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Effect of stocking density on survival and growth of mud crablings, *Scylla* sp., in laboratory conditions

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Abstract
Mud crablings, *Scylla* sp. were reared, for a period of six weeks in fiberglass aquarium under laboratory conditions, to determine the effect of four different stocking densities of 1, 2, 3 and 4 crabling/l of water on their survival and growth. Salinity of water was maintained at 25 ppt throughout the rearing period. Stocking rates of 1, 2, and 3 crabling/l resulted in a similar ($p>0.05$) survival rates of 75, 74, and 83.5%, respectively, that of 4 crabling/l resulted in significantly lower ($p<0.05$) survival rate of 56%. No significant difference was observed among different stocking densities in average growth of carapace length (CL), carapace width (CW) and body weight (BW).

Key words: *Scylla* sp., Stocking density, Survival, Growth

Introduction

In Bangladesh, the mud crab, *Scylla* species is distributed throughout the coastal districts of Cox's Bazar, Chittagong, Noakhali, Bhola, Barisal, Potuakhali, Bagerhat, Khulna and Satkhira (Ahmed 1992). As there is flourishing international trade in live mud crab and the market is highly demanding, this non-conventional fisheries commodity has been playing a significant role in export earnings of Bangladesh.

Mud crabs are mainly caught from mangrove areas at high tide especially when they move with the tidal water in search of food. Higher demand for mud crabs in international markets in recent years has been resulting in their drastic decline in fisheries through intensive and indiscriminate natural fishing. Not only to conserve this natural fisheries resources, but also for ensuring predictable supply of crabs for export market, there is an urgent need for development of mud crab production through aquaculture. The mud crab is a very good alternative to shrimp and in diversification of aquaculture activities in brackishwater environment. Though interest on crab farming in coastal region of Bangladesh has been generated, inadequate supply of suitable sized crabs for stocking in grow-out ponds has been a great constraint towards the expansion of culture and fattening of mud crabs. Supply of juvenile crabs of more or less similar size should be ensured for the development of their culture and fattening.

Collections of crabs from the wild vary in size and age with the seasons. This hinders the development of large-scale crab culture, though there is sufficient market demand. Nursing of crablings in controlled conditions may be an effective tool in producing juvenile crabs of similar size for stocking in grow-out ponds. Mud crab, *Scylla* species is cannibalistic by nature and within their reach they normally attack each other with their chelae. Mortality due to the cannibalistic nature of mud crabs has been widely reported (Iversen 1986, Ryther and Bardach 1974, Costlow 1967). To avoid the mortality due to cannibalism, stocking density is a key factor to be considered carefully. The present experiment was carried out in fiberglass aquarium in laboratory conditions with the aim to understand effects of different stocking densities on survival rate and growth of mud crablings, *Scylla* species.

Materials and methods

The experiment was conducted for a period of six weeks in the Wet Laboratory of Brackishwater Station, Bangladesh Fisheries Research Institute. Twelve fibreglass aquariums having 71 cm L x 33 cm W x 30 cm H in size were set in the laboratory with a provision of continuous aeration. Each aquarium was filled up with 25 litre of water having 25 ppt salinity, which was maintained throughout the experiment. Few pieces of small stones and rocks were used in the bottom of each aquarium for the shelter of crablings. The crablings of *Scylla* sp. (CL, 1.12±0.12; CW, 0.78±0.07 & BW, 0.23±0.07) were collected from natural sources of Paikgacha region, Khulna. They were accustomed to the laboratory conditions for a period of two days prior to release in aquarium (Zainoddin 1992).

Four different stocking densities of 1, 2, 3 and 4 crablings/litre were tested to examine its effect on survival rate and growth of carblings. Each stocking density was considered as a treatment and assigned in a Randomized Complete Block (RCB) design with three replications. During the experimental period, slaughterhouse waste was given daily as feed to crablings @ 5% of the biomass. To avoid decomposition of uneaten food particles and as well as to maintain water quality, each aquarium was replenished by new water (nearly 40-50%) regularly through siphoning with a plastic pipe. Temperature of new water was maintained very similar to aquarium water.

