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Azhar Ali

Bangladesh Fisheries Research
Institute, Mymensingh, Bangladesh

M Rafiqur Rahman

Department of Fisheries Biology and
Genetics, Bangladesh Agricultural
University, Mymensingh, Bangladesh

M Kamruzzaman Hossain

Department of Fisheries, Ministry of
Fisheries and Livestock, Bangladesh

Harun-Ar-Rashid

Department of Fisheries, Ministry of
Fisheries and Livestock, Bangladesh

KM Moinul Hasan

Department of Fisheries, Ministry of
Fisheries and Livestock, Bangladesh

MA Kalam Azad

Department of Fisheries, Ministry of
Fisheries and Livestock, Bangladesh

Sirajum Monira Shanta

Department of Fisheries Biology and
Genetics, Bangladesh Agricultural
University, Mymensingh, Bangladesh

M Motasim Bella

Department of Fisheries Biology and
Genetics, Bangladesh Agricultural
University, Mymensingh, Bangladesh

Shabnam Mostary

Department of Fisheries, Ministry of
Fisheries and Livestock, Bangladesh

M Ashik Ullah

Department of Fisheries Biology and
Genetics, Bangladesh Agricultural
University, Mymensingh, Bangladesh

Correspondence

M Rafiqur Rahman

Department of Fisheries Biology and
Genetics, Bangladesh
Agricultural University,
Mymensingh, Bangladesh

Optimization of stocking density of Thai Sharpunti, *Barbonymus gonionotus* (Bleeker) in monoculture system

Azhar Ali, M Rafiqur Rahman, M Kamruzzaman Hossain, Harun-Ar-Rashid, KM Moinul Hasan, MA Kalam Azad, Sirajum Monira Shanta, M Motasim Bella, Shabnam Mostary and M Ashik Ullah

Abstract

The optimization of stocking density of Thai silver barb (*Barbonymus gonionotus*) was investigated in monoculture system over a period of 3 months from July 15, 2016 to October 15, 2016. Three different stocking densities of 150, 200 and 250 fingerlings per decimal were tested in T1, T2 and T3, respectively. At the stocking, all the fishes were of same age group and the average weights of fingerlings were 8.16 ± 0.26 , 8.14 ± 0.28 g and 8.17 ± 0.30 g in T1, T2 and T3, respectively. Fishes in all the experimental ponds were supplemented mega pre starter for the first 15 days, starter feeds for next 45 days and grower feeds for the rest of 15 days. Water quality parameters were within suitable range for fish culture in all the experimental ponds. At the experimental period, highest growth parameters and survival rates were estimated in T1 compared to others two treatments (T1 and T2), indicating the decrease of growth performance with the increasing stocking density. The highest gross productions were obtained in T2, but the highest net productions were in T1 where the stocking densities were 150 and 200 per decimal in T1 and T2, respectively. However, more research still needed to further optimize stocking density of Thai Sharpunti in monoculture system. Till then, stocking density of 150 and 200 *B. gonionotus* fish per decimal will yield a better production to fish farmers in monoculture system.

Keywords: *Barbonymus gonionotus*, stocking density, monoculture

1. Introduction

Thai sharpunti (*Barbonymus gonionotus*) is one of the most commercially important cultivated fish in Thailand but it is well known in South East Asia and cultured in Thailand, Indonesia, Vietnam and Srilanka [1]. The total fish production of the Bangladesh is 38.78 lakh metric tons in which aquaculture contribution is about 56.82% and silver barb and indigenous barb contributes nearly 2.32% in total aquaculture production [2]. It can survive in brackish water at salinities of more than 7.0 ppt and grows to table size within three to four months [3]. It normally spawns in flood and running waters. To maximize its production alone or in association with other species, the cultural techniques of this species must be developed under the existing environmental conditions. The species has high potential for culture in seasonal ponds, ditches and road-side canals where the major carps do not perform well. It is a herbivore, feeding mainly on aquatic plants, grasses and algae [4, 5].

