Asian Australas. J. Biosci. Biotechnol. 2016, 1 (2), 380-385

Asian-Australasian Journal of Bioscience and Biotechnology
ISSN 2414-1283 (Print) 2414-6293 (Online)
www.ebupress.com/journal/aajbb

Article

Effects of stocking density on growth and production of shing (*Heteropneustes fossilis)* in ponds

Md. Mamunur Rahman[1]*, Debashis Kumar Mondal[2], Md. Rurul Amin[1] and Masum Billah[1]

[1]Department of Aquaculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[2]Senior Scientific Officer, Bangladesh Fisheries Research Institute, Brackish water station, Paikgacha, Khulna, Bangladesh

*Corresponding author: Md. Mamunur Rahman, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. Phone: +8801717386027; E-mail: mamunurrahman125@gmail.com

Received: 07 August 2016/Accepted: 25 August 2016/ Published: 31 August 2016

Abstract: To assess the effects of stocking density on growth and production of shing (*Heteropneustes fossilis)*in ponds, an experiment was carried out for a period from 06 August to 22 December, 2015. Three stocking densities used were 80, 160 and 240 fish /decimal and designated as T_1, T_2 and $T_{3,}$ respectively. Each treatment has two replications. Shing having a mean body weight of 1.18g was used in T_1, T_2 and $T_{3,}$ respectively. A commercial feed fed at the rate of 50% of body weight up to first 15 days and then gradually it was readjusted to 35%, 25%, 15%, 5% and 2% respectively. The water quality parameters were monitored at 15 days interval and the ranges were: temperature 23.0 ºC to 30.25 ºC, pH 6.64 to 8.16, dissolved oxygen 4.91 to 6.99 mg/l and transparency 36.15 to 41.5 cm. Results showed that, the fish stocked at the rate of 80 fish/decimal in T_1 get best individual weight gain (42.63g) followed by T_2(38.52g) and T_3 (34.82g), respectively. The SGR ranged between (1.77to1.81) %/day. There was significant variation ($P<0.01$) among the survival rate which ranged from 66.45% to 88.75%. The production was 3.02 kg, 4.96 kg and 5.55 kg/dec/134 days in T_1, T_2 and $T_{3,}$ respectively. But the highest production of 5.55kg/dec/134 days was obtained in T_3 with stocking density of 240 fish/dec might be due to higher stocking density. Although the highest production was obtained in T_3 but individual growth performance of shing (*Heteropneustes fossilis)* was highest in T_1. The highest net profit was found (BDT 2591) in treatment T_2 compared to treatments T_1 (BDT 1800) and T_3 (BDT 1479). The cost benefit ratios were 1.59, 1.48 and 1.10 % in T_1, T_2 and T_3 respectively.

Keywords: stocking density; shing; growth; production

1. Introduction

Bangladesh is a country with hundreds of rivers and more then lakh ponds and is notable for being a fish-loving nation, acquiring the name "Machh-e Bhat-e Bangali" which means, "Bengali lives on fish and rice". In the agro-based economy of Bangladesh, fish and fisheries play an important role, providing fulltime employment to 1.4 million people and part time work to 11 million, and contributing some 10 percent of the total export earnings (FAO, 1995). This sector contributes 4.43% to gross domestic product (GDP), 2.73% of export earnings and 60% of the total protein supply in the diet of the people of Bangladesh (DoF, 2012). In inland fisheries, the culture fisheries production was 1859808 MT of which live fish production was 102670 MT (DoF, 2012). The stinging catfish, *Heteropneustes fossilis* (Bloch) is commercially as well as aquaculturally an important species in many Asian countries (Akand *et al.*, 1991) and it is an indigenous species to IndoPak-Bangladesh subcontinent. It is locally known as “shingi or shing”. Earlier very few studies were conducted on the biology of *H. fossilis* like Mia (1984) reported length-weight relationship, Das *et al*. (1989) calculated fecundity and Singh and (Goswami, 1989) studied age and growth. No published information is available on the effect of stocking density on growth and survival rate of *H. fossilis*. For the development and culture technique of indigenous catfish (*H. fossilis*) stocking density might play a very important role. Considering the lack of information on these lines, the present investigations were carried out to ascertain an optimum stocking density of *H. fossilis* fed with formulated pelleted feed. At this initial stage of shing farming the farmers must have adequate information about a proper stocking density to serve their purpose. With this point of view, the present research has been designed primarily to understand some practical information on different stocking density including feeding with formulated diet. The main objectives of the research work were as follows. To study the effects of stocking density on the growth performances of shing in ponds, to compare the production of shing at different stocking densities and to assess the water quality parameters.

