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SOME ASPECTS OF CAPTIVE BREEDING BIOLOGY OF MUD CRAB, *SCYLLA SERRATA* IN BANGLADESH

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ABSTRACT

Sarower MG, Aktar N, Mostafa M, Sabbir W, Islam MS (2012) Some aspects of captive breeding biology of mud crab, *Scylla serrata* in Bangladesh. *J. Innov. Dev. Strategy*. 6(2), 1-6.

The aquaculture of *Scylla serrata* has been practiced based primarily on capture and fattening of juvenile from the wild. Due to natural dependency to culture and environmental changes, made the species a threatened one. With the aim of bringing this species into culture system, bloodstock and embryonic development, and breeding technique of the mud crab *S. serrata* were investigated to develop hatchery technology in Bangladesh. Ten broods of *S. serrata* were collected from brood rearing pond to develop a crab breeding program in hatchery. Broods were spawned within three days and hatched within 7-8 days. The average fecundity was approximately 10,00000±70750 and the hatching rate was 5%. In embryonic development, only blastula stage and in larval development, newly hatch zoea stage was identified. The high mortality rate of the embryo and larvae due to might be low dose of disinfectant and improper transportation of eggs. However, present findings will be act as the baseline for the further research to establish a hatchery which is needed for the country to sustain coastal aquaculture against natural calamities as well as diseases outbreak in the shrimp farming.

Key words: *Scylla serrata, broodstock management, breeding technique, embryonic development, larval development*

INTRODUCTION

Crabs of the genus *Scylla*, commonly referred to as mud crabs, are commercially important in Southeast Asia. *Scylla serrata* is the most widespread of the four recognized *Scylla* species (Keenan *et al.* 1998). Mud crab aquaculture has been practiced for many years in Asian countries, based primarily on capture and fattening of juvenile from the wild which has led to over-exploitation in many areas. In Bangladesh, mud crab culture has been gaining popularity among the coastal communities in greater Khulna and Chittagong regions in Bangladesh (Azam *et al.* 1998). This is due to high demand in international markets and search for alternative coastal aquaculture species of shrimp because of its mass mortality due to disease outbreaks.

Mud crab farmers depend completely on natural wild seed. So, seed is a limiting factor for the expansion of crab culture in Bangladesh. The continuous collection of wild seeds for grow-out culture has threatened the wild stock population. Moreover, seed production of *S. serrata* is still dependent on natural spawners. As crab seed resources from the wild are practically limited, future expansion of mud crab farming will have to depend upon hatchery produced seed, which in turn depends on the availability of berried female. Besides, an essential component of hatchery production is the establishment of a broodstock that can produce a predictable supply of fertilized eggs (Wickins and Lee, 2002). Thus, domesticated broodstock can be a convenient alternative to wild spawners for a steady supply of the crab seeds and stability in the production of their larvae.

Though there is a great potential of this species to introduce in our aquaculture practices, no hatchery yet establish for seed production. Bangladesh has a coastline of 710 km with 6,18,780 ha of mangrove tidal flat and 80,000 ha of prime area which is suitable for brackish water aquaculture (Anon. 2004). To date, captive breeding (Prasad and Neelakantan, 1989; Mann *et al.* 1999; Millamena and Quinitio, 2000; Hai *et al.* 2001; Djunaidah *et al.* 2003; Quinitio *et al.* 2001; Hamasaki *et al.* 2002; Ruscoe *et al.* 2004) and larval rearing (Dat 1999; Quinitio *et al.* 2001; and Quinitio and Parado-Estepa, 2008) of mud crab were done in some other countries. However, problems involved in seed production of *S. serrata* in different hatcheries are due to lack of availability of mature brood, low rate of hatching, low survival rate (only 10-15% because of mass mortality in the first and second zoeal stages) etc (Heasman and Fielder, 1983; Mann *et al.* 1999; and, Hamasaki *et al.* 2002). The present experiment was conducted to develop brood in captivity, to produce seed of *S. serrata* under a hatchery condition and to observe their embryonic development.

MATERIALS AND METHODS

Broodstock management

Broodstock rearing was conducted at Munshigonj, Satkhira with the collaboration of local NGO `Sushilon` from September 2011 to March 2012. Ten ponds were selected with an average size of 30 decimal each and were prepared by sun drying method. Each pond was fenced by bamboo stick with an average height of 3 feet. Female crabs (average weight 150 ± 25.50 g) were stocked at the density of 150 pond^{-1} and reared for about two weeks for gonad development. Different types of trash fish were given twice daily as a live feed at the rate of 10% of the body weight.

