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Asian Journal of Animal and Veterinary Advances

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Asian Journal of Animal and Veterinary Advances 8 (2): 216-226, 2013
ISSN 1683-9919 / DOI: 10.3923/ajava.2013.216.226
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Growth and Survival of Fingerlings of a Threatened Snakehead, *Channa striatus* (Bloch) in Earthen Nursery Ponds

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ABSTRACT

Nursery rearing of a high-valued threatened snakehead fish, *Channa striatus* was studied in relation to varying stocking densities in earthen ponds. The experiment was conducted for eight weeks in nine earthen nursery ponds having an area of 0.012 ha with an average depth of 0.8 m. Fry produced from natural propagation was first reared in indoor cemented cisterns with hatched *Artemia* cyst as live food for 10 days and then stocked at 150,000, 200,000 and 250,000 ha^{-1} in treatment-1 (T_1), treatment-2 (T_2) and treatment-3 (T_3), respectively. At stocking, mean length and weight of fry was 1.17±0.18 cm and 0.15±0.03 g, respectively. Fry in all the experimental ponds were fed with a supplementary feed comprising of fish meal (50%) and mustard oil cake (50%) at the rate of 5-8% of the estimated body weight. In addition, chopped trash fishes were supplied at the rate of 5% of the estimated biomass daily, till harvest. The physicochemical parameters of water and plankton were monitored simultaneously and were within the acceptable range for fish culture. Growth parameters (final weight, final length, weight gain, length gain and specific growth rate) and survival of fingerlings were significantly higher in T_1 than those in T_2 and T_3, respectively. Feed Conversion Ratio (FCR) was significantly lower in T_1 followed by T_2 and T_3 in that order. Significantly higher survival of fingerlings was obtained in T_1 than those in T_2 and T_3. Overall, highest growth and survival were obtained from T_1 where stocking density of fry was 150,000 ha^{-1}. Hence, of the treatments evaluated, stocking density of 150,000 fry ha^{-1} appears to be the most efficient stocking density for rearing of *C. striatus* fingerlings in earthen nursery ponds. This study represents the first successful attempt to produce fingerlings of the threatened *C. striatus* in nursery ponds, the findings of which might immensely be helpful towards the protection of snakehead from extinction as well as for its conservation, stock enhancement and rehabilitation.

Key words: *Channa striatus*, fry, stocking density, fingerling, growth, survival

INTRODUCTION

Channa striatus, commonly referred to as snakehead is a native air-breathing freshwater fish of tropical Asia and Africa (Ng and Lim, 1990). Air-breathing fish have significant advantages for aquaculture, because they can survive in harsh environment with low level of dissolved oxygen and high ammonia content (Ng and Lim, 1990; Qin *et al.*, 1997) and therefore, are often cultured in grow-out ponds at densities of 40-80 fish m^{-2}, with annual yields ranging from 7 to 156 mt ha^{-1} (Wee, 1982; Qin and Fast, 1998). Snakehead is very hardy and can remain alive for long period out of water, if kept moist, because it possesses a pair of suprabranchial cavities for aerial respiration (Hughes and Munshi, 1973). This characteristic is valuable for marketing, because live snakehead fetch considerably higher prices than dead fish (Wee, 1982; Qin and Fast, 2003). Like all other members of the genus, *Channa*, this fish has the habit of setting in the bottom mud of the ponds, ditches and the swamps as the water dry up and of going deeper and deeper into the mud as desiccation proceeds. As long as the skin and breathing apparatus are kept moist, the fish can survive without water for a number of months, occupying pockets in the stiff mud sometimes nearly a meter below the surface and subsisting on the stored fat until rains set in (Rahman, 2005).