2. Materials and Methods

2.1. Experimental site

A 138 days experiment was carried out from 6st August to 22th December, 2015 to evaluate the effect of stocking density on growth and production of shing (*Heteropneustes fossilis*) in 6 experimental ponds situated in the Field Laboratory Complex, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. The area of each pond was 2 decimal with an average depth of 5 fts, all ponds were rectangular in shape possessed more or less similar size, basin conformation and bottom type. Three different stocking densities of shing (*H. fossilis*) were tested in the experiment. Stocking density was maintained as treatment and which replicated twice.

Table 1. Experimental layout of shing (*H. fossilis*) culture in ponds.

Treatment	Replication (Pond no.)	Pond size (dec.)	Stocking size (g)	Stocking density/dec
T_1	R-1 (1)	2	1.18	80
	R-2 (2)			80
T_2	R-1 (3)			160
	R-2 (4)			160
T_3	R-1 (5)			240
	R-2 (6)			240

The fingerlings of *H. fossilis* were used in this experiment were collected from a private hatchery which name "Noha Aqua farm", Muktagacha, Mymensingh, Bangladesh and transported to the farm in oxygen filled polythene bags covered by jute bags. Commercial pellet feeds named "Quality Fish Feed" was selected for the present experiment. At the beginning of the experiment, feed was supplied at the rate of 50% of the body weight of reared shing and gradually it was re-adjusted to 35%, 25%, 15%, 5%, and 2% respectively. Actually the above feeding rates were standard feeding rate, but I have tried to maintain feeding to the fry up to satiation. The fry were fed 3 times up to 1st day to 30th days and then 2 times daily up to harvesting.

2.2. Analysis of experimental data on growth performances

Experimental data was collected during the growth trial were used to determine the following growth parameters:

Cumulative weight (g) = Mean final fish weight (g)

Mean cumulative weight gain (g) = Mean final weight (g) – Mean initial weight (g)

$$\text{Percent weight gain(\%)} = \frac{\text{Mean final weight (g) - Mean initial weight (g)}}{\text{Mean initial weight (g)}} \times 100$$

$$\text{Mean daily weight gain (g)} = \frac{\text{Mean final weight (g) - Mean initial weight (g)}}{T_2 - T_1}$$

Where, $T_2 - T_1$= duration of experimental period

$$\text{Specific growth rate (SGR) (\%/day)} = \frac{\log_e W_2 - \log_e W_1}{T_2 - T_1} \times 100$$

Where, W_1= initial live body weight (g) of shing

$W_{2=}$ final live body weight (g) of shing

T_1=initial time of the experiment

T_2= final time of the experiment

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

$$\text{Production (kg/dec/240 days)} = \frac{\text{No. of fish harvested} \times \text{Average final weight of fish (g)}}{1000}$$

2.3. Analysis of water quality parameters

Water temperature, dissolved oxygen, pH and transparency were recorded weekly during the study period and data were collected between 7.00 am to 8.00 am of the day with the help of respective kits.

2.4. Statistical analysis

The data obtained on the growth performance of fish, survival rate and production were statistically analyzed by the SPSS.