Stocking density is an important parameter in fish culture, since it has direct effects on the growth, survival and hence on production of fish [6]. It is an established fact that growth rate progressively increases as the stocking densities decreases and vice-versa. This was because of relatively less number of fish in a pond of similar size could get more space, food and dissolved oxygen etc. at the same time. Generally direct relationship exists between food abundance and growth rate whereas population density of the species and its growth rate tend to be inversely related [7]. However, there may be no relationship between food abundance and growth rate when a space limiting effects operates on the population [8]. Higher stocking density may cause crowding effects and reduction of growth rate. Stocking densities and management measures practiced by pond operators in Bangladesh are not based on scientific knowledge, thus resulting in poor growth and low production. To obtain maximum production as well as economic returns it would be necessary to stock the ponds at optimum stocking

densities for optimum growth.

2. Materials and Methods

2.1 Description of the study area and duration of the experiment

The experiment was carried out for a period of 3 months from July 15, 2016 to October 15, 2016 in six experimental ponds situated at the Field Laboratory complex, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. All the Ponds were divided under three treatments i.e. T1, T2 and T3 each having two replicates.

2.2 Description of the ponds

The area of each pond was 2 decimal with an average water depth of 3-4 feet. All the ponds were of similar shape, size, basin conformation and bottom type. The ponds were free from aquatic vegetation, completely independent and well exposed to sunlight. The ponds consist of inlet and outlet to provide water and when needed.

2.3 Pond preparation before stocking

At first the weeds of all ponds were cleaned manually and dikes were repaired and rotenone was applied at the dose of 100g per decimal to remove undesirable fish species. After 10 days lime was applied at the rate of 1 kg per decimal and the ponds manured with cowdung at the rate of 10 kg per decimal. Seven days after liming, the ponds were fertilized with Urea and TSP at the rate of 100 g per decimal for each fertilizer.

2.4 Stocking of Thai Sharpunti

The ponds were stocked with fingerlings after 7 days of fertilization. Before stocking all fingerlings were kept into a hapa for half an hour for acclimatization and the weight of fish were recorded individually with the help of a digital electric balance. All the ponds were stocked with *B. gonionotus* of 150, 200 and 250 fish per decimal in T1, T2 and T3, respectively. During the stocking the average weights of fingerlings were 8.16 ± 0.26 , 8.14 ± 0.28 g and 8.17 ± 0.30 g in T1, T2 and T3, respectively.

2.5 Feed supply

Commercially available Mega pre-starter fish feed (containing 36% protein) was applied for the first 15 days, starter feeds (32% protein) applied for next 45 days and grower feeds (32% protein) applied for the rest of 15 days. One day after stocking the fish, feeds were applied at the rate of 13% and gradually it was readjusted from 11%, 9%, 7%, 5% and 3%, respectively. For proper feeding, the feed was broadcasted homogeneously in each time. Fortnightly growth was monitored in each pond to adjust the feeding rate. The fish were fed twice daily at 10 hr and 17hr.

2.6 Study of water quality parameters

The water quality parameters such as water temperature, transparency, dissolved oxygen (DO), pH, total ammonia and total alkalinity were monitored fortnightly throughout the experimental period between 09.00 and 10.00 hr. Temperature ($^{\circ}\text{C}$) and dissolved oxygen (mg/l) were determined directly by a digital water quality analyzer Hanna DO meter (Model-HI 9146, Romania), pH by a digital pH-meter (Milwaukee pH meter, Model-PH55/PH56, USA), and transparency (cm) by a secchi disc and ammonia nitrogen by a UV VIS Spectrophotometer water analysis kit (DR 6000TM, USA).

Total alkalinity was estimated following the standard method of Stirling and APHA [9, 10].

2.7 Biological parameters (Plankton population)

Plankton samples were collected fortnightly from experimental ponds. Ten litre samples of pond water were collected from different areas and depth of the pond and filtered through a fine mesh (25 mm) phytoplankton net. Filtered sample was taken into a measuring cylinder and carefully made up to standard volume with distilled water. Using a plastic tubing, water was siphoned off from the measuring cylinder and plankton were concentrated into 50 ml and preserved using 5% buffered formalin in small plastic vials for subsequent studies. From each 10 ml preserved sample, 1 ml subsample was examined using Sedgwick-Rafter cell (S-R cell) under binocular microscope. All the plankton present in 10 squares of the cell chosen randomly were counted and used for quantitative estimation by using the following formula [11].

$$N = \frac{A \times 100 \times C}{V \times F \times L}$$

Where,

N = No. of plankton cells or units per litre or original water

A = Total no. of plankton counted

C = Volume of final concentrate of the sample in ml.