Collection and acclimatization of berried crabs

Ten berried crabs were collected from the broodstock management pond. Berried crabs were transferred and were kept at "Sundarban Galda Hatchery", Khulna with proper sheltering. Berried mud crabs were disinfected by 0.4 $ml.L^{-1}$ formalin for 30 minutes for disinfection. After disinfection, the adult mud crabs were acclimatized by maintaining proper salinity concentration, before the initiation of trials on breeding. Before releasing berried crabs, hatchery water was filtered and then bleaching powder mixed with water at the proportion of 1 kg bleaching at 50 ton water. Brine water was mixed with water and finally, salinity kept at 30 ppt. Then, water was aerated for 12 hours and again kept for additional 6 hours for settlement. Again, water was filtered. Temperature, salinity and pH were maintained properly in the hatchery tank. However, no feed was given at that time.

Observation of embryonic development and estimation of hatching rate

Released eggs of mud crabs were transferred at the Fish Biology Laboratory at Khulna University to observe the embryonic development by using microscope and photo of embryo were taken by microscopic camera (Carl Zeiss Micro Imaging GMBH, Germany). After hatching, the total numbers of hatchling were taken at 500 ml beaker. Then, one-fourth milliliter (0.25 ml) samples were counted and calculate the total hatchling followed the estimation of hatching rate.

Fecundity estimation

Fecundity was calculated by gravimetric method. For this, another same size of 10 broods were collected from the broodstock ponds and the fecundity was obtained by using the below formula.

$$F = \frac{\text{Total gonad weight} \times N}{\text{Weight of small portion of total gonad}}$$

Here, F = Fecundity; N= Number of eggs

Statistical analysis

The data were analyzed by using Microsoft excel. The linear regression was performed to indicate the relationship between body size and fecundity of the species.

RESULTS

Maturation of brood crabs

Water quality parameters were measured daily during gonad development at the broodstock management pond which is mentioned in table 1. The average carapace length (CL), and total weight of crab at the time of stocking in the pond were 90±7.08 mm and 139±25.25 g, respectively.

Table 1. Water quality parameters at brood management pond at Munshigonj, Satkhira

Parameters	Measures
Water depth	1.5 m
Salinity	4-8 ppt
pH	7.5 to 8.2
Water Temperature	25-28ºC

The egg bearing crabs was reported within 10 to 12 days (Fig. 1A). When the female mud crab was ready to spawn, eggs were bright orange when extruded and turned almost black by the time they were ready to hatch and transfer to the hatchery (Fig. 1B).

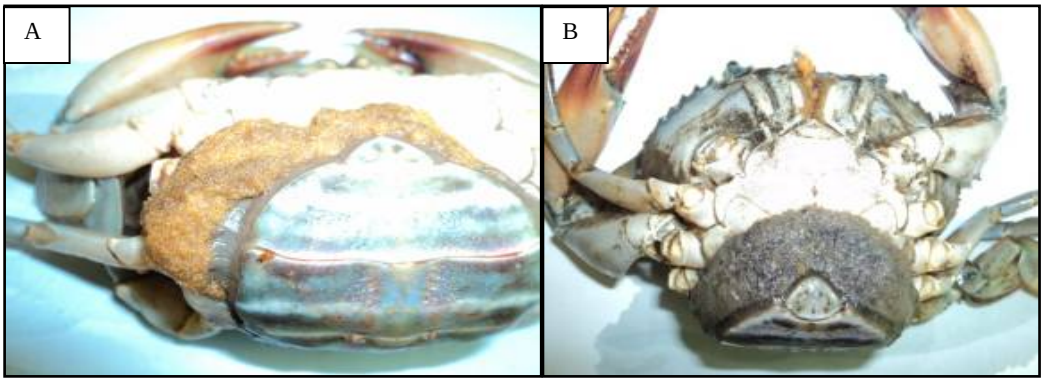

Fig. 1. Extruded eggs of experimental mud crab (*Scylla serrata*) from the broodstock management pond, Munshigonj, Satkhira; A) Early maturation and B) Late maturation which ready to spawn

Breeding and embryonic development

The berried crabs were kept in the hatchery and waited for the hatch. Within three days, among the stocked ten berried crabs, eight of them released egg and rest two was died. During this period, the range of pH, salinity and temperature were recorded as 7.5-7.6, 28-30 ppt and 26-28ºC.

Hatching and larval development

The eggs hatched within 7-8 days in the aquarium at the Fish Biology Laboratory, Khulna University (Fig. 2). However, the maximum embryos were died within 12 hours (Fig. 3). Due to the high mortality rate of embryos in the aquarium, only blastula stage was possible to observe (Fig. 3 Inset).