2.5. Benefit-cost analysis

$$\text{Benefit-cost ratio (BCR)} = \frac{\text{Total income}}{\text{Total cost}}$$

R = I – (Fc + Vc)
Where,
R = Net return
I = Total income from shing sale
Fc = Fixed costs and
Vc = Variables cost

3. Results and Discussion

3.1. Water quality parameters

In the present study the average temperature recorded were (28.22±2.02), (28.5±1.86) and (28.225±1.97) in T_1, T_2 and T_3, respectively. The water temperature of the treatments varied from 23.0 ºC to 30.25 ºC during the study period. The maximum temperature 30.25 ºC was recorded in T_2 in 17 August, 2015. The minimum temperature 23.0 ºC was noted in T_3 in 10 December, 2015 due to low intensity of sunlight and some rainfall. Actually, temperature of shallow and small pieces of water body follows the air temperature (Vass and Sachlan, 1956) Begum (1998), Rahman (2000), Kohinoor (2000), Mondol (2012), Kohinoor (2012)and Haque (2014) who measured water temperature in ponds of BAU Campus, Mymensingh and found to vary from 29 to 32˚C, 21.8 to31.10˚C, 26.3 to 33ºC, 29.7 to 29.9˚C, 18.5 to 32.9˚C,26.7-30.60ºC, 27.90-27.49˚C and 24 to 32.8˚C respectively, which were more or less similar to that of the present study. During the experimental period dissolved oxygen content of the ponds were found between 4.91 to 6.99 mg/l. DoF (1996) reported that the range of dissolved oxygen suitable for fish culture would be 5.0 to 8.0 mg/1. Rahman (2000), and Maghna (2012) who measured dissolved oxygen (mg/1)in ponds of BAU Campus, Mymensingh and found to vary from 2.2 to 8.8 mg/l, 3.40 to 8.79 mg/l, 7.5 to 7.6 mg/l, and 4.8 to 5.4 mg/l, respectively. Ahmed *et al.* (2012) measured dissolved oxygen ranged from 6 to 8.5 mg/l. From the above discussion, it may be concluded that the oxygen content of the experimental ponds were within the good productive range. In the present study, the mean (±SD) values of pH of the water in T1, T2 and T3 were (7.55 ± 0.31), (7.56 ± 0.42) and (7.54 ± 0.35), respectively. Ahmed *et al.* (2012) found pH range from 6.5 to 8.5. Chakma (2011) recorded pH range between 7.44 and 7.66. Kohinoor *et al.* (2012) recorded pH range 7.08-7.15. The pH values were within the suitable ranges for shing culture. In the present study, the values of Water Transparency were noted to vary from 36.15 to 41.5 cm. The mean (±SD) values of transparency were recorded (38.75 ± 1.64), (39.77 ± 0.46) and (38.29 ± 1.26) cm in T_1, T_2 and T_3, respectively. Boyd (1982) recommended a transparency between 30-45 cm as appropriate for fish culture. Wahab *et al*. (1994) found transparency depth ranging from 15.0 to 74.0 cm in polyculture ponds. Rahman (1992) concluded that the transparency of productive water bodies should be 40.00 cm or less. Thus it might be concluded that all of water quality parameters were within suitable range for fish culture.

3.2. Growth performances

During the present study, growth performance of shing *(H. fossilis)* was investigated in this experiment. The highest mean weight gain was 42.63g in T_1 with lowest stocking density of 80/decimal compared to other T_2 (160/decimal) and T_3 (240/decimal) although same feed was supplied in all treatments. These phenomenon indicated that lower stocking density reduces competition among the fishes which influenced them to take feed properly and it might be absent in the treatments with higher stocking densities. The present results coincide with the findings of Kawamoto *et al.* (1957) who achieved best growth at lower stocking densities in shing farming. While Mollah (1985) reported that the lower density gave higher size and higher survival rate in *Clarias macrocephalus*. They also reported that the lower density gave larger size and higher survival rate in *H. fossilis* in pond. The highest mean (±SD) value (3512.71±192.96) % of percent weight gain was found in

