condition, berried female is found to migrate towards deeper sea in order to get suitable saline condition to spawn since natural seawater is 35.5 ppt. As in the present experiment the range of salinity was noted as 18-6 ppt which is lower than the required level for crab maturation and this is apparently the main cause of development very low percent (not more than 3%) of berried female during the experimental period. The range of water temperature was 28-33°C, which is more or less suitable for crab maturation. The range of pH and dissolved oxygen were 7.9-8.6 and 5.6-6.5 ppm respectively and these were also found suitable for culture and maturation of mud crab (*Scylla serrate*).

Initial carapace width of male crab in T_2 (12.08 cm) shows significant higher value than that of T_1, T_3 and T_4, that indicates the size variation of male crab at the time of stocking. For similar cause initial weight of male crab show significant differences among the treatments. No significant difference in final carapace width and weight of male crab among the treatment was observed. This was might due to the non-molting of male crab during experimental period. Incase of female, initial weight in T_3 and T_2 though showed significant difference than others but no significant difference in initial carapace width, final carapace width and final weight was observed. The average initial carapace width of male crab during stocking period was 11.92 cm and this was more or less appropriate carapace width when male crab attains its maturity. Prasad and Neelakantan (1990) reported that male crab attains maturity when the range of carapace width is 8.1 to 90 cm. At 9.7 cm carapace width 50 percent of males become mature. According to Quinn and Kojis (1987) *S. serrate* becomes sexually mature at a smaller size (10.0 cm carapace width) than others species (*S. pramamosain* at 12 cm). The initial average carapace width of female crab was 10.50 cm at stocking time. Prasad and Neelakantan (1989) observed that female crab attained sexual maturity after reaching 8.0 cm carapace width and above. 50% of female at size range 9.1 to 10.0 cm carapace width are sexually mature. Jayamnna and Jinadasa (1993) cited the size of female crab at first maturity was 12.0 cm. Poovachiranon (1992) stated that female crab attain sexual maturity when their maturity index value is at least 0.88 or their carapace width is about 11.0 cm. Considering the findings of the authors mentioned above, the crabs reared in this experiment collected from neaby brackishwater river had the carapace width which were supposed to attained maturity in natural environment but in practice it was not. Because low range of salinity has a direct effect on crab maturation and the river salinity was ranging between 18-6 ppt (higher salinity existed for a very short time). So in spite of having higher initial carapace width of both male and female, none of them attained maturity in low saline brackishwater river, which was further continued where experimented in the ponds of similar environment with density higher than the nature. Highest survival rates of both male and female crabs were found at low stocking density (6000/ha, in T_1), which agrees with the finding of Chaiyukam and Pamichsuka (1977). The authors also studied the relationship among stocking density, survival rate and production of mud crab *Scylla serrate* and found a maximum survival of 57 percent with 10,000/ha stocking density where they observed low survival with consequent increase in stocking density. So the inverse effect of stocking density on survival rate of crab was confirmed by the present study. Baliao *et al.* (1981) also suggested that crabs stocked at low densities (5000/ha) had the highest average weight and survival percentage. In this experiment compare to female crab, average higher survival was

recorded for male with similar decreasing trend with increasing stocking density. The probable cause of low survival in female population might the grasping and attacking nature of adult males over the females, that might cause biological injury to females and ultimately die. Srinivasagam *et al*. (1984) observed the cannibalistic nature of crab over even the same species during and after molting. Regarding brood development very low percentage (less than 3.o%) of female have been found to berried which is apparently due to late stocking in May and the lower salinity range (6-18 opt) of the rearing ponds as well. Though there is controversy about the spawning time of *Scylla serrate* in various region, preferably in Bangladesh, it has been observed that though crab spawn are available year round at different degrees but its abundance Is mostly observed during March-June. Jayamanna and Jinadasa (1993) stated that mud crab spawn all through the year with two peak, one in December-March and another in September-November. However considering the above observation of spawning time and frequency of spawning it can be concluded that the period of experimented in the present study does not have any impact on maturity study of fnud crab.

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