V = Volume of a field = 1mm^3

F = No. of fields counted

L = Volume of original water in litre

The mean population density of plankton was recorded and expressed numerically per litre of water (cells l^{-1})

2.8 Growth study of fishes

Fortnightly growth rate of *B. gonionotus* under each treatment were properly monitored. For this purpose 10% sharpunti were sampled from each of the pond in the morning (from 08h to 09h) by using seine net. The weight of the body of each fish sample was measured in nearest gram (g) by using a portable balance (Model HI 400EX). General pond condition and fish health conditions were monitored regularly during the culture period. The sampled fish were handled carefully. Any mortality of fish during the study period was observed and recorded.

The following parameters were used to evaluate the growth of sharpunti:

Weight gain (g) = Mean final weight (g) - Mean initial weight (g)

$$\% \text{ Weight gain} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100$$

Specific Growth Rate

$$\text{SGR (\% per day)} = \frac{\text{Ln final weight} - \text{Ln initial weight}}{\text{Number of experimental days}} \times 100 \quad [12]$$

Average Daily Gain

$$\text{ADG} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Total Experimental days}}$$

Cumulative weight gain (g)

CWG = Mean final fish weight

2.9 Harvesting of *B. gonionotus*

After 90 days of culture, the fishes were harvested by repeated netting using a seine net. During harvesting all fish were counted and weighed individually for each pond to assess the survival rate and production.

2.10 Estimation of survival rate and production of *B. gonionotus*

The survival rate of the *B. gonionotus* of each treatment was calculated from the number of fish at the end of the experiment. The gross and net production for each treatment was determined by multiplying the average weight (g) gained by the total number of survived fish at the end of the experiment. The survival rate was estimated by the following formula:

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

2.11 Statistical analysis

Statistical analysis of the collected data of the experiment was performed by one way analysis of variance by computer (SPSS package program). Comparison between treatment means was carried out by analysis of variance (ANOVA) followed by Duncan's Multiple Range Test [12].

3. Results and Discussion**3.1 Water quality parameters**

The comparison of mean values of water quality parameters among three treatments were recorded during the experimental period is presented in Table.1. One-way analysis of Variance (ANOVA) was performed to observe the significant difference among the treatments which are also shown in Table 1.

Table 1: Mean values (\pm SD) of water quality parameters of fortnightly samples during the experimental period

Parameters	T ₁	T ₂	T ₃
Water temperature (°C)	29.13 \pm 1.69 ^a	29.00 \pm 1.70 ^a	28.91 \pm 1.81 ^a
Dissolved oxygen (mg/l)	5.23 \pm 0.42 ^a	4.48 \pm 0.48 ^b	4.04 \pm 0.53 ^c
pH	7.37 \pm 0.78 ^a	7.26 \pm 0.76 ^a	7.69 \pm 0.77 ^a
Transparency (cm)	25.00 \pm 2.8 ^c	29.81 \pm 3.49 ^b	35.06 \pm 6.88 ^a
Total alkalinity (mg/l)	59.13 \pm 8.75 ^c	66.94 \pm 9.10 ^b	77.00 \pm 8.40 ^a
Total ammonia-nitrogen (mg/l)	0.14 \pm 0.03 ^c	0.19 \pm 0.05 ^b	0.25 \pm 0.08 ^a

Mean values in the same row with different superscripts are significantly different ($p < 0.05$)

Water temperature of the ponds under different treatments was recorded fortnightly. The water temperature was more or less similar in different ponds. The mean values of water temperature were 29.13 \pm 1.69, 29.00 \pm 1.70 and 28.91 \pm 1.81 °C in T1, T2 and T3 respectively (Table 1). The ranges of water temperature were 26.50 to 32.50 °C in T1, 26.00-31.50 °C in T2 and 26.00-32.00 °C in T3, respectively. The water temperature were suitable ranges for fish culture and there was no significant difference ($p > 0.05$) among the treatments when ANOVA was performed (Table 1). Moniruzzaman and Mollah [14] recorded water temperature range of 29.73-29.75 °C from an earthen ponds of shaprpunti culture. Ahmed *et al.* [15] recorded water temperature of 30.41 °C from a pond situated at Bangladesh Agricultural University Campus,