T_1 whereas the lowest mean (±SD) value (2850.85±167.79) % of percent weight gain was found in T_3. The results indicated that the percent weight gain varied in different stocking densities which coincides with the findings of Narejo *et al* (2005) and Rahim (2010). He found percent weight gain ranged from 3971 to 5415%. Stocking density is an important parameter which directly affects the growth of fish and its production (Backiel and Lecren, 1978).The mean specific growth rate (SGR) varied from 1.76 ±0.24 (T_3) to 1.81 ±0.21 (T_2), (%/day) .The harmful effects of stocking density on the culture of fish are the reduction of growth and survival rate and increase of food conversion ratio (Powel, 1972). At higher stocking densities, presence of abundant feed substance could produce a competitive interaction among the larvae causing a stressful situation (Houde, 1975).A similar experience with regards to growth, i.e. retardation of fish growth at higher densities, was observed by Lakshmanan *et al*. (1971) and Jena *et al.* (1998) while working with carps and other fish species. They obtained the highest values of specific growth rate at lowest stocking densities. The highest survivability was recorded in T_1 (88.75%) and the lowest survivability was in T_3 (66.45%). Mollah (1985) reported that the lower density gave larger size and higher survival rate in *Clarias macrocephalus*. Barua (1990) reported that the survival rates were higher in the larvae raised at the stocking densities of 2, 4 and 8 fish per litre compared to those obtained 16 fish per litre. Ita *et al*. (1989) reported that lower stocking density showed higher survival (60%). The highest production was observed to be 22.21Kg/138 days in T_3 and the lowest production was observed to be 12.11Kg/138 days in T_1.Although the mean weight gain (g) in $T_1$was highest but total production was highest in T_3 which might be due to higher number of fishes. The present result supports the findings of Kohinoor *et al.* (2012) who achieved the best production from higher stocking densities compared to that achieved with the lower ones.

Table 2. Average (Mean ± SE) values of growth performance of shing *(H. fossilis)* under three different treatments during the study period.

Weight	T_1	T_2	T_3	LSD	Level of sig.
Initial weight	1.18	1.18	1.18	-	ND
Mean Cumulative Weight (g)	17.16 ±5.37 ^{a}	16.32 ±4.81 ^{a}	14.65 ±4.43 ^{b}	0.94	**
Mean weight gain (g)	15.98 ±5.37 ^{a}	15.14 ±4.81 ^{b}	13.47 ±4.43 ^{c}	0.57	**
Percent weight gain (%)	1354.30±454.82 ^{a}	1292.98±415.60 ^{b}	1141.65±375.50 ^{c}	0.34	**
Specific growth rate (SGR) %	1.77 ±0.18	1.81 ±0.21	1.76 ±0.24	0.22	NS
Average daily weight gain (g)	0.203 ±0.03 ^{a}	0.200 ±0.02 ^{a}	0.177 ±0.02 ^{b}	0.01	**
Survivability rate (%)	88.75 ± 6.51 ^{a}	80.46 ±3.33 ^{b}	66.45 ± 3.11 ^{c}	7.88	**
Total Production (kg/134 days)	12.10 ±3.22 ^{b}	19.84 ±2.10 ^{a}	21.21 ±2.56 ^{a}	2.91	**

**= significant at 1% level of probability (P≤0.01)

- NS= Not significant
- In column figures with same or without letter do not differ significantly

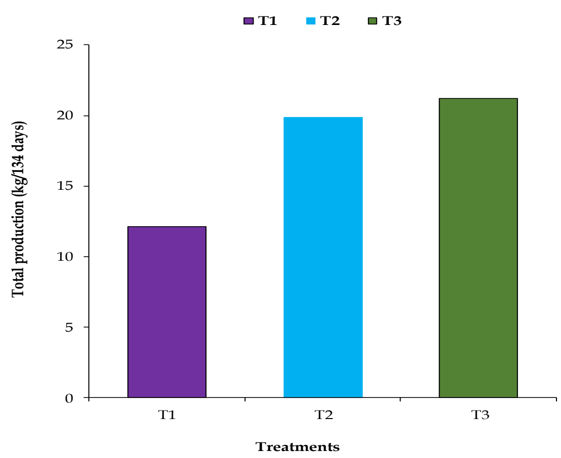

Figure. 1. Total production (Kg/138 days) of shing *(H. fossilis)* in three different treatments.

