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CULTURE POTENTIALS OF STINGING CATFISH SHING (*HETEROPNEUSTES FOSSILIS*) UNDER DIFFERENT STOCKING DENSITIES IN NORTHERN REGION OF BANGLADESH

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ABSTRACT
An experiment was undertaken in nine experimental mini ponds (each size 0.006 ha) to assess the growth performances, production potentials and highest net benefit of stinging catfish Shing, *Heteropneustes fossilis* for the period of seven months from June to December 2012. Three stocking densities were tested with three replications for each, viz., 1,85,000/ha (T_1), 2,00,000/ha (T_2) and 2,25,000/ha (T_3). Physico-chemicals parameters of the pond water were within the suitable level for fish culture. After seven months, the final mean weight, SGR (% per day) and survival rate of *H. fossilis* in T_1 were significantly higher ($P<0.05$) than those in T_2 and T_3. Feed conversion ratio (FCR) was significantly lowest in T_1 (2.51±0.04) followed by T_2 (3.12±0.53) and the highest in T_3 (3.93±0.07). Among the treatments, significantly ($P<0.05$) the highest production obtained in T_1 (9,708.16±421.40), followed by T_2 (7,595.99±399.59) and T_3 (5,760.79±450.76 kg/ha/210 days). However, the highest net benefit was also obtained in T_1 (BDT 28,35,873/ha), where the stocking density was 1,85,000/ha. Therefore, among the treatments in seven months culture of Shing (*H. fossilis*), individuals 1,85,000/ha stocking density would be the best recommendation for the farmers.

KEY WORDS: Culture potentials, *Heteropneustes fossilis*, stocking densities, net benefit

INTRODUCTION

In northern region of Bangladesh, remain more than 60% seasonal small ditches or ponds which retain water only 4-6 months round the year (Rahman *et al*., 2013). The farmers in this region believe that these waters could not be utilized for fish production purpose due to their seasonal nature, but actually they hold tremendous potential for adopting intensive culture of species having shorter life cycle, hardy and survive in adverse ecological condition, high nutritive value as well as high market price. Shing (*Heteropneustes fossilis*, Bloch) is an indigenous stinging cat fish of South-East-Asia which have the above mentioned characteristics (Khan *et al.*, 2003 and Kohinoor *et al.* 2012). The species is not only recognized for its delicious taste and market value but is also highly esteemed from nutritional and medicinal properties of view (Chakraborty and Nur, 2012). It remains high amount of iron (226 mg/100 g) and fairly high content of calcium compared to many other freshwater fishes (Saha and Guha, 1939). It is considered as a valuable food fish species and recommended as diet for the sick and convalescents. Being a lean fish it is very suitable for people for whom animal fats are undesirable (Rahman *et al.*, 1982). But in recent years, the fish has become gradually been endangered as the natural habitats and breeding grounds of this fish has been severely degraded due to over exploitation, ecological changes, reduction of water bodies, application of pesticides in rice cultivation, release of chemical effluents from industrial plants and hydrological changes due to construction of flood control infrastructure (Khan *et al.*, 2003 and Kohinoor *et al.*, 2012).

Although seed production of *H. fossilis* through induced breeding and culture technology have been developed in Mymensingh region (Azadi and Siddique, 1986) but in northern region of Bangladesh has not yet been well flourished due to scarcity of fry and fingerlings and lack of appropriate culture technology. Therefore, the present study was undertaken to optimize and evaluate production potentials of *H. fossilis* at Freshwater sub-station experimental ponds, Bangladesh Fisheries Research Institute (BFRI), Saidpur, Nilphamari in northern Bangladesh under different stocking densities.

MATERIALS AND METHODS

Description of the study area and duration: The present experiment was carried out in Freshwater Sub-station, Bangladesh Fisheries Research Institute, Saidpur, Nilphamari located at 25° 46′ 41″ N, 88° 53′ 51″ E of Bangladesh for a culture period of seven months during July 2012 to January 2013. Nine experimental mini ponds were undertaken for three treatments each with three replicates. The average area of the ponds was 0.006 ha with depth of 1.18- to 1.21 m.

Pond preparation: Prior to stocking, the experimental ponds were dried and cleaned for unwanted weeds and species. The dried ponds were exposed to sunlight for several days and then liming the bottom soil (@ 250 kg/ha of Ca_2O) and enclosed by fine nylon mosquito net. After five days, ponds were filled up with underground water and fertilized with cow dung at the rate of 100 kg/ha and waited for a week to allow the water become suitable for stocking.