Channa striatus, locally known as 'Shol', is a commercially important species along with other species of the genus *Channa* in Bangladesh (Mollah *et al.*, 2009; Rahman *et al.*, 2012). The flesh of this fish is firm, white, practically boneless and has the most agreeable flavor. It is one of the main food fishes in Thailand, Indo-China and Malaysia (Mollah *et al.*, 2009). The heavy dark skin is good for soup and is usually sold separately (Davison, 1975). It is commercially cultivated in Thailand, Philippines, Vietnam, Cambodia, India and Pakistan (Wee, 1982; Mollah *et al.*, 2009). Its flesh is claimed to be rejuvenating, particularly during convalescence from serious illness (Mat Jais *et al.*, 1997) and as a post natal diet (Wee, 1982). It is widely consumed for its nutritional value as well as for its beneficial effect in wound healing (Wee, 1982; Mat Jais *et al.*, 1994). It is also well known for its therapeutic effect in wound healing and pain reduction due to osteoarthritis (Michelle *et al.*, 2004).

The fish is carnivorous and subsists on a variety of living creatures including fish, frogs, snakes, insects, earthworms and tadpoles. In Bangladesh, it is considered as one of the most common food fish and much favorite to the buyers and consumers due to high taste and qualities (Rahman *et al.*, 2012). Once, the fish was abundantly found in open water bodies such as natural depressions, floodplains, inundated paddy fields etc. *Channa striatus* usually breeds during the onset of monsoon in ditches, ponds and flooded paddy fields. The absolute fecundity of the fish varies from 16,330 to 56,467 in the size range of 34.2-51.50 cm (Rahman *et al.*, 2012). The young remain at the surface in shoals guarded by their parents, hiding just below the surface of water. During the past few years, the production of *C. striatus* from the natural water bodies is declining day by day due to habitat degradation and man-induced hazards in aquatic ecosystem. These factors not only caused havoc to the biodiversity but also destroyed the feeding and breeding grounds of this important fish species. As a result, the fish is not very much available in the market. The fish is now considered to be a threatened species in Bangladesh (Khan *et al.*, 2000). In our recent study, it was observed that monoculture of snakehead in earthen grow-out pond is encouraging (Rahman *et al.*, 2012). While, a few attempts have been made to develop captive breeding protocols and larval rearing techniques of snakehead (Haniffa *et al.*, 2000, 2004; Mollah *et al.*, 2009; Sarowar *et al.*, 2010), no efficient attempts were undertaken to develop fry and fingerling rearing techniques in earthen nursery ponds. There is a need, therefore, for development of breeding and seed production techniques of *C. striatus* for conservation of their gene pool and biodiversity.

For the development of any aquaculture operation, one of the main obstacles to overcome is the availability of fry/fingerlings (Webber and Riordan, 1976). The life cycle of any species of fish from hatchlings to fry/fingerlings stage have high mortality and even 100% mortality is not uncommon.

Lakhamanan *et al.* (1971) stated that besides supplementary feed, among other factors, stocking density play a vital role influencing growth and survival of fry and fingerlings in nursery ponds. Good quality fingerlings are needed to establish a successful fish culture package of *C. striatus*. The present experiment has therefore been undertaken to develop a suitable technique for mass seed production of *C. striatus* in order to obtain optimum growth and survival of fingerlings in a controlled nursery-rearing system.

MATERIALS AND METHODS

Collection and rearing of broodstock: Three months before the onset of the breeding season, 80 adult fishes of *C. striatus* were collected from the Brahmmaputra river basin and floodplains of greater Mymensingh region of Bangladesh. Soon after collection, the fishes were stocked in a well-prepared pond at a density of 3000 ha^{-1}. The fishes were fed with supplementary feed comprising of fish meal (35%) and mustard oil cake (65%) at the rate of 4-6% of estimated body weight. Different live foods such as small fishes and shrimps and chopped trash fishes were also given to all the brood fishes at regular intervals.