Table 3. Benefit-cost analysis of shing *(H. fossilis)* under three different treatments during the study period.

Investment (BDT/dec)	T_1 (BDT)	T_2 (BDT)	T_3 (BDT)
Pond preparation (liming & fertilization)	250	250	250
Lease Cost	400	400	400
Cost of fry	1200	2400	3600
Feed cost	1094	2195	3055
Labor cost	100	100	100
Total cost	3044	5345	7405
Fish production (kg)	12.11	19.84	22.21
Price of fish/kg	400	400	400
Gross income	4844	7936	8884
Net profit	1800	2591	1479
Cost benefit ratio	1.59	1.48	1.10
Average cost benefit ratio		1.42	

3.3. Benefit-Cost analysis

From the experiment it was found that the highest net profit was BDT 2591 in T_2. That time the market price was BDT 400/kg fish. Culture of shing *(H. fossilis)* at stocking density (160 fish/dec) showed higher benefit in short period of time. The similar result was found by Karim (2006) and Alim (2013) who stated that the highest benefit was found at lower stocking density in 98 days. The average cost benefit ratio was 1.42. So it might be concluded that the cost benefit ratio in T_2 was more beneficial than T_1 and $T_{3.}$

4. Conclusions

Under the experimental condition, different treatments showed different growth rates. From the present experiment, it was found that the total production was increased with the increase of stocking density, but the individual fish growth rate was decreased with the increase of stocking density. The cost-benefit ratio were 1.59, 1.48 and 1.10 in T_1, T_2 and T_3 respectively. The net profit in T_2 was (BDT 2591) highest among the treatment. Based on the present experiment, it can be recommended that farmers could be suggested to rear shing (*Heteropneustesfossilis)* at lower stocking density (80 fish/dec) to get higher growth and survival and thereby higher profit in a short period of time but commercial purpose the total production was increased with the increase of stocking density.

Conflict of interest

None to declare.

References

Ahmed GU, T Khatun, MB Hossain and M Samsuddin, 2012. Health condition of a farmed tilapia *(oreochromis niloticus)* in earthen ponds, Northern Bangladesh. Bangladesh J. Fish., 12: 287-293.

Akand AM, MR Hasan and MAB Habib, 1991. Utilization of carbohydrate and lipid as dietary energy sources by stinging catfish (*Heteropneustesfossilis*). In: Fish nutrition research in Asia, SS De Silva (Editors). Fourth Asian Fish Nutrition Workshop,*Asian Fisheries Society,* Manila, Philippines. pp. 93-100.

Alim A, 2013. Effects of stocking density on growth and production of monosex male tilapia (*oreochromis niloticus*) in ponds,MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 56.

Backiel T and ED LeCren, 1978. Some density relationship for the population parameters. In: SDGerkings (Editors) Ecology of freshwater fish production, Blackwell Scientific Publications, Oxford. pp. 279-302.

Barua G, 1990. Gonadal development and fry rearing of *Clariasbatrachus,* PhD Dissertation, Fisheries Biology and Limnology Department, BAU, Mymensingh. pp. 253.

Begum F, 1998. Effectiveness of urea along with a constant quantity of poultry manure on plankton production in fish pond, MS Thesis, Department of Aquaculture, BAU, Mymensingh. pp. 49.

Boyd CE, 1982. Water Quality Management for Pond Fish Culture. Elsevier, Netherlands. pp. 318.

Chakma A, 2011. Growth performance of thaipangus (*pangasianodonhypophthalmus*) using prepared and commercial feed, MS Thesis, Department of Aquaculture, BAU, Mymensingh. pp. 58.

Das M, S Dewan and SC Debnath, 1989. Studies on fecundity of *Heteropneustesfossilis* (Bloch) in a mini pond of Bangladesh Agricultural University, Mymensingh. Bangladesh Journal of Agricultural Science, 16: 1-6.

DoF, 2012. Annual Report 2012-2013. Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. pp. 111.

FAO, 1995. National workshop on fisheries resources development and management in Bangladesh. pp. 160-176.