Sources and stocking of Shing fingerlings: The fingerlings of Shing (*H. fossilis*) used in this experiment were produced in the hatchery of Freshwater Sub-station, Bangladesh Fisheries Research Institute, Saidpur, Nilphamari. Fingerlings of Shing (*H. fossilis*) were stocked at the rate of 1,85,000, 2,00,000 and 2,25,000 individuals/ha under treatment-1 (T_1), treatment-2 (T_2) and treatment-3 (T_3), respectively on 01 July 2012. Before stocking the initial mean weights of the fingerlings were measured using sensitive balance (OHAUS Model CS-2000).

Feed supply: After stocking, in order to meet up the increasing dietary demand, in all the treatments, a 35% protein containing floating pelleted feed (MEGA feed) were applied at the rate of 12-4% of estimated fish biomass twice daily at 6.00 hr in the morning and at 19.00 hr in the late afternoon. The fingerlings were fed at the rate of 12% of their body weight for the first month and it was reduced to 4% on the subsequent months. During the culture trial, in every month all the experimental ponds were applied lime and salt at the rate of 125 and 74 kg/ha, respectively.

Growth measurement: The growth of experimental Shing (*H. fossilis*) was observed fortnightly for each pond random sampling method. At least 50 fishes were sampled with the help of a cast net to measure the growth to assess the health status and for feed adjustment.

Physico-chemicals properties: Physico-chemicals parameters such as surface water temperature (^oC), water depth (cm), transparency (cm), dissolved oxygen (mg/l), pH and ammonia (mg/l) was measured fortnightly using a Celsius thermometer, a graduated pole, a Secchi-disk a portable dissolved oxygen meter (HI 9142, Hanna Instruments, Portugal) and a portable pH meter (HI 8424, Hanna Instruments, Portugal) and a portable amonia test kit (Hanna), respectively. Total alkalinity was determined following the titrimetric method according to the standard procedure and methods (Clesceri *et al*., 1992).

Harvesting of fish: After seven months of rearing, the fish were harvested by dewatering the ponds. During harvested, at least 100 fish were counted and individually weighted from every treatments to assess growth, survival, FCR and production. Specific growth rate (SGR %day) and feed utilization efficiency were calculated according to Ricker (1975) respectively as follows:

SGR (%/day) = In [W.sub.2] - In[W.sub.1]/[T.sub.2] - [T.sub.1] x 100
Where,
[W.sub.1] = initial live body weight (g) at time [T.sub.1] (day) and
[W.sub.2] = final live body weight (g) at time [T.sub.2] (day).

Feed Conversion Ratio (FCR) = Dry weight (g) of feed supplied / Live weight (g) of fish gained

Data analysis: The mean values for water quality parameters, growth, survival, FCR, production were tested using one-way analysis of variance (ANOVA), followed by testing of pair-wise differences using Duncan's Multiple Range Test (Vann, 1972). Significance was assigned at the 5% level. All statistical analysis was done by using the SPSS (Statistical Package for Social Science) version-21.5.

RESULTS AND DISCUSSION

Physico-chemicals properties

The results of physico-chemicals parameters in three treatments are presented in Table 1. The physico-chemicals parameters measured in different treatments throughout the experimental period were found within the acceptable range for fish culture. The mean water temperature was measured 27.94±4.19, 27.42±4.31 and 26.96±4.10 ºC in T_1, T_2 and T_3, respectively. However, there was no significant (P>0.05) variation among the treatments. Rahman *et al.* (2013) reported a surface water temperature ranged from 26.93 to 27.41 in monoculture of Thai koi (*Anabas testudineus).* Roy *et. al.* (2002) also observed temperature ranged of 28 to 30 ^oC in cultured ponds water. The present findings agree with the finding of Mollah and Haque (1978), Wahab *et al.* (1995) and Kohinoor *et al.* (1998).

The pH values of the different treatments ponds water were found to be slightly alkaline and pH mean values of 7.62±0.63 (T_1), 7.81±0.62 (T_2) and 7.78±0.05 (T_3) were not statistically significant ($P>0.05$). Azad *et al.* (2004) recorded pH ranging from 6.18 to 9.16 in polyculture ponds. According to Swingle (1969), pH range from 6.5 to 9.0 is suitable for pond culture which agree to the present study.