Natural propagation and nursing of fry: When the fish attained gonadal maturity, male and female broods (800-1300 g) were placed in a pond together with natural substratum (water hyacinth) during their natural breeding season (April-July). Fresh ground water was supplied everyday to maintain natural phenomena for breeding. In the last week of May, a total number of 30,669 fry (1533±271) produced from 20 pairs of snakehead with a mean length of 0.50±0.11 cm and weight of 0.02±0.01 g were collected by fine-meshed nylon net from the brood pond and transferred to shallow cemented cisterns (570×105 cm). The fry were fed with hatched *Artemia* cyst three times daily. After 10 days of rearing, the fry attained a mean length of 1.17±0.18 cm and weight of 0.15±0.03 g.

Rearing of fingerlings: The fry were then reared for 8 weeks in nine earthen nursery ponds with a surface area of 0.012 ha and an average depth of 0.8 m. In order to assess optimum growth and survival of fingerlings in nursery ponds, different stocking densities of fry (No./ha) *viz.*, 150,000 (T_1), 200,000 (T_2) and 250,000 (T_3) were tested with three replicates for each. After drying, quickhime (CaO, 250 kg ha^{-1}) was spread over the pond bottom. Ponds were then filled with ground water and fertilized with organic manure (cowdung, 1000 kg ha^{-1}). Before stocking, all the nursery ponds were surrounded by fine-meshed nylon nets fixed with locally available bamboo poles to protect the fish from escaping as well as to prevent the predators (such as frogs, snakes etc.) from entering the ponds. The stocked fry were fed twice daily with a mixture of ingredients comprising of fish meal (50%) and mustard oil cake (50%) at the rate of 8% of the estimated body weight for the 1st 2 weeks, 7% for the 2nd 2 weeks, 6% for the 3rd 2 weeks and 5% for the 4th two weeks. In addition, chopped trash fishes were supplied at the rate of 5% of the estimated biomass daily till harvesting. Subsequent to stocking, the ponds were manured with cowdung (1000 kg ha^{-1}) at weekly intervals.

Water quality parameters: Physicochemical parameters of pond water were monitored weekly between 9:00 and 10:00 h. Temperature (°C) and dissolved oxygen (mg L^{-1}) were determined directly by a digital water quality analyzer (YSI, model 58, USA), pH by a digital pH-meter (Jenway, Model 3020, UK) and transparency (cm) by a secchi disc and ammonia nitrogen by a HACH water analysis kit (DR 2000, USA). Total alkalinity was measured following the standard method (Stirling, 1985; APHA, 1992).

Plankton monitoring: Quantitative and qualitative estimates of plankton in the experimental ponds were also taken weekly. Plankton samples were collected from the ponds by passing 10 L of depth-integrated water samples through fine-meshed plankton net (25 μm) to obtain a 50 mL sample. The samples were preserved immediately with 5% buffered formalin in plastic bottles. Plankton density was estimated by using a sub-sampling technique. A Sedgwick-Rafter (S-R) cell was used under a calibrated compound microscope for plankton counting. Plankton count was made using the formula proposed by Rahman (1992).

Estimation of growth, survival and feed utilization: Twenty randomly selected individuals from each experimental pond were sampled weekly until they attained fingerling stage. Growth in terms of increase in length and weight, Specific Growth Rate (SGR) and Feed Conservation Ratio (FCR) was estimated. Length and weight gain were calculated simply by deducting the mean initial length and weight values from that of the final. SGR, the instantaneous change in weight of fish calculated as the percentage increase in body weight per day over any given time interval (Brown, 1957). The FCR was calculated according to Castell and Tiews (1980). At the termination of the experiment, the surviving fish were counted and weighed individually and the data were used for subsequent analyses. Survival rates were estimated on the basis of the number of fish harvested:

$$\text{Survival (\%)} = \frac{\text{No. of fish harvested}}{\text{No. of fish stocked}} \times 100$$

Analysis of experimental data: The mean values for growth, survival, water quality parameters and plankton abundance of different treatments were tested using one-way analysis of variance (ANOVA). A "Bartlett's test" was used to analyze the homogeneity of variances (Bartlett, 1937). When variances were not significantly heterogeneous and no major departures from normality, a one way analysis of variance (ANOVA) was done followed by Duncan's New Multiple Range test (Duncan, 1955). All statistical analyses were performed with the aid of a computerized statistical package, 'Stat View' version 4.0. Standard deviation in each parameter and treatment was calculated and expressed as mean±SD. The level for statistical significance was set at 0.05%.

