

Nursery rearing of *Macrobrachium rosenbergii* (de Man) using hapa-nets : effects of stocking density

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Abstract

An experiment was conducted in two phases for 45 days each to study the effects of six stocking densities (phase-I: 100, 200 and 300 PL/m² and phase-II: 250, 500 and 750 PL/m²) on growth and survival of *Macrobrachium rosenbergii* postlarvae (PL) in nylon hapa-nets (1.8 m x 1.8 m x 1.4 m) installed in a pond. Stocking densities of 100, 200 and 300 PL/m² resulted in similar ($P < 0.05$) body length (47 - 48 mm) and survival rate (84 - 88%), while body weight (0.62 g) in PL with 300/m² was significantly lower than that (0.70 g) in PL with 100 and 200/m². The growth (body length 47 mm and weight 0.64 g) and survival (84%) of PL stocked at 250 PL/m² density were significantly higher ($P < 0.05$) than that of PL at 500 and 750/m². Besides the variation in growth and survival in PL at six test stocking densities, a sharp increase in body weight of PL was observed beginning at the 4th week of rearing.

Key words : *M. rosenbergii*, Stocking density, Hapa-net

Introduction

Nursery rearing of newly raised *M. rosenbergii* postlarvae (PL) for 1-3-month period, prior to stocking in the grow-out pond, is an important step in freshwater prawn aquaculture. Though direct stocking of 1-4-week old PL to grow-out pond is practiced by many farmers elsewhere (Alston 1989), incorporation of nursery rearing into both traditional and non-traditional prawn culture systems has significant effects in order to improve survival, grow-out inventory control and ultimately to optimize the production (Malecha 1986). Prawn nursery is also useful particularly, in a country like Bangladesh, where climatic conditions and intermittent water availability restrict the length of pond growing season and prevent continuous culture to market size (New 1990).

For successful prawn nursery operation, commercial nursery operators must need to know the effects of factors such as stocking density of PL, habitat

complexity and, feeds and feeding schedule. A number of published reports on prawn nursery systems (Sandifer and Smith 1977, Smith and Sandifer 1979, Smith et al. 1983, Heinen and Mensi 1991) are available, but there have been no research reports, except Angell (1994), on prawn nursery system in Bangladesh conditions. The present study was designed to optimize the stocking density of prawn PL, aiming at resulting in higher survival and growth, in hapa-net nursery system. Once the standard density is known, research and development efforts would be focused on reducing the cost of production and improving the yield, using appropriate feeds and feeding management.

Materials and methods

Preparation and installation of hapa-net

Nine nylon hapa-nets of 0.3 mm mesh size measuring 1.8 x 1.8 x 1.4 m³ each were installed in a 0.4 ha pond at the Freshwater Station of Fisheries Research Institute, Mymensingh. During hapa installation, the pond was under carp culture and as it was not possible to make the pond complete drained-out and sun-dried due to periodical raining, most of the fishes were harvested by repeated netting. Monoammonium sulphate (21-0-0) and lime were applied in a 1:10 ratio at the rate of 1.5 kg/decimal. Underground water was supplied through central drainage system and the water depth ranged from 85 - 90 cm during the study period. Only bamboo poles were driven into the pond bottom and used to make the supporting frame for hapa-nets. The upper and lower corners of each hapa-net were fastened with bamboo poles in such a way that the nets remained suspended in the water column without touching the pond bottom about 10 cm above the pond bottom. At each hapa-nets, a few dry coconut leaves were positioned horizontally in the water column to serve as shelters as well as substrates for the prawn PL. A feeding tray (1.2 m x 1.2 m) made of plastic mosquito screen sewn to a wire frame was provided with each hapa-nets.

Stocking of PL

Phase-I : Three stocking densities such as 100, 200 and 300 PL/m² were assigned in a randomized block design with three replications for each. Ten-day old *M. rosenbergii* PL were collected from a nearby prawn hatchery and transported to the pond site using oxygenated plastic bags. The PL were acclimated to pond conditions and stocked at 17.00 h in the hapa-nets according to the assigned densities. The initial body length (BL) of 9.6 mm and body weight (BW) of 8 mg were recorded by random measuring of PL (n = 100).

Phase-II : Three stocking densities of 250, 500 and 750/m² of *M. rosenbergii* PL₁₂ (BL = 10.5 mm and BW = 9 mg) with three replications for each were

tested. Transportation and stocking procedures were similar to that followed in the Experiment I.