Table 1: Physico-chemicals properties of fortnightly samples over the 210 days experiment.

Parameters	Treatment-1 (T_1) (1,85,000/ha)	Treratment-2 (T_2) (2,00,000/ha)	Treatment-3 (T_3) (2,25,000/ha)
Temperature(^{0}C)	27.94±4.19^a	27.42±4.31^a	26.96±4.10^a
Water depth (cm)	120.85±15.24^a	121.85±14.89^a	118.74±17.74^a
pH	7.62±0.63^a	7.81±0.62^a	7.78±0.05^a
Transparency (cm)	28.78± 3.70^a	29.11 ±2.62^b	31.93±3.55^c
Dissolved oxygen (mg/l)	4.89±0.74^a	4.34±0.84^b	4.36±0.67^b
Total alkalinity (mg/l)	115.93±28.16^a	109.28±21.43^{ab}	103.07±15.10^b
Ammonia-nitrogen (NH_4-N) (mg/l)	0.08±0.06^a	0.11±0.01^{ab}	0.12±0.12^b

*Mean± SD (Standard deviation); Figures in the same row having the same superscript are not significantly different (P > 0.05).

Dissolved oxygen (DO) content was varied from 4.34 to 4.89 mg/l among the treatments. The mean dissolved oxygen (DO) concentrations in T_1 (4.89±0.74 mg/l) was significantly (P<0.05) different from the other treatments. However, there was no significant variation between the T_3 (4.36±0.67) and T_2 (4.34±0.84 mg/l). In all the experimental pond water, comparatively lower level of dissolved oxygen as observed that might be due to sampling time where was monitored at about 900-10.00 am. Wahab *et al.* (1995) reported dissolved oxygen ranging from 2.2 to 7.1 mg/l in nine ponds of BAU campus, Mymensingh. Rahman *et al.* (2013) was found dissolved oxygen 4.13 to 4.71 mg/l, while Kohinoor *et al.* (2012) measured dissolved oxygen 4.23 to 5.32 mg/l in *H. fossilis* cultured ponds. According to Rahman *et al*. (1982) dissolved oxygen content of a productive pond should be 5.00 mg/l or more. The dissolved oxygen in present experiment were around 5.0 mg/l.

Total alkalinity values depending upon the location, season, plankton population, nature of bottom deposits etc. Total alkalinity was significantly (P<0.05) highest in T_1 (115.93 ±28.16) followed by T_2 (109.28 ±21.43) and lowest in T_3 (103.07 ±15.10 mg/l). Boyd (1982) advocated that the total alkalinity should be more than 20 mg/l in fertilized ponds as production increases with the increase in total alkalinity. The variations of total alkalinity in all the treatments were within the productive range for aquaculture ponds (Wahab *et al*., 1995; Kohinoor *et al*., 1998).

The mean transparency was varied from 28.78 to 31.93 cm among the treatments and mean values were 28.78 ± 3.70, 29.11 ±2.62 and 31.93 ±3.55 cm in T_1, T_2 and T_3, respectively. In the present study, the transparency of water showed significant difference (P<0.05) among the treatments, which might be due to variations in abundance of plankton. Boyd (1982) reported that the range of transparency from 15-40 cm is suitable for fish culture. Rahman *et al.* (2013) found transparency rage from 28 to 31 cm in their fish ponds. From the above findings, it is concluded that the transparency content the experimental ponds were within the good productive range.

The mean values of ammonia-nitrogen (NH_4-N) contents in the present study were significantly (P<0.05) highest in T_3 (0.12±0.12) followed by T_2 (0.11±0.01) and T_1 (0.08±0.06 mg/l). Kohinoor *et al.* (2001) found the ammonia-nitrogen ranged from 0.01-1.55 mg/l in monoculture ponds. Boyd (1982) reported that the suitable range of ammonia-nitrogen in fish culture less than 0.1 mg/l. Ammonia-nitrogen contents in T_2 and T_3 were higher that might be due to higher stocking density both the treatments. The droppings of the fish might be increased ammonia in the ponds. New (1987) reported that excessive use of feed or fertilizer caused sediments in the pond bottom which may produce ammonia in the ponds. This might be happened in T_2 and T_3 in this experiment. However, according to Kohinoor *et al.* (1998; 2001) ammonia-nitrogen level content in the experimental ponds of T_1 is not lethal to the fishes.