RESULTS

Water quality assessment: The mean values and ranges of physicochemical parameters over the 8-week nursing of *C. striatus* fingerlings are presented in Table 1. The mean water temperatures in T_1, T_2 and T_3 did not significantly differ ($p>0.05$). Mean secchi disc transparency levels were significantly different ($p<0.05$), increasing from T_1 to T_3. The mean Dissolved Oxygen (DO) level was significantly higher ($p<0.05$) in T_1 followed by T_2 and T_3 in that order. The pH decreased from T_1 to T_3 but did not significantly differ ($p>0.05$). Total alkalinity decreased from T_1

Table 1: Analysis of water quality parameters of weekly samples over the 8-week experiment

	Treatment 1		Treatment 2		Treatment 3	
Parameters	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range
Water temperature (°C)	30.44 ± 1.38^{a}	28.60-31.70	30.52 ± 1.45^{a}	28.70-31.80	30.58 ± 1.48^{a}	28.80-31.90
Transparency(cm)	35.50 ± 3.85^{c}	32.50-43.00	46.65 ± 4.32^{b}	37.50-48.50	54.58 ± 4.28^{a}	46.50-59.50
Dissolved oxygen (mg L^{-1})	5.19 ± 0.69^{a}	4.20-6.10	4.62 ± 0.75^{b}	3.70-5.70	4.02 ± 0.66^{c}	3.40-5.10
pH	7.86 ± 0.36^{a}	7.50-8.40	7.75 ± 0.32^{a}	7.40-8.30	7.67 ± 0.28^{a}	7.30-8.20
Total alkalinity (mg L^{-1})	135.24 ± 25.89^{a}	89.50-172.50	133.90 ± 26.26^{a}	87.50-167.50	132.10 ± 27.62^{a}	84.50-165.00
Ammonia-nitrogen (mg L^{-1})	0.33 ± 0.17^{a}	0.01-1.00	0.36 ± 0.21^{a}	0.01-1.10	0.40 ± 0.25^{a}	0.01-1.20

Values in the same row having the same superscript are not significantly different at p>0.05

Table 2: Analysis of plankton abundance of pond water of weekly samples over the 8-week experiment

	Treatment 1		Treatment 2		Treatment 3	
Plankton group	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range
Phytoplankton (cells L^{-1})						
Bacillariophyceae	3750 ± 221^{a}	3450-4025	3263 ± 223^{b}	3000-3575	2744 ± 240^{c}	2425-3100
Chlorophyceae	4522 ± 207^{a}	4150-4725	3963 ± 262^{b}	3575-4325	3225 ± 277^{c}	2925-3775
Cyanophyceae	2975 ± 208^{a}	2725-3250	2594 ± 269^{b}	2225-2950	2122 ± 294^{c}	1850-2625
Euglenophyceae	2525 ± 253^{a}	2250-2950	2225 ± 233^{b}	1950-2600	2025 ± 250^{c}	1700-2425
Total	13772 ± 879^{a}	12575-14950	12045 ± 767^{b}	10750-13450	10116 ± 563^{c}	8900-11900
Zooplankton (Individnals L^{-1})						
Crustacea	7769 ± 461^{a}	7375-8625	6453 ± 574^{b}	5850-7450	5159 ± 647^{c}	4375-6175
Rotifera	9547 ± 499^{a}	8925-10450	8428 ± 520^{b}	7725-9150	6772 ± 576^{c}	5975-7625
Total	17316 ± 1257^{a}	16300-19075	14881 ± 1397^{b}	13575-16600	11931 ± 1141^{c}	10350-13800

Values in the same row having the same superscript are not significantly different at p>0.05

to T_3 but no significant (p>0.05) differences were noticed among the treatments. Ammonia-nitrogen contents in T_1, T_2 and T_3 showed increasing trends but the variations were not statistically significant (p>0.05).