Feeding to PL

The prawn were fed with a commercial shrimp feed (Saudi-Bangla nursery feed-1 and 2) at the rate of 25% of body weight during 1st week, 15% during 2nd week and 10% during rest of the culture period. The proximate composition of the feed is given in Table 1. The amount of feed was adjusted based on the estimated progressive gain in total biomass and observations of leftover feed on feeding trays. The daily ration was equally apportioned into two feedings: one at 8.00 h and another at 17.00 h. The feed was spreader on the feeding trays, which were hung close to the bottom of hapa-nets. The feeding trays were washed thoroughly prior to each feeding.

Table 1. Proximate composition (dry matter basis) of prawn feed

Parameters	% composition
Moisture	12
Crude protein	40
Crude lipid	5
Crude fibre	6
Ash	18

Source : Saudi Bangla Fish Feed Ltd., Dhaka, Bangladesh

Data recording and analysis

For the estimation of increment in growth, total BL (from tip of the rostrum to end of the telson) and BW of randomly sampled prawn (n = 50) were measured from each hapa-nets once in a week. The survival rate was estimated finally at the end of study by direct counting. Water quality parameters i.e. temperature, dissolved oxygen (DO), pH, ammonia and alkalinity were recorded weekly using a HACH Kit (Model FF-2). The water quality parameters were within the acceptable limits for prawn culture in ponds (Table 2). The growth and survival data were subjected to a one-way analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) at 5% level of significance using a PC equipped with statistical package (Statgraphics, Version 4.0).

Table 2. Mean values of water quality parameters during the experiment (phase-I and phase-II)

Water quality parameters	Days from the initiation of experiments						
	1	7	14	21	28	35	42
Temperature ($^{\circ}\text{C}$)	29.5	28.0	28.8	28.6	27.8	27.9	28.0
DO (mg/l)	4.0	5.0	6.1	4.2	4.0	7.0	4.0
pH	8.0	8.0	8.5	8.5	8.0	8.0	8.0
Ammonia (mg/l)	0.2	0.2	0.2	0.4	0.3	0.3	0.2
Alkalinity (mg/l)	170	160	146	139	140	141	155

Results and discussion

The production data of 45-day nursery rearing of *M. rosenbergii* PL at different stocking densities are given in Table 3. The BL, BW and survival rates (SR) were inversely related to stocking densities of 250 - 750 PL/m², though were not to 100 - 300 PL/m². In the phase-I experiment, *M. rosenbergii* PL stocked at 250/m² attained significantly higher ($P < 0.05$) BL (46.8 ± 1.27 mm), BW (635.3 ± 0.72 mg) and SR ($84.3 \pm 3.7\%$), while those at 750/m² had the lowest values. In the phase-II experiment, all the test stocking densities resulted in similar ($P < 0.05$) average gain in BL (47 - 49 mm) and SR (84 - 88%). The final body weight attained by PL at 100 and 200 PL/m² were significantly higher ($P < 0.05$) than that at 300 PL/m². The rate of progressive increase in body weight was also higher in PL with 100 - 300/m², though a sharp increase in body weight was observed in PL at each stocking density beginning at the 4th week of nursery rearing (Fig. 1).

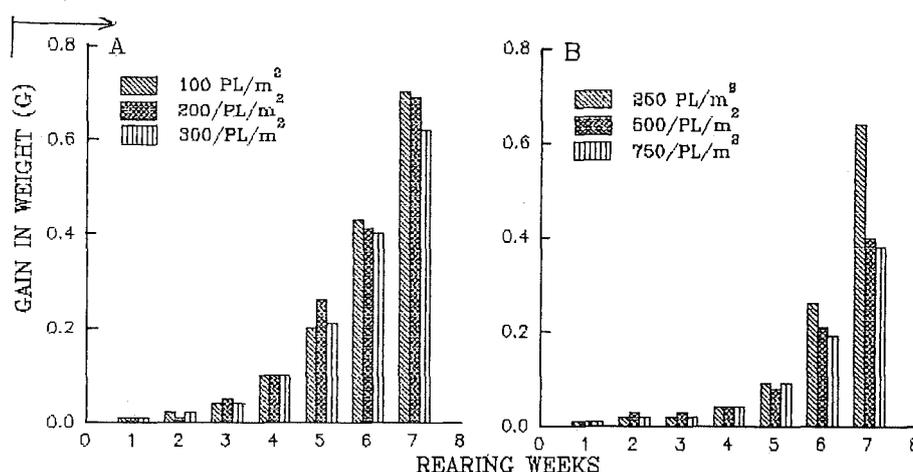


Fig. 1. Weight gain in *M. rosenbergii* PL at different stocking densities in hapa-net nursery system (A : pahse-1; B : pahse-2).