At least 50% of the stocked crabs in each aquarium were sampled in every week to record data in respect of survival rate, carapace length (CL), carapace width (CW), and body weight (BW). However, the aquariums were checked daily for any mortality of crablings. To measure the CL and CW a vernier slide caliper to the nearest 0.1 mm was used. An electric balance to the nearest of 0.01 g was used for measuring body weight. The experimental data were then analyzed by one way ANOVA and F values were computed. Duncan`s New Multiple Range Test (DNMRT) at 1% level was also employed for further analysis of the results.

Results and discussion

The values of water temperature, salinity, and pH in crabling rearing aquariums varied from 27-31^{0}C, 24-26 ppt, and 7.8-8.3, respectively, throughout the experiment. These water quality values were within the suitable range in conformity with Zainoddin (1992) who has reported that zoea through megalopa metamorphosed successfully to the first crab at 28-30^{0}C, with a salinity ranging from at 25-30 ppt and pH from 8.0-8.7. However, different authors have reported different suitable ranges of water quality parameters in rearing of mud crablings. Marichamy and Rajapackiam (1992) indicated that the most suitable range of temperature for crab larvae, including the megalopa stage, was 28-31^{0}C and salinity of around 35 ppt. Rearing of crab zoea has also been done at a mean temperature of 27.5^{0}C and salinity of 31±2 ppt (Ong 1964, Ong 1966, Heasman and Fielder 1983). Though the water temperature and salinity ranges reported by above authors are higher than that has been maintained during the present experiment, there have been reports on crab larval rearing in a lower temperature of 22-24^{0}C (DuPlesis 1971, Brick 1974). All of the above authors used higher salinity range of 30-35 ppt particularly in rearing of zoea stages, but they reared megalopa larvae in a reduced salinity range of 26-28 ppt, as the post-larval stages are expected to have greater tolerance to reduce salinity and temperature. It is to note that, crablings were well suited with the temperature and salinity ranges that were maintained in aquarium during the present experiment.

The changes in carapace length (CL), carapace widths (CW) and body weight (BW) of mud crablings reared at four different stocking densities of 1, 2, 3, and 4/l in laboratory conditions are shown in Figs. 1, 2 and 3. While the CL, CW, and BW values of crablings at the end of experiment were 1.57 cm, 1.16 cm, and 0.48 g for 1 crabling/l (T1), that for 2 crablings/l (T2) were 1.54 cm, 1.14 cm, and 0.60 g, that for 3 crablings/l (T3) were 1.77 cm, 1.33 cm, and 0.64 g, and that for 4 crablings/l (T4) were 1.93 cm, 1.34 cm, and 0.77 g respectively. No significant difference was observed among four different stocking densities in the changes of CL, CW and BW of mud crablings during the experimental period. However, the growth of crablings increased in progress with the rearing period irrespective of variation in stocking densities (Figs. 1, 2 and 3).

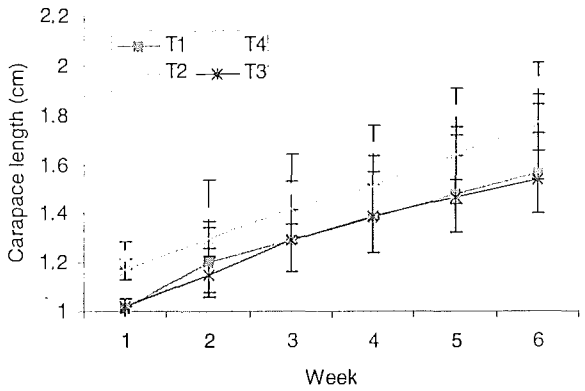

Fig. 1. Changes of carapace length of mud crablings under four different stocking densities.

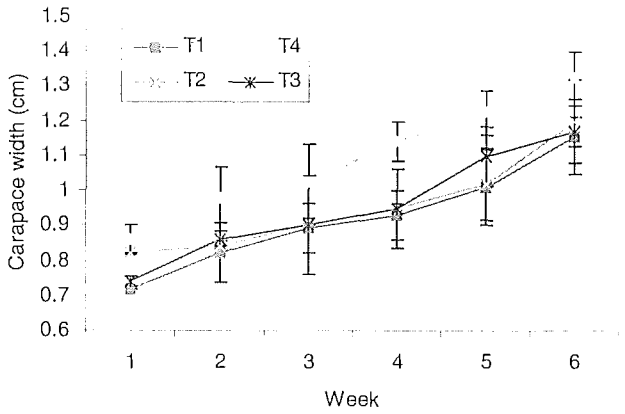

Fig. 2. Changes of carapace width of mud crablings under four different stocking densities.