Mymensingh. These results are more or less similar with the present findings. Dissolved oxygen is one of the most important factors for fish culture which was recorded during the experimental period. The values of dissolved oxygen ranged from 4.38 to 6.10 mg/l⁻¹, 3.60 to 5.17 mg/l⁻¹ and 3.20 to 5.10 mg/l⁻¹ and mean values were 5.23 \pm 0.42, 4.48 \pm 0.48 and 4.048 \pm 0.53 mg/l⁻¹ in treatments 1, 2 and 3 respectively (Table 1). The mean values of dissolved oxygen were more or less similar in all treatments and there was significant ($p < 0.05$) difference among them. Similar results were found Moniruzzaman and Mollah [14], Ahmed *et al.* [14] and Mollah *et al.* [16]. The pH values of the pond water under the three treatments were found acceptable range for fish culture. The values of pH ranged from 6.3 to 8.5, 5.9 to 8.6 and 6.3 to 8.6 and mean values were 7.37 \pm 0.78, 7.26 \pm 0.76 and 7.69 \pm 0.77 in T1, T2 and T3 respectively (Table 1). One-way ANOVA showed no significant ($p > 0.05$) difference among the three treatments (Table 1). Dewan *et al.* [17] stated that the optimum pH range for carp polyculture in pond is 6.5 to 9.0. More or less similar results were recorded Ahmed *et al.* [15], Israfil [18] and Kabir [19] in their experimental ponds. During the study period, water transparency was observed to vary from one pond to another. The mean values of water transparency were 25.0 \pm 2.8, 29.8 \pm 3.49 and 35.06 \pm 6.88 cm in T1, T2 and T3 respectively (Table 1). The ranges of water transparency were 21 to 33 cm in T1, 24 to 38 cm in T2 and 26 to 47 cm in T3. The highest transparency value was recorded as 47 cm in T3 and the lowest value was 21 cm in T1. The mean values of transparency were significant ($p < 0.05$) difference among the treatments. Rahman [11] concluded that the transparency of productive water bodies should be 40 cm or less. The present findings were agreed with Rahman *et al.* [20] and Wahab *et al.* [21]. The highest mean value of total alkalinity was recorded in T3 (77.00 \pm 8.40 mg/l⁻¹) and the lowest was in T1 (59.19 \pm 8.75 mg/l⁻¹) but the variations among the treatments were statistically significant $p < 0.05$. The ranges of total alkalinity were 49 to 76, 52 to 81 and 62 to 91 in T1, T2 and T3, respectively. According to Rahman [11] total alkalinity of productive ponds should be 20 ppm or more. Mairs [22] considered a total alkalinity of 40 mg/l⁻¹ or more to be productive than the water bodies with lower alkalinity. Uddin [23] reported total alkalinity values between 45 and 180 40 mg/l⁻¹. In the present study, the alkalinity levels in water were within the productive range as stated by Rahman *et al.* [11], Mairs [22] and Uddin [23]. The mean values of ammonium-nitrogen (NH₄-N) were 0.14.0 \pm 0.03, 0.19 \pm 0.05 and 0.25 \pm 0.08 mg/l⁻¹ in T1, T2 and T3 respectively (Table 1). The ranges of ammonium-nitrogen (NH₄-N) were 0.09 to 0.19, 0.11 to 0.28 and 0.15 to 0.39 mg/l⁻¹ in T1, T2 and T3, respectively. The highest value of ammonium-nitrogen (NH₄-N) was recorded as 0.39 mg/l⁻¹ in T3 and the lowest value was 0.09 mg/l⁻¹ in T1. The mean values of ammonium-nitrogen (NH₄-N) were significant ($P < 0.05$) difference among the treatments. Boyd [24] reported that the suitable range of ammonia-nitrogen in fish culture less than 0.1 mg/l⁻¹. However, in the present study the level of ammonia-nitrogen content in the experimental ponds is not lethal for sharpunti culture [25].

3.2 Biological parameters (Plankton population)

The group-wise mean abundance of plankton observed in three treatments is shown in Table 2. Phytoplanktonic population mainly comprised of Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae. The

highest mean value of phytoplankton was recorded 8595 ± 1544 cells l^{-1} in T1 and the lowest value was observed 13936 ± 1303 cells l^{-1} in T3. Cyanophyceae was the dominant phyto planktonic group and Euglenophyceae abundance was the lowest in terms of number among the treatments throughout the experiment. There was significant ($p < 0.05$) variation among the treatments with regard to phytoplankton population. The zooplankton population was represented by only two groups viz., Crustacea and Rotifera. The mean values of zooplankton were 5743 ± 269 , 4755 ± 197 and 3549 ± 329 cells l^{-1} in T1, T2 and T3, respectively and the difference was significant ($P < 0.05$). Rotifera was the dominant group in terms of abundance among the treatments. Phytoplankton population showed an inverse relationship with zooplankton population. Similar results were also recorded by Islam and Saha [26] and Rahman and Rahman [27].