Plankton enumeration: The plankton populations recorded from the pond water over the 8-week experiment are summarized in Table 2. The phytoplankton comprised of 28 genera under four groups viz., Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae. Significantly higher (p<0.05) abundances of Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae were recorded in T_1 than in T_2 and T_3. Among the phytoplankton groups, Chlorophyceae was the most dominant group in all the treatments followed by Bacillariophyceae, Cyanophyceae and Euglenophyceae in that order. The mean total phytoplankton abundance was significantly higher (p<0.05) in T_1 than those recorded in T_2 and T_3. The zooplankton population consisted of 12 genera including nauplius in two major groups viz., Crustacea and Rotifera. Rotifera were dominant over Crustacea during the entire experiment in all treatments. However, the abundance of Rotifera and Crustacea was significantly higher (p<0.05) in T_1 than those in T_2 and T_3. The abundance of total zooplankton was also significantly highest (p<0.05) in T_1 followed by T_2 and the lowest in T_3.

Growth and survival of fingerlings: Weekly growth in terms of length and weight of fingerlings are depicted in Fig. 1 and 2, respectively. The increase in length was significantly higher (p<0.05)

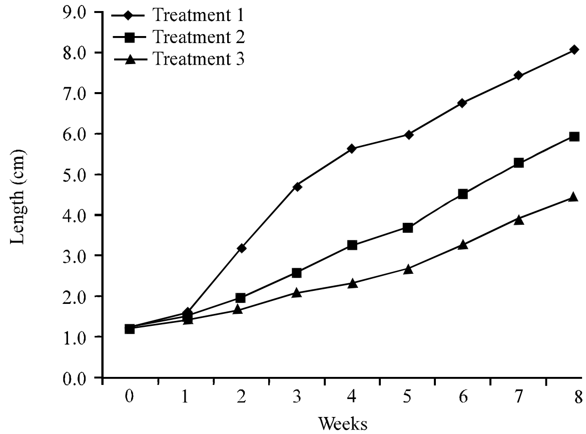

Fig. 1: Weekly mean length increment of *C. striatus* fingerlings at different stocking densities in nursery ponds

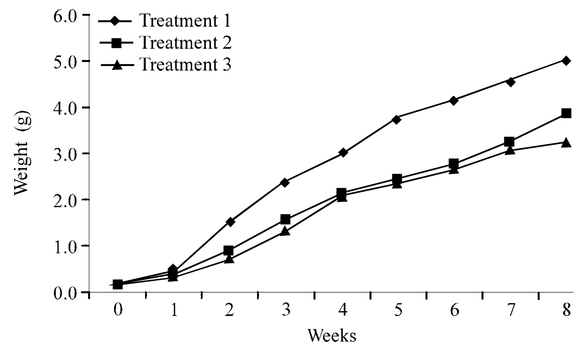

Fig. 2: Weekly mean weight increment of *C. striatus* fingerlings at different stocking densities in nursery ponds

Table 3: Growth performances, feed utilization and survival of *Channa striatus* fingerlings after 8 weeks of rearing

