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Culture Potential of Thai Sharpunti, *Barbodes gonionotus* (Bleeker) with Major Carps in Seasonal Ponds

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Abstract: Thai sharpunti, *Barbodes gonionotus* (Bleeker) was cultured with major carps *viz.*, rohu (*Labeo rohita*), catla (*Catla catla*), mrigal (*Cirrhinus mrigala*) and silver carp (*Hypophthalmichthys molitrix*) in seasonal ponds over a period of 90 days. Three treatments differing in stocking densities were tested with three replicates each. The stocking density of rohu, catla, mrigal and silver carp fingerlings in all the experimental ponds was 494, 494, 1,482 and 1,235 ha^{-1}, respectively. In addition, Thai sharpunti fingerlings was stocked at the rate of 9.880, 14.820 and 19.760 ha^{-1} in T_1, T_2 and T_3, respectively. All the fishes were fed with supplementary diet comprising of rice bran and mustard oil cake (1:1) at the rate of 6-7% of the estimated body weight twice daily. Physico-chemical parameters and plankton populations of pond water were taken every fifteen days interval and were within the normal range for fish culture. The total production of fish at the end of the experimental period was 1,248.34, 1,343.19 and 1,592.67 kg ha^{-1} in T_1, T_2 and T_3, respectively. Significantly higher ($p<0.05$) production of fish was obtained in T_3 due to higher number of Thai sharpunti. Despite this, consistently higher individual weight gain of rohu, catla, silver carp and Thai sharpunti was observed in T_1 than in T_2 and T_3. Other growth performances (final weight and specific growth rate) and survival of fish also followed the similar trends as weight gain. Considering the highest individual growth and survival of fish, the stocking density of Thai sharpunti in T_1 may be recommended for culture with Indian major carps in seasonal ponds to attain quick marketable size and to avoid disease risk.

Key words: *B. gonionotus*, *L. rohita*, *C. catla*, *C. mrigala*, *H. molitrix*, polyculture

INTRODUCTION

Thai sharpunti or silver barb (*Barbodes gonionotus*) was first introduced to Bangladesh from Thailand in 1977. It is an herbivore, feeding mainly on aquatic plants, grasses and algae (Phaohorm, 1970; Srisuwantach, 1981). It has high market value and become increasingly popular for its bright silvery appearance and good taste. The main reasons for its introduction to Bangladesh are that it is similar to local barb species, the natural environment of Bangladesh is suitable for growing this fish and it can be cultured in both shallow seasonal and deeper perennial ponds. Moreover, since silver barb reaches marketable size within four months, it is an ideal fish for culture in the large numbers of seasonal ponds of Bangladesh (Gupta, 1990). Silver barb responds well to comparatively low cost and simple management practices (Akhteruzzaman, 1991) and thus making it suitable for poor and marginal farmers. It has been proved to be a good species for culturing in seasonal ponds, rice fields etc. and has high production potential compared to some native carp species (Kohinoor *et al.*, 1994). Stocking density of different fish species in a polyculture system plays a vital role on overall production of fish. Higher density of one species may affect the growth of another species, similarly lower density of a species may reduce the overall production. Thai sharpunti owing to its rapid growth within a short time and comparatively high economic returns, it has been very popular among the farmers. Its inclusion into the polyculture system as an additional species may raise the overall production and economic returns (Mahmud, 1998).

Some research works have been conducted on culture of Thai sharpunti with major carps. But species

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combinations, stocking density, fertilization rate, feeding rate and frequency and rearing techniques varied from one researcher to another. For this reason, the compatibility and production performance of Thai sharpunti varied with exotic and indigenous carp species (Das *et al*., 1982; Uddin *et al*., 1994; Wahab *et al*., 1995; Haque *et al*., 1998; Kohinoor *et al*., 1994, 1999; Mahmud, 1998; Miaje, 1999). Therefore, the present work was undertaken to find out suitable stocking combinations and to evaluate growth and production performances of Thai sharpunti in polyculture with major carps.