Haque M, 2014. Optimization of stocking density on growth and production of mono-sex tilapia in pond, MS Thesis, Department of Aquaculture, BAU, Mymensingh. pp. 51.

Houde ED, 1975. Effect of stocking density and food on survival, growth and yield of laboratory reared of sea bream, *Archosargusrhomboidales* (L.). J. Zool., 7: 115-127.

Ita EO, CT Madu, WS Omorinkoba and A Pandogari, 1989. Preliminary estimator of the survival rate of *Clariasanguillaris* fry under outdoor hatchery management system. Annual Report National Institute of Fisheries Resource, Nigeria. pp. 88-94.

Jena JK, Aravindakshan PK, Chandra S, Muduli HK and S Ayyappan, 1998. Comparative evaluation of growth and survival of Indian major carps and exotic carps in raising fingerlings, Journal of Aquaculture Tropics, 13: 143–150.

Karim, 2006. Study on effect of stocking dendity on the growth and production of Thai koi *(Anabas testudineus)* in Mymensingh region, MS Thesis, Department of Aquaculture, Faculty of fisheries, Bangladesh Agricultural University, Mymensingh. pp. 48.

Kawamoto NY, Incuye Y and S Nakanishi, 1957. Studies on effects by the ponds areas and densities of fish in the water upon the growth rate of carp (*Cyprinuscarpio*, L), Handbook of freshwater, Fisheries Biology. Lowasae University press, 1:752-759.

Kohinoor AHM, 2000. Development of culture technology of three small indigenous fish mola (*Amblypharyngodon mola*), punti (*Puntiussophore*), and chela (*Chela cachius*) with nites on some aspect of their biology, PhD Thesis, Department of Fisheries Management, Mymensingh. pp. 287.

Kohinoor AHM, Khan MM, Yeasmine S, Mandol P and MS Islam, 2012. Effects of stocking density on growth and production performance of indigenous Stinging catfish, *Heteropneustesfossilis* (bloch). International Journal of Agricultural Resources Innovation & Technology, 2: 9-14.

Lakshmanan MAV, Sukumaran KK, Murty DS, Chakraborty DP and MT Philipose, 1971. Preliminary observations on intensive fish farming in freshwater ponds by the composite culture of Indian and exotic species, Journal of Inland Fisheries Society of India, 3: 1–21.

Mia GK, 1984. Length-weight relationship and condition factor in the air-breathing catfish, *Heteropneustesfossilis* (Bloch). Bangladesh J. Zool., 12: 49-52.

Maghna MSA, 2012. Studies on the stocking density of hormone treated tilapia (*Oreochromis niloticus*) fry, MS Thesis, Department of Aquaculture, Bangladesh Agriculture University, Mymensingh. pp. 57.

Mollah MFA,1985. Effects of stocking density and water depth on the growth and survival of freshwater catfish (*Clariasmacrocephalus*) larvae. Indian J. fish., 32: 1-17.

Mondol A, 2012. Investigation on the health status of some exotic fishes from framing condition of Mymensingh area, MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 51.

Powell MR, 1972. Cage and race-way culture of striped bass in brackish water in Alabama, 26th Annual Conferences Southeast Association Game Fish Committee. pp. 533-565.

Rahman MS, Chowdhury MY, Haque AKMA and MS Haq 1992. Limnological studies of four ponds. Bangladesh J. Fish.**,** 3-5: 63-68.

Rahman MM, 2000. Effect of species combination on pond ecology and grouth of fish in carp-SIS polyculture system, MS Thesis, Department of Fisheries Management, BAU, Mymensingh. pp. 56.

Rahman AKA, 2005. Freshwater fishes of Bangladesh. *Zoological society of Bangladesh*. Dhaka. pp. 209-211.

Rahim A, 2010. Effects of stocking density on growth and production performance of mono-sex Tilapia (*Oreochromis niloticus*) in ponds, MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 61.

Wahab MA, Begum M and ZF Ahmed, 1994. The effect of silver carp introduction in the polyculture of major carps, Bangladesh Agricultural University, Research Progress, 5: 429-437.