Table 2: Mean values (\pm SD) and ranges of plankton abundance (cells/l) of pond water of weekly samples under the three treatments during the culture period

Plankton group	Treatment-1	Treatment-2	Treatment-3
<i>Phytoplankton</i>			
Bacillariophyceae	4216 \pm 621 ^a	3523 \pm 790 ^{ab}	3191 \pm 730 ^b
Cyanophyceae	6632 \pm 1429 ^a	5915 \pm 839 ^b	5250 \pm 552 ^c
Chlorophyceae	4830 \pm 397 ^a	4078 \pm 803 ^b	3383 \pm 687 ^c
Euglenophyceae	2917 \pm 276 ^a	2632 \pm 182 ^b	2112 \pm 95 ^c
Total	18595 \pm 1544 ^a	16148 \pm 1386 ^b	13936 \pm 1303 ^c
<i>Zooplankton</i>			
Crustacea	2681 \pm 387 ^a	2238 \pm 277 ^b	1887 \pm 203 ^c
Rotifera	3062 \pm 730 ^a	2517 \pm 582 ^b	2007 \pm 420 ^c
Total	5743 \pm 269 ^a	4755 \pm 197 ^b	3549 \pm 329 ^c

Mean values in the same row having the same superscripts are not significantly different ($P > 0.05$).

Wahab *et al.* [21] recorded phytoplankton numbers ranging from 2.0×10^5 to 8×10^5 cells l^{-1} and zooplankton between 2×10^4 to 2×10^5 in three ponds. Haque *et al.* [28] observed phytoplankton and zooplankton abundance of 3.78 ± 0.15 to 50.64 ± 1.29 cells l^{-1} and 4.91 ± 0.8 to 6.16 ± 0.8 cells l^{-1} , respectively in their study. However, Rahman *et al.* [29] recorded phytoplankton and zooplankton ranging from (61.36 ± 8.66) to $(67.99 \pm 10.75) \times 10^3$ cells l^{-1} and (5.57 ± 1.41) to $(6.89 \pm 1.08) \times 10^3$ cells l^{-1} , respectively in carp polyculture. Compared to these observations, the plankton abundance was lower in the present study and this might be due to lower quantity of fertilizer use.

3.3 Growth parameters

Fortnightly growth parameters of *Barbonymus gonionotus* under three stocking densities using the same feeding regime were studied during the experimental period. The growth parameters like initial weight (g), weight gain (g), % weight gain, specific growth rate or SGR (% per day), Average daily gain (g), cumulative weight gain (g) were recorded and shown in Table 3.

The average stocking weights of *B. gonionotus* were 8.16 ± 0.26 , 8.14 ± 0.28 and 8.17 ± 0.30 g in T1, T2 and T3, respectively. There was no significant different ($p > 0.05$) in stocking weights among the treatments. The significantly ($p < 0.05$) highest growth (58.97 ± 1.42) was observed in T1 followed by T2 (46.19 ± 1.90) and T3 (36.99 ± 0.86). The percent weight gain (%) of *Barbonymus gonionotus* in

different treatments ranged from (552.71 ± 10.48) to (822.69 ± 17.43). The lowest percent weight gain of 36.99 ± 0.86 was observed in T3 while the significantly ($p < 0.05$) highest percent weight gain 36.99 ± 0.86 was observed in T1 followed by T2 (667.38 ± 23.28).

Table 3: The mean values (\pm SE) of growth parameters of *Barbonymus gonionotus* under three treatments during the culture period

Growth parameters	Mean (\pm SE) values		
	T1	T2	T3
Initial weight (g)	8.16 \pm 0.26 ^a	8.14 \pm 0.28 ^a	8.17 \pm 0.30 ^a
Weight gain (g)	58.97 \pm 1.42 ^a	46.19 \pm 1.90 ^b	36.99 \pm 0.86 ^c
% Weight gain	822.69 \pm 17.43 ^a	667.38 \pm 23.28 ^b	552.71 \pm 10.48 ^c
SGR (% per day)	2.34 \pm 0.02 ^a	2.11 \pm 0.04 ^b	1.90 \pm 0.02 ^c
Average daily gain (g)	0.66 \pm 0.02 ^a	0.51 \pm 0.02 ^b	0.41 \pm 0.01 ^c
Cumulative weight gain (g)	67.13 \pm 1.42 ^a	54.33 \pm 1.90 ^b	45.16 \pm 0.86 ^c

Mean values in the same row having the same superscripts are not significantly different ($P > 0.05$).