Table 3. Growth and survival of *M. rosenbergii* PL at different stocking densities in hapa-net nursery for 45 days

Stocking density (PL/m ²)	Mean body length (mm)	Mean body weight (mg)	Mean survival rate (%)
<i>Phase-I</i>			
750	37.0 ± 0.86 ^b	379.6 ± 0.94 ^b	60.9 ± 4.0 ^b
500	39.2 ± 0.92 ^b	403.1 ± 1.03 ^b	72.8 ± 7.5 ^b
250	46.8 ± 1.27 ^a	635.3 ± 0.72 ^a	84.3 ± 3.7 ^a
<i>Phase-II</i>			
300	47.7 ± 0.58 ^a	624.8 ± 0.80 ^b	85.1 ± 4.0 ^a
200	48.5 ± 1.01 ^a	697.4 ± 0.68 ^a	83.8 ± 5.2 ^a
100	47.0 ± 1.59 ^a	702.6 ± 0.21 ^a	88.2 ± 4.2 ^a

Means with the same superscripts are not significantly different ($P < 0.05$)

The results obtained at different test stocking densities indicate that a stocking density within the range of 100 - 300 PL/m² may results in a desirable growth of 47 - 49 mm BL, 635 - 702 mg BW and 84 - 88% SR for a hapa-net *M. rosenbergii* nursery rearing system. The final body lengths attained by prawn at each stocking density (Table 3) are higher than those are desired in stocking the grow-out ponds. Stocking of ponds with 25 mm juvenile prawn is suggested to reduce initial losses and allow a more predictable pond survival rate (Ling 1967). The final body weights of 0.6 - 0.7 g obtained with 100 - 300 PL/m² in the present experiment are also comparable with 0.4 - 0.9 g (Smith *et al.* 1983), 0.4 - 0.6 g (Heinen and Mensi 1991) final weight in postlarval prawn reared for 60 - 90 days at variable stocking densities of 500 - 1000 PL/m². MacLean and Ang (1994), however, reported a final weight gain of 1.75 g with 63% SR for 38 days rearing of prawn PL in net enclosures, but the stocking density was only 10 PL/m².

Besides growth, final survival rate of *M. rosenbergii* PL is a major factor to be considered in nursery rearing, as the internal rate of return (IRR) in prawn nursery has been reported very sensitive to variations in survival (Angell 1994). Several studies in elsewhere (Sandifer and Smith 1975, Willis *et al.* 1976, Smith and Sandifer 1979a, Kneale and Wang 1979, Saha *et al.* 1989, Heinen and Mensi 1991) have shown that prawn PL stocked at rates between 100 - 700/m² for 45 - 60 days of nursery systems may result in final survival rates of 60 - 80%. Though Smith *et al.* (1983) recorded about 90% survival of prawn PL at stocking densities of 1000 - 1500/m² in a an enclosed nursery system, only 28 - 37%

survival has been reported (Angell 1994), for nearly the same range of stocking density, in a cage nursery system in Bangladesh condition. Nursery rearing of *M. rosenbergii* PL in earthen ponds is limited (Williams and Berrigan 1977). Though Saha et al. (1989) reported 52% survival at the stocking density of 175 PL/m² in 30 days of rearing in earthen ponds and a desirable mean final weight of 1 - 2 g after 40 - 90 days may be achieved in earthen pond nursery (Corbin et al. 1986), the survival rate is not always known due to problems in complete harvesting of benthic juvenile.

The fact is that the stocking density and survival of prawn PL are highly variable and depend on nursery systems, rearing conditions and management practices including feeds and feeding. The results of the present experiment reveal that the nursery of prawn in hapa-nets has the advantages of reducing mortality and full recovery of prawn juvenile. The higher growth and survival of prawn juvenile might also be influenced by introducing the artificial habitat in nursery compartment (Smith et al. 1979b) and multiple feeding (McSweeney 1977) with food having 40% dietary protein (Table 1). It has been reported that *M. rosenbergii* postlarvae may need a minimum dietary protein level of about 30 - 35% (D'Abramo and Reed 1988). Though feeding prawn PL once daily has been found to result in good survival, growth and yields of postlarval *M. rosenbergii* (Heinen and Mensi 1991), juvenile prawn activity patterns lend support for the need of multiple feeding (Corbin et al. 1986). The multiple feeding is also necessary to achieve better feed utilization and to prevent the accumulation of uneaten food. However, another experiment is necessary on the best formulation of food using locally available ingredients and on the outdoor feeding schedule as well.

Conclusions

The results of the present study show that nursery rearing of *M. rosenbergii* postlarvae in hapa-nets at densities as high as 300/m² may offer benefits of rearing of sufficient numbers of postlarvae to allow them to grow to a desirable stocking size and to survival, and to faster turnover for both the hatchery and nursery operators. The present study also indicates the possibility of holding and rearing prawn postlarvae, either produced in hatchery or caught from nature in late season (September - October), at high stocking density over the winter period for stocking at the beginning of the next grow-out season.

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