Growth and production performances

The growth parameters, survival rate, production and FCR of Shing (*H. fossilis*) in three treatments have been reported in Table 2. The mean final weights of *H. fossilis* at the end of the experiment were 73.34±3.60, 60.78.35±1.57 and

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47.75±3.70 g in T_1, T_2 and T_3, respectively. Among the three treatments, significantly (P<0.05) the highest mean final weight was recorded in T_1 which was subsequently followed by T_2 and T_3. The monthly sampling weight of *H. fossilis* under different stocking densities are shown in Fig. 1. The figure indicates that the growth rate was always higher in T_1 then followed by T_2 and T_3. The results also indicated that higher growth rate was always observed at lower stocking densities in the experiment. More or less similar types of growth were observed by Kohinoor *et al*. (2012), who recorded the growth 49.50 to 69.42 g from six months cultured of *H. fossilis*.

Table 2. Growth performances, survival and production of Shing (*H. fossilis*) after 210 days rearing.

Treatment No.	Mean initial wt. (g)	Final wt. (g)	SGR (% per day)	Survival (%)	Production (kg/ha)	FCR
T_1	3.74±0.10[a]	73.34±3.60[a]	1.23±.021[a]	71.61±3.17[a]	9708.16±421.40[a]	2.51±0.04[a]
T_2	3.73±0.08[a]	60.78±1.57[b]	1.16±0.01[b]	62.47±2.02[b]	7595.99±399.59[b]	3.12±0.53[b]
T_3	3.74±0.06[a]	47.75±3.70[c]	1.06±0.04[c]	53.62±3.91[c]	5760.79±450.76[c]	3.93±0.07[c]

*Mean± SD (Standard deviation); Figures in the same row having the same superscript are not significantly different (P > 0.05).

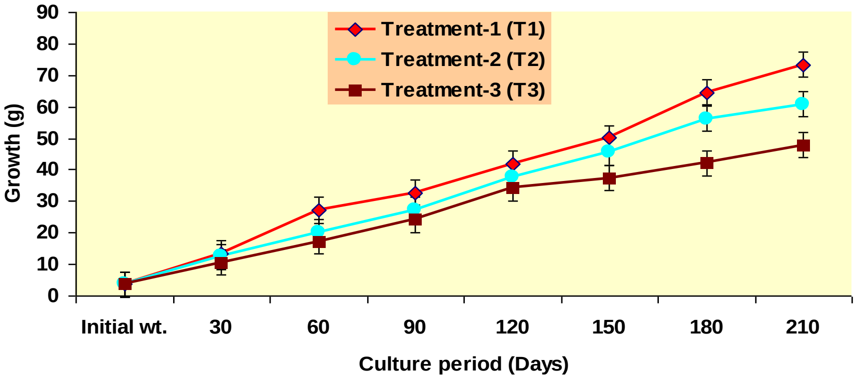

Figure 1. The monthly sampling weight of Shing *(H. fossilis)* under different stocking ensities

At the end of the experiment, the SGR (% per day) attained under T_1, T_2 and T_3 were 1.23±0.02, 1.16±0.01 and 1.06±0.04%, respectively. The result of the experiment revealed that significantly (P<0.05) the highest SGR value (1.23) was recorded in T_1 while lowest (1.06) was obtained in T_3.

The survival rate of *H. fossilis* as recorded in the present study was 71.61±3.17, 62.47±2.02 and 53.62±3.91% for T_1, T_2 and T_3, respectively. In T_1 showed significantly (P<0.05) the highest survival (71.61%) while in T_3 showed the lowest (53.62%). The survival rate in the experiment was showed negatively influences by stocking densities. It might be due to for high competition and less space among the fishes. Khan *et al*. (2003) and Kohinoor *et al*. (2012) recorded survival rates of *H. fossilis* 76.13 to 98.81 and 71 to 817, respectively those were higher survival rates from the present study. Backiel and Le Cren (1967) described that stocking density has direct effect on growth and survival of fish. Lower survival rate in the present study, this might be due to high competition for food and space among the fishes for higher stocking density of *H. fossilis* in present study than previous.