The specific growth rate of *Barbonymus gonionotus* in different treatments ranged from 1.90 ± 0.02 to 2.34 ± 0.02 . The lowest specific growth rate (1.90 ± 0.02) was observed in T3 while the significantly ($P < 0.05$) highest specific growth rate (2.34 ± 0.02) was observed in T1 followed by T2 (2.11 ± 0.04). The lowest average daily gain (g) was 0.41 ± 0.01 observed in T3 while the significantly ($P < 0.05$) highest average daily gain (g) was 0.66 ± 0.02 observed in T1 followed by T2 (0.51 ± 0.02). The lowest cumulative weight gain (g) was 45.16 ± 0.86 observed in T3 while the significantly ($P < 0.05$) highest cumulative weight gain (g) was 45.16 ± 0.86 observed in T1 followed by T2 (54.33 ± 1.90). In the present study, all the growth parameters were highest in T1 and gradually decreased in T2 and T3, respectively due to increase stocking density. Similar results were found Moniruzzaman and Mollah [14], Ahmed *et al.* [15], and Mollah *et al.* [16].

3.4 Survivals and production of *B. gonionotus*

The survivals and gross and net production of Thai Sharpunti obtained from the present study were recorded and given in Table 4. The mean survival rate of *B. gonionotus* in three treatments was 90.68 ± 0.68 , 85.93 ± 0.90 and $77.38 \pm 1.84\%$ in T1, T2 and T3, respectively. The lowest average survival rate was 77.38 ± 1.84 observed in T3 while the significantly ($p < 0.05$) highest survival rate was 90.68 ± 0.87 observed in T1 followed by T2 (85.93 ± 0.90). Moniruzzaman and Mollah [14] reported the survival rate of 87.50 to 94.37% where Thai sharpunti *Barbodes gonionotus* were cultured in earthen ponds and rice bran was used as supplementary feed. Lakshmanan *et al.* [30] observed a carp survival rate of 80% in polyculture, where ponds were fertilized with both organic and inorganic fertilizers and fishes were fed with a mixture of rice bran and mustard oil cake. In another study, Kohinoor *et al.* [31] obtained a survival rate of 86 to 94% in the monoculture of Thai sharpunti. Wahab *et al.* [32] found that the survival of fish including sharpunti was higher than 80% in polyculture of native carps. Mollah *et al.* [16] reported the survival rate of 86.87 to 93.30% where Thai Sharpunti was cultured in earthen ponds for a period of 4 months and maintained stocking density from 20000 to 30000 per hectare. The present study also agreed with the above findings.

Table 4: The survival rate and gross and net productions of *B. gonionotus* after 90 days of culture; mean \pm SE with range in parentheses

Treatments	Initial stocking wt. (kg ha ⁻¹)	Total production (kg pond ⁻¹)	Survival rate (%)	production (kg ha ⁻¹ per 90 days)	
				Gross	Net
T1	306.00	18.26 \pm 0.21 ^a	90.68 \pm 0.87 ^a	2282.21 \pm 26.58 ^a	1976.21 \pm 26.58 ^a
T2	407.00	18.68 \pm 0.85 ^a	85.93 \pm 0.90 ^a	2334.93 \pm 15.87 ^a	1927.93 \pm 15.87 ^a
T3	510.63	17.47 \pm 0.09 ^a	77.38 \pm 1.84 ^b	2182.74 \pm 10.40 ^b	1672.11 \pm 10.39 ^b

Figures in the same column having the different superscript are significantly different ($p < 0.05$)