	Treatment 1		Treatment 2		Treatment 3	
Plankton group	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range
Initial length (cm)	1.17 ± 0.18^a	0.90-1.60	1.17 ± 0.18^a	0.90-1.60	1.17 ± 0.18^a	0.90-1.60
Final length (cm)	8.06 ± 0.23^a	7.82-8.28	5.94 ± 0.18^b	5.75-6.10	4.43 ± 0.15^c	4.30-4.60
Initial weight (g)	0.15 ± 0.03^a	0.11-0.20	0.15 ± 0.03^a	0.11-0.20	0.15 ± 0.03^a	0.11-0.20
Final weight (g)	5.02 ± 0.18^a	4.85-5.21	3.84 ± 0.16^b	3.68-3.99	3.23 ± 0.11^c	3.10-3.32
Weight gain (g)	4.87 ± 0.18^a	4.70-5.06	3.69 ± 0.16^b	3.53-3.84	3.08 ± 0.11^c	2.95-3.17
Length gain (cm)	6.89 ± 0.23^a	6.65-7.11	4.77 ± 0.18^b	4.58-4.93	3.27 ± 0.15^c	3.13-3.43
Specific growth rate (SGR) (%/day)	6.27 ± 0.07^a	6.21-6.34	5.79 ± 0.08^b	5.71-5.86	5.48 ± 0.06^c	5.41-5.53
Food conversion ratio (FCR)	2.05 ± 0.09^a	2.02-2.15	2.30 ± 0.09^b	2.21-2.38	2.59 ± 0.09^c	2.51-2.68
Survival (%)	76.67 ± 1.67^a	75.00-78.0	66.67 ± 2.52^b	64.00-69.0	57.33 ± 2.52^c	55.00-60.0

Values in the same row having the same superscript are not significantly different $p>0.05$

in T_1 than those in T_2 and T_3 (Fig. 1). Weight increment was also followed the same trends being highest in T_1 followed by T_2 and the lowest in T_3 (Fig. 2). Results of the different growth and production parameters of fingerlings under different treatments at the termination of the experimental period are summarized in Table 3. The initial length and weight of fry, stocked in all the experimental ponds were the same i.e., 1.17±0.18 cm and 0.15±0.03 g. The highest increase in length and weight was obtained in T_1 followed by T_2 and the lowest in T_3. The mean final length and weight of fingerlings in different treatments were statistically significant ($p<0.05$). The highest weight and length gains were obtained in T_1 and lowest in T_3. Significantly higher Specific Growth Rate (SGR) was observed in T_1 than those in T_2 and T_3, respectively. Food Conversion Ratio (FCR) was significantly lower in T_1 than in T_2 and the highest in T_3. Therefore, SGR and FCR values were best for fingerlings in T_1 where the lowest number of fry (150,000 ha^{-1}) was reared. The survival rate was also significantly higher ($p<0.05$) in T_1 than in T_2 and in T_3, respectively.

DISCUSSION

Water temperature is one of the most important factors, which influence the physicochemical and biological events of water body. The range of water temperature (28.60-31.90°C) is within the suitable range for rearing of snakehead fingerlings in nursery ponds that agree well with the findings of Haylor and Mollah (1995), Mollah and Hossain (1998) and Rahman *et al.* (2005, 2008a). Highest transparency depth was recorded in T_3, possibly due to the reduction of the plankton population by higher density of fish (Haque *et al.*, 1994; Rahman *et al.*, 2005, 2008b). The dissolved oxygen level was low in ponds stocked with a high density of fish compared to ponds stocked with a low density. Fluctuations in dissolved oxygen concentrations might be attributed to the photosynthetic activity, alteration of cloudy and sunny weather of the monsoon and variation in the rate of oxygen consumption by fish and other aquatic organisms (Boyd, 1982). However, the concentration of dissolved oxygen was within the suitable range in the experimental ponds (Mollah and Hossain, 1998; Rahman *et al.*, 2005, 2008a, b; Chakraborty and Mirza, 2007). The pH values are within the range of good water quality for rearing of fry/fingerlings and food fishes in earthen ponds (Rahman and Rahman, 2003; Chakraborty and Mirza, 2007; Jena *et al.*, 2007; Rahman *et al.*, 2012). Alkalinity levels in the present study indicate productivity of the ponds was medium to high (Bhuiyan, 1970; Boyd, 1982; Jhingran, 1991; Rahman *et al.*, 2009). The concentration of ammonia-nitrogen observed from the experimental ponds is lower than that was recorded by Dewan *et al.* (1991), Kohinoor *et al.* (2001) and Jena *et al.* (2007). However, the present level of ammonia-nitrogen content in the experimental ponds is not toxic to the fishes (Kohinoor *et al.*, 1998; Rahman *et al.*, 2008a, 2012).