The mean FCR value of T_1, T_2 and T_3 were obtained 2.51±0.04, 3.12±0.53 and 3.93±0.07, respectively. The FCR value of T_1 was found to be significantly (P<0.05) lowest which indicates that lower amount of feed was needed to produce one unit fish biomass and highest was found in T_3.

The mean production of *H. fossilis* in T_1, T_2 and T_3 were 9708.16±421.40, 7595.99±399.59 and 5760.79±450.76 kg/ha/210 days, respectively. Significantly (P<0.05) the highest production was obtained in T_1 then followed by T_2 and the lowest in T_3. The region behind the highest production in T_1 might be best stocking density and, the value of individual final weight and survival rate were found to be higher than the rest of the treatments. Lipton (1983) observed that *H. fossilis* attained 35.54 g over 112 days with gross production 1242 g/m^2 in cage culture system. In a study, Kohinoor *et al*. (2009) found that the production of native koi (*Anabas testudineus*) in monoculture system was 1,916 kg/ha/5 months, where the stocking density was 50,000/ha. While Khan *et al.* (2003) evaluated that the production of *H. fossilis* in different stocking densities and got the gross production range 2080 to 3364 kg/ha. A study conducted by Rahman *et al*. (2013) on station level which production was obtained 4800.40 to 5582.23 kg/ha in six months from Thai koi (*A. testudineus*) monoculture system. The production noticed in the present experiment was higher than the above mentioned results. This might be due to higher stocking density, long culture period as well as best management practices.

Cost-benefit analysis

In the present experiment, the total cost of production (BDT/ha) was lower in T_1 (15,32,799) than those in T_2 (15,28,579) and T_3 (15,23,696) (Table 3). The net benefits generated from 210 days culture period was obtained as BDT 28,35,873, 18,89,616 and 10,68,659/ha for T_1, T_2 and T_3, respectively. However, the highest net benefit of BDT 28,35,873/ha was found from T_1 where *H. fossilis* stocked in 1,85,000 individuals/ha. Siddik and Khan (2007) recorded the cost and benefit of Monosex Tilapia (*Oreochromis niloticus*) in monoculture system and got the net benefit of BDT 69,277.32/ha/6 months where fish were fed formulated feed. Kohinoor *et al.* (1993) observed that monoculture of Raj punti (*Puntius gonionutus)* gave a net benefit BDT 68,135 to 75,028/ha from 6 months cultured. In another study, Rahman *et al.* (2013) found that the net benefit BDT 1,00,784 to 4,43,458/ha/6 months in monoculture of Thai koi *(A. testudineus*) in northern Bangladesh. In the present experiment, the net benefit was higher than the above findings. Among the treatments in seven months of culture experiment of Shing (*H. fossilis*), individuals 1,85,000/ha stocking density would be the best recommendation for farmers.

Table 3. Costs and benefits analyses of Shing (*H. fossilis*) production in one hectare (ha) earthen ponds for culture period of 210 days.

Items	Treatments		
	T_1 (BDT)	T_2 (BDT)	T_3 (BDT)
A. Cost			
Pond lease (BDT 65,000.00/ha/yr)	65,000	65,000	65,000
Pond preparation	70,000	70,000	70,000
Fingerlings (BDT 1.5/fingerling)	2,77,500	3,00,000	3,37,500
Feed (BDT 40.00/kg)	9,74,699	9,47,979	9,05,596
Harvesting cost	40,000	40,000	40,000
Labour (2 labour @ BDT 220.00/day)	1,05,600	1,05,600	1,05,600
Total costs	15,32,799	15,28,579	15,23,696
B. Gross benefit			
Sell price of *H. fossilis*	43,68,672	34,18,195	25,92,355
Net benefits (B-A)	28,35,873	18,89,616	10,68,659

*Selling price of *H. fossilis* after harvesting was BDT 450/kg

So, the total production and economic return of *H. fossilis* was very encouraging and, this culture system could add an extra production and income to the fish farmers than the other fish culture especially in northern Bangladesh.

CONCLUSION

From this experiment, it can be concluded that treatment T_1 (1,85,000 fingerlings/ha) is advisable for monoculture of *H. fossilis* due to higher total weight gain, better feed conversion ratios as well as higher net profit. Application of this findings for *H. fossilis* culture might be developed the aquaculture production especially in northern Bangladesh and extremely helpful towards the protection of this species from extinction.

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