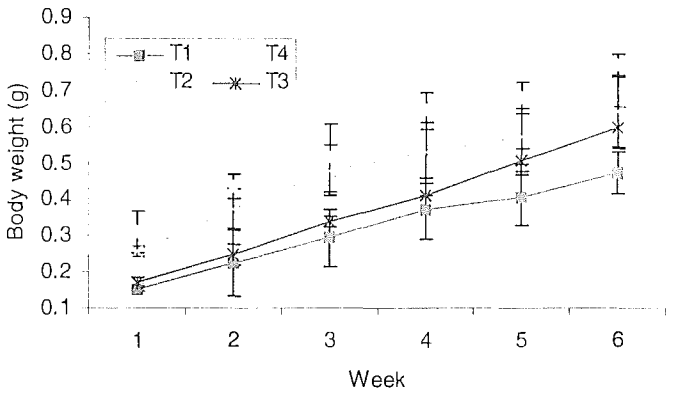

Fig. 3. Changes of body weight of mud crablings under four different stocking densities.

Survival rates of crablings in different weeks under four different treatments are shown in Table 1. In each treatment, incremental rate of mortality was observed with the continuation of the experiment. Though the rate of mortality was not significantly different ($p>0.01$) among the treatments up to the 3rd week, but that was significantly different ($p<0.01$) from the 4th week onwards (Tables 1 and 2). At the end of the experiment, survival rates of crablings for T1, T2, and T3 ranged between 74-83.5%, without any significant difference ($p> 0.01$), but that for T4 was significantly as low as 56%. This significantly lower survival rate, with a high stocking density of 4 crablings/l, might be due to occurrences of easy cannibalism. The more the density the more the cannibalism was observed. Generally, immediately after moulting crabling`s body become very soft and pass through a very critical time of their life. Due to softness of their body, crablings are being easily attacked by other crablings. Sudden death of crablings was also observed due to their inability in moulting. Unsuccessful moulting and cannibalistic nature of mud crablings were the major causes of low survival.

Scientists from the National Taiwan University observed a maximum production of 60% of mud crab seed by rearing the larvae in water treated with sand filter, UV light and antibiotics (Marichamy and Rajapackiam 1992).

Table 1. The mean survival of mud crablings, *Scylla* species at different weeks and stocking densities

Week	Survival (%)			
	1 crabling/l (T1)	2 crablings/l (T2)	3 crablings (T3)	4 crablings/l (T4)
1st	98	100	100	95.5
2nd	96	96	99	94
3rd	92	92	97.5	86.5
4th	83.5[a]	82[a]	89[a]	65[b]
5th	79.5[a]	77[a]	86.5[a]	60.5[b]
6th	75[a]	74[a]	83.5[a]	56[b]

*Different letters are significantly different with each other when compared with DNMRT

Table 2. The computed F-value of ANOVA at different weeks and Stocking densities of mud crablings, *Scylla* species survival

Week	F-values	Tabulated F-values
1st	4.294[NS]	16.69 - 1%
2nd	0.809[NS]	
3rd	3.585[NS]	
4th	132.179[*]	
5th	62.569[*]	
6th	43.666[*]	

NS= Not significant; *= Significant at 1% level

The high cannibalism during the first crab stage and onwards is a constraint in the nursery and it could be as high as 60 percent within a few days at a stocking density of 10 pcs/litre (Zainoddin 1992). Cannibalism continued even when enough food was provided. The author suggested that it may be reduced by lowering the stocking density to 5 pcs./litre. Though the present experiment was not conducted in such a sophisticated manner, as followed by Marichamy and Rajapackiam (1992), the results on survival rate are in conformity with that has been reported above authors. The survival rates of 74-83.5% with the stocking densities of 1-3 crablings/l also suggest that a stocking density up to 3/l could be practiced in nursing mud crablings under normal laboratory conditions. While stocking density of crablings are very much critical factor for crab culture, it is very important to make sure that same sizes of crab are stocked. Application of sufficient food in time to avoid cannibalism is also very important to notice. To reduce high mortality caused by cannibalism in larval stages, direct stocking of crabs of megalopa and onward stages to the pond maintaining a standard stocking density is recommended.

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