The significantly higher plankton abundance was recorded in T_1 and this might be due to the lower density of fish than those in T_2 and T_3. It seems likely that in the ponds where stocking density was high, consumption of plankton by the fishes was also high. Generally, higher plankton number in water normally indicates higher productivity of the pond. It was also found in all the ponds that zooplankton abundance was higher than phytoplankton, might be due to manuring with organic fertilizer (Rahman *et al.*, 2008a, b), excess uneaten feeds (Keshavnath *et al.*, 2002; Chakraborty and Mirza, 2007), higher rate of supplementary feeding (Butt and Khan, 1988; Islam, 2002; Rahman *et al.*, 2005) and the decreased grazing pressure on phytoplankton due to carnivorous nature of snakehead (Sarowar *et al.*, 2010; Rahman *et al.*, 2012). It was also evident that live zooplankton improved the growth and survival of snakehead fry (Marimuthu and Haniffa, 2006).

Growth performances (final length, length gain, final weight, weight gain and specific growth rate) of fingerlings of *C. striatus* was significantly higher in T_1 where the stocking density of fry (150,000 ha^{-1}) was low compared to those of T_2 (200,000 ha^{-1}) and T_3 (250,000 ha^{-1}) although same food was applied in all the treatments at an equal ratio. The low growth rate of fry and fingerling in treatment T_2 and T_3 appeared to be related with higher densities and increased competition for food and space (Islam, 2002; Islam *et al.*, 2002; Rahman and Rahman, 2003; Rahman *et al.*, 2005, 2008b, 2009). High density of fingerlings in combination with increased concentration of food in the rearing system might have produced a stressful situation and toxic substance which could be the probable cause for poor growth in treatment T_2 and T_3 (Haque *et al.*, 1994; Rahman and Rahman, 2003; Rahman *et al.*, 2008a, b).

The FCR values in T_1 were significantly lower than those in T_2 and T_3, respectively. Similar FCR values were obtained by Rahman *et al.* (2012), while culturing snakeheads in monoculture ponds. The FCR values are lower than the values reported by Das and Ray (1989), Islam (2002) and Islam *et al.* (2002). Snakehead fed with a formulated feed had an FCR value of 1.0 (Qin and Fast, 2003), which is much lower than the values obtained in our present study. De Silva and Davy (1992) reported that digestibility plays an important role in lowering the FCR value by efficient utilization of food. Digestibility, in turn, depends on daily feeding rate, frequency of feeding and type of food used (Chiu *et al.*, 1987). However, the lower FCR value in the present study indicates better food utilization efficiency, despite the values increased with increasing stocking densities. Fingerlings of *C. striatus* had significantly higher survival in T_1, where, the stocking density was lower than T_2 and T_3. The reasons for reduced survival rates in these treatments were probably due to higher stocking density of fry as well as competition for food and habitat in the experimental ponds (Haque *et al.*, 1994; Kohinoor *et al.*, 1994; Rahman and Rahman, 2003; Rahman *et al.*, 2005, 2008a, b, 2009).

The present study revealed that the growth and survival of snakehead fingerlings were inversely related to the stocking densities of fry. In all respects, a stocking density of 150,000 fry ha^{-1} showed highest performances than those obtained at higher stocking rates. The nursery operators may use this density for rearing of *C. striatus* fingerlings for 8 weeks in nursery-rearing system. Owing to the natural and man-induced hazards in aquatic ecosystem, spawning and feeding grounds of this important fishery have severely been degraded. Under the prevailing situation, production of quality seeds through application of our present findings might have important implications towards the protection of snakehead from extinction as well as for its conservation, stock enhancement and rehabilitation.

ACKNOWLEDGMENTS

We are much indebted to the Director General and Chief Scientific Officer, Bangladesh Fisheries Research Institute for providing experimental facilities at the pond complex of Freshwater Station, Mymensingh during this research work. Special thanks and appreciations are also due to research assistants and field workers, who provided many helps for successfully conducting the experiment.

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