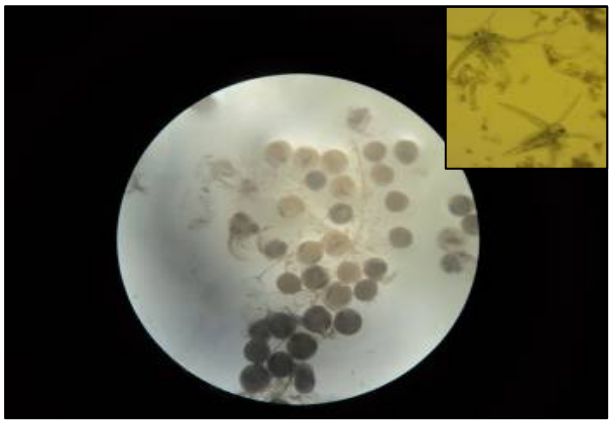

Fig. 2. Eggs of mud crab (*Scylla serrata*) are started to hatch at Fish Biology Laboratory of Khulna University and new hatched Zoea stage (Inset)

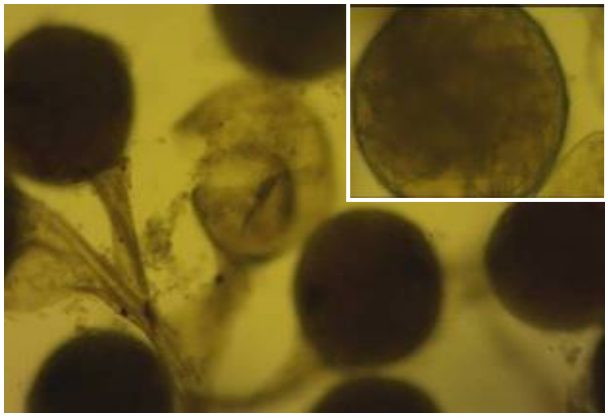

Fig. 3. Dead eggs of mud crab (*Scylla serrata*) observed after few hours of spawn. However, blastula stage noticed for the few eggs (Inset)

Continues microscopic observation, newly hatched zoea was observed (Fig. 2). Unfortunately, all the zoea was died before reaching at the megalopa stage. So, it was impossible to observe rest of larval stage of *S. serrata.* The hatchlings were taken at 500 ml beaker and ¼th ml (0.25 ml) sample was taken for three times from the beaker. The average hatchling was count as 45000±3250 individual^{-1}, having 5% of hatching rate.

Fecundity estimation

The carapace width and total weight of the experimental mud crab for fecundity estimation were raging from 75 mm to 87 mm and 175 g to 225 g, respectively. The total gonad weight was ranging from 34 g to 45 g. The average fecundity were observed to be 9,75,000±70750 individual^{-1}. Regression analysis showed a strong positive relationship between carapace width and fecundity (Fig. 4).

DISCUSSION

Maturation of mud crab

In the current study, various water quality parameters were recorded during broodstock management. Hill (1974) showed for the broodstock development salinity is needed 15 ppt and temperature at 31.2°C. However, though temperature supported by the study of Hill, the salinity was less than 8 ppt. It was due to considered the natural salinity of the area of the season. The source of water as well as source of brood crabs for the broodstock management pond was from the natural river system. Present study did not cover the success rate of ovarian

development of the species stocked in the broodstock management pond due to some business strategy of host organization. This segment of study was conducted with support of local NGO, Sushilon. However, it could be guessed that 100% ovarian development of the species, supplying various trash fish such as tilapia, chingri and snail, were given for attaining very fast gonad development. Ali and Saha (2012) observed 100% maturation of mud crab with supplying the trash fish as a feed rather than artificial feed. It is generally accepted that broodstock feed quality and quantity are important determinants of egg quality and viability of crustacean (De Caluwe *et al.* 1995, and Millamena and Quinitio, 2000).

Generally egg color is considered to be an indicator of egg quality as well as spawning time in *S. serrata* (Ong 1966). It is observed that mud crab eggs were bright orange when extruded and turned almost black by the time they were ready to hatch. However, the color of the crab eggs ranged from pale yellow to orange-red and it might be species-specific (Islam *et al.* 2010). In aspect on the size of maturity, present study showed earlier maturation than other studies. It is found that mature crab showed at the carapace width 7.5±1.25 cm. Jayamanna and Jinadasa (1993) reported that wild *S. serrata* crab attained first maturity at 12 cm CW whereas Robertson and Kruger (1994) reported 10.2 cm from a wild catch. Another such studies indicated *S. serrata* become reproductively mature starting at around 90 mm carapace width, often within the first year of life (Knuckey 1996). However, the early maturation of the species from the present study might be due to the supplementary feeding in the rearing pond or due to effect of over fishing of the species in the locality.