The mean gross and net production of *B. gonionotus* after 90 days of culture period were 2282.21 \pm 26.58 and 1976.21 \pm 26.58, 2334.93 \pm 15.87 and 1927.93 \pm 15.87 and 2182.74 \pm 10.40 and 1672.11 \pm 10.39 kg ha⁻¹ in T1, T2 and T3, respectively (Table 3). The growth and survival was inversely related with stocking density but the total production did not maintain the same trends. The highest production was obtained from T2 where the stocking density was 50000 fingerlings ha⁻¹ which significantly different ($p < 0.05$) from the production obtained from T3. But in case of gross and net production, there was no significant difference ($p > 0.05$) between T1 and T2. The lowest production was found in ponds stocked with 62500 fingerlings ha⁻¹. Water quality parameters in all ponds were suitable ranges for fish culture during the culture period. Moniruzzaman and Mollah [14] recorded the gross and net production of *B. gonionotus* of 1292.85 and 888.39 kg ha⁻¹ after 120 days of culture with fertilizer and rice bran. Kohinoor *et al.* [31] obtained *B. gonionotus* production of 23.84 kg ha⁻¹ after 6 months culture for fertilized pond along with supplemental feeding and 2,129.72 kg ha⁻¹ after 6 months culture with only supplementary feed as rice bran. Hussain *et al.* [33] obtained *B. gonionotus* production of 1,952 kg ha⁻¹ with only supplemental feed as rice bran and 689 kg ha⁻¹ with only fertilizers after 5 months of culture. The results of the present study showed more or less similar with the above findings.

4. Conclusion

The present study revealed that the stocking density had significant effects on growth and survival of Thai sharpunti. But in case of gross total production, the stocking density of 200 fish per decimal showed better results than both of 150 and 250 fish per decimal stocking densities. However, the stocking density of 150 per decimal showed better performance than both of stocking density of 200 and 250 fish per decimal. So, it could be concluded that the stocking density both of 150 and 200 fish per decimal is suitable and advisable in monoculture system of *B. gonionotus* for getting higher production at farmer's level.

5. References

1. Tantong H, Thawornnan W, Khunthong J. Induce spawning and culture of Plea Ta Pick Khao (*Barbonymus gonionotus* Bleeker). National Inland Fisheries Institute, Bangkok, Thailand, 1980, 4.
2. FRSS. Fisheries Statistical Report of Bangladesh. Fisheries Resources Survey System (FRSS). Department of Fisheries, Bangladesh, 2015, 31(57).
3. Gupta MA, Rab MA. Adoption and economics of silver barb (*Puntius gonionotus*) culture in seasonal waters in Bangladesh. ICLARM Technical Report, 1994, 41.
4. Phaothorn S. The study of biology, feeding and growth of *Puntius gonionotus* (Bleeker). Annual Report, Bangkok, Thailand, 1970, 19-33.
5. Srisuwantach V. Induced breeding of Thai silver barb (*P. gonionotus*, Bleeker). SAFIS manual No. 10, Eng. Transl., South-East Fish. Dev. Center, Thailand, 1981.
6. Backiel T, Lecren ED. Some density relationship for the population parameters. In: Ecology of freshwater fish production Gerking SD (Ed.). Blackwell Scientific Publications. Oxford, 1978, 279-302.
7. Le Cren ED. Some factors regulating the size of populations Freshwater. International Association of Theoretical and Applied Limnology. 1965; 13:88-105.
8. Johnson WE. On mechanism of self-regulation of population abundance in *Oncorhynchus nerca*. International Association of Theoretical and Applied Limnology. 1965; 13:66-87.
9. Stirling HP. Chemical and Biological Methods of Water Analysis for Aquaculturists. Institute of Aquaculture, University of Stirling, Stirling, 1985, 119.
10. APHA. Standard Methods for the Examination of Water and Waste-water. American Public Health Association, 1015 Eighteenth Street, N.W. Washington, DC, 1992; 1134.
11. Rahman MS. Water Quality Management in Aquaculture. Published by Bangladesh Rural Advancement Committee, Dhaka, Bangladesh, 1992, 84.
12. Brown ME. Experimental studies on growth. In: The physiology of Fishes. Brown ME (Ed.). Academic press. New York. 1957; 1:361-400.
13. Duncan DB. Multiple Range and Multiple F-tests. Biometrics. 1995; 11:1-41
14. Moniruzzaman M, Mollah MFA. Effects of rice bran on growth and survival of Thai sharpunti *Barbodes gonionotus* in earthen ponds. Journal of Bangladesh Agricultural University. 2010; 8(1):161-171
15. Ahmed GU, Rahman MM, Alam MN, Sarker B. Comparative study on growth performance of Thai Sharpunti (*Puntius gonionotus*) using two different weeds duck weed (*Lemna minor*) and Azolla fern (*Azolla pinmeta*). Research in Agriculture, Livestock and Fisheries. 2015; 2(2):369-374.
16. Mollah MFA, Moniruzzaman M, Rahman MM. Effects of stocking densities on growth and survival of Thai Sharpunti (*Barbonymus gonionotus*) in earthen ponds. Journal of Bangladesh Agricultural University. 2011; 8(1):9(2):327-338.
17. Dewan S, Wahab MA, Beveridge MCM, Rahman MH, Sarker BK. Food selection, electivity and dietary overlap among planktivorous Chinese and Indian Major carp fry and fingerlings grown in extensively managed, rain-fed ponds in Bangladesh. Aquaculture and Fisheries Management. 1991; 22:277-294
18. Israfil M. Effects of periphyton on monoculture of Thai Sharpunti (*Puntius gonionotus*). MS Thesis, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, 2000, 86.
19. Kabir ANMA. Use of duckweed (*Lemna minor*) as feed for fishes in polyculture. M.S. Thesis, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, 2003, 74.