Breeding and embryonic development

S. serrata eggs hatched within 7-8 days at 26 to 28^{o}C which supported by other such studies like 7 to 9 days (Samuel and Soundarapandian, 2010); 6 to 12 days at 26.5 to 30.5^{o}C (Quinitio *et al.* 2001) and 7-14 days at 25 to 30^{o}C (Marichamy and Rajapackiam, 1992). However, Heasman and Fielder, 1983 reported that the incubation period of *S. serrata* eggs may two to three times longer at 18 to 20^{o}C than at 26 to 28^{o}C.

Maximum mortality of embryos was observed due to might be the low dose of formalin and lack of aeration during transformation of embryos. The eggs had to carry long distance from the hatchery to the University Laboratory. Moreover, various fungi and other parasites generally kept with berried females and it causes higher mortality for the embryo. Quinitio *et al.* (2001) found that when incubation period was extended to more than eight days, fungal (*Lagenidium*) and ciliate (*Zoothamnium*) fouling cause retarded embryonic development and egg mortality due to restricted oxygen exchange across the egg membrane. Though present study showed incubation period is within 8 days, it is thought that microbial infection started earlier as the low dose of disinfectant. However, due to the mass mortality, only blastula stage was possible to observe. In another studies, it is observed five distinct stages of embryonic development of *S. serrata* (Quinitio *et al.* 2007; Samuel and Soundarapandian, 2010). In very recent, Ates *et al.* (2012) found 10 distinct stages of embryo of *S. serrata.*

Hatching and larval development

The hatching rate was significantly low to compare to the other study. The estimated hatching rate was only 5% whereas, 75% of hatching rate of S. *serrata* noticed by Prasad and Neelakantan (1989) and 94% by Hai *et al.* (2001) in incubator tank. Even though, the 5% of hatching of the eggs, unfortunately, all the zoeas were died before reaching at the megalopa stage. So, it was not possible to observe rest of the stage of larval development of mud crab. Whereas, Marichamy and Rajapackiam (1992) reported 3 to 4 days duration for each of the 5 zoea stages and 8 to 11 days for megalopa at 27 to 30^{o}C. Mortality was highest during metamorphosis from zoea to megalopa and as many dead larvae were siphoned out from the tank bottom.

Fecundity

Fecundity appears to bear some broad relationship to the care accorded to the eggs (Lagler *et al.* 1967). Knowledge about fecundity of a species is essential for evaluating the commercial potentialities of its stock, life history, potential for commercial farming as well as for estimation of reproductive potential and actual management of any fishery (Lagler 1956). Fecundity in most crab genera generally increases with size (Prasad and Neelakantan, 1989). Results showed the similar strong trend of fecundity with the carapace width (Fig. 4). The fecundity range was 9, 00000 to 11, 00000 of experimental species which size range was 75 to 87mm which is supported by Srinivasagam *et al.* (2000) where they found 10,00000 to 23,00000 with the carapace width 85 to 137 mm.

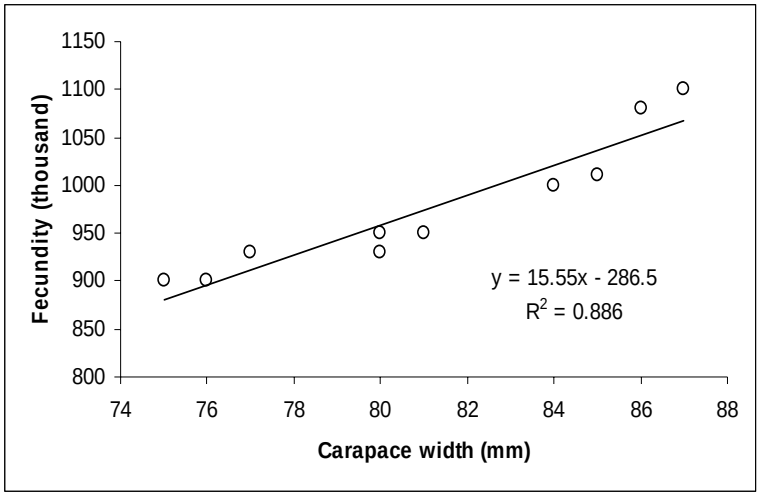

Fig. 4. Relationship between carapace width and fecundity of mud crab, *Scylla serrata* from Munshigonj, Satkhira. The carapace width and fecundity of mud crab showed strongly correlated (r^2=0.886)

CONCLUSION

The present first preliminary study in the country showed 5% hatching success of the species *S. serrata* in captive condition. The stage of zoea was recognized in larval development. However, mass mortality limited the study to observe the late larval stages. Thus, further research is suggested on breeding of mud crab for the further proceed to establishment of hatchery in the local condition.

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