20. Rahman MA, Hossain MK, Azad MAK, Kamruzzaman M, Rashid HA, Rahman MM, *et al.* Culture potential of Thai Sharpunti, *Barbodes gonionotus* (Bleeker) with major carps in seasonal ponds. Pakistan Journal of Biological Sciences. 2006; 9(10):1891-1897
21. Wahab MA, Islam MT, Ahmed ZE, Haq MS, Haque MA, Biswas BK. Effect of frequency of fertilization on the pond ecology and growth of fishes. Bangladesh Agricultural University Research Progress. 1994; 9:410-419.
22. Mairs DF. A total alkalinity atlas for marine lakes waters. Limnology and Oceanography. 1996; 11:68-72
23. Uddin MM. Effects of addition of small fish on pond ecology and production in polyculture. M.S. Thesis, Bangladesh Agricultural University, Mymensingh, 2002, 31.
24. Boyd CE. Water Quality Management for Pond Fish Culture. Elsevier, the Netherlands, 1982, 318.
25. Rahman MA, Yeasmine S, Khan MM. Growth, survival and production of a threatened silurid catfish, *Ompok pabda* (Hamilton) fingerlings in nursery pond. Malaysian Applied Biology. 2008; 37(1):47-56.
26. Islam AKMN, Saha JK. Limnological studies of Ramna lake at Dhaka. Dhaka University Studies (B). 1975; 23:36-46.
27. Rahman MA, Rahman MR. Studies on the growth and survival of sharpunti (*Puntius sarana* Ham.) spawn at different stocking densities in single stage nursing. Progressive Agriculture. 2003; 14(1&2):109-116.
28. Haque MS, Wahab MA, Wahid MI, Haq MS. Impacts of Thai silver barb (*Puntius gonionotus* Bleeker) inclusion in the polyculture of carps. Bangladesh Journal of Fisheries Research. 1998; 2:15-22.
29. Rahman MR, Rahman MS, Khan MGQ, Mostary S. Suitability of Mahseer (*Tor putitora* Hamilton) in polyculture with Indian major carps. Progressive Agriculture. 2007; 18(2):175-182.
30. Lakshmanan MAV, Sukumaran KK, Murty DS, Chakraborty DP, Philiposoer MT. Preliminary observations on intensive fish farming in freshwater ponds by the composite culture of Indian and exotic species. Journal of Inland Fisheries Society, India. 1971; 2:1-21
31. Kohinoor AHM, Akhteruzzaman M, Shah MS. Production of *Puntius gonionotus* (Bleeker) in ponds. Bangladesh Journal of Zoology. 1993; 21(2):77-83.
32. Wahab MA, Ahmed ZF, Islam MA, Haq MS, Rahmatullah SM. Effects of introduction of common carp, *Cyprinus carpio* (L.) on pond ecology and growth of fish in polyculture. Aquaculture Research. 1995; 26:619-628.
33. Hussain MG, Akhteruzzaman M, Kohinoor AHM, Karim KAT, Shah MS. Semi-intensive culture of *Puntius gonionotus* (Bleeker). Bangladesh Journal of Fisheries. 1989; 12(2):32-38.