MATERIALS AND METHODS

The experiment was carried out for a period of 90 days from 01 September to 30 November 2002 at the Field Laboratory of Fisheries Faculty, Bangladesh Agricultural University, Mymensingh. Nine earthen ponds each having a surface area of 0.02 ha with an average depth of 1.5 meter, were used in this experiment. The ponds were prepared by removal of aquatic weeds and other unwanted materials. Ponds were cleaned properly and then poisoned by phostoxin at a dose of 250 tablets per hectare. Four days after poisoning, quicklime (Ca_2CO_3, 250 kg ha^{-1}) was mixed with pond water. Seven days subsequent to liming, the ponds were fertilized with cowdung (1000 kg ha^{-1}), urea (25 kg ha^{-1}) and triple super phosphate (25 kg ha^{-1}). Soon after the appearance of light-plankton bloom, all the ponds were stocked with fingerlings of rohu (*Labeo rohita*), catla (*Catla catla*), mrigal (*Chirrhinus mrigala*) and silver carp (*Hypophthalmichthys molitrix*) at the rate of 494, 494, 1,482 and 1,235 ha^{-1}, respectively. In addition, Thai sharpunti (*Barbodes gonionotus*) was stocked at the rate of 9,880 14,820 and 19,760 ha^{-1} in treatment-1 (T_1), treatment-2 (T_2) and treatment-3 (T_3), respectively. All the fishes were fed with supplementary diet comprising of rice bran and mustard oil cake (1:1) at the rate of 6-7% of the body weight twice daily. The food requirement of fishes was adjusted according to weight gains (g) for which 10% of the fish from each pond were sampled fortnightly. Growth in terms of final weight, weight gain and SGR (%/day) were monitored fortnightly from each of the experimental pond.

The physico-chemical parameters of pond water viz., temperature (°C), transparency (cm), dissolved oxygen (mg L^{-1}), pH, nitrate-nitrogen (NO_3-N, mg L^{-1}), phosphate-phosphorus (PO_4-P, mg L^{-1}), total alkalinity (mg L^{-1}) and Chlorophyll-a (μg L^{-1}) were analyzed every fifteen days interval, following the standard method (APHA, 1992). The samples of water from each experimental pond were collected between 09.00 and 10.00 h. For quantitative and qualitative analysis, plankton samples were collected fortnightly from each of the experimental pond. Ten liters of water were taken at different areas and depths from each pond and then passed through fine-meshed plankton net (55 μm). The samples were decanted into nine labeled plastic bottles and then preserved with 5% buffered formalin solution for further analysis. The samples were studied using a Sedgwick-Rafter (S-R) counting cell under a binocular microscope (Olympus, Model BH-2). From the concentrated volume of the plankton samples, 1 mL was taken by a dropper and then transferred into the S-R cell and left to settle for 10 min. All planktonic organisms were then counted from 10 squares of the cell, chosen randomly and were enumerated to phytoplankton and zooplankton groups. Plankton was expressed as cells per liter of water from each pond. The quantitative analysis of both phytoplankton and zooplankton were done according to Rahman (1992) whereas the qualitative analysis of plankton was done according to Ward and Whipple (1959), Prescott (1962) and Bellinger (1992).

After 90 days of rearing, fishes were harvested by repeated netting, followed by drying the ponds. The fishes were counted and weighed individually to assess growth, survival and production. The data obtained from the present study were analyzed statistically to observe the performance of fishes in different species combinations. The mean values of growth, survival and production were compared using one-way analysis of variance (ANOVA) followed by Duncan's New Multiple Range Test (Zar, 1974; Gomez and Gomez, 1984). Standard error (±SE) of treatment means was calculated from the residual mean square in the analysis of variance.

RESULTS AND DISCUSSION

The results of physico-chemical parameters in Table 1 shows that mean values of water temperature were 29.43±2.80, 29.36±2.83 and 29.28±2.91°C in T_1, T_2 and T_3, respectively. The mean temperature was found to be highest in the month of September (35°C) and lowest in November (22°C). This decreasing trend might be due to cold weather in winter months. Dewan *et al.* (1991) reported a temperature range of 30.2 to 34.0°C (June-August), while Wahab *et al* .(1996) recorded the same from 28.5 to 31.3°C (August-November) in their experiments with carps. The water transparency values ranged between 8.0 and 61.0 cm with a mean of 26.37±12.61, 23.82±9.15 and 20.71±4.52 cm in T_1, T_2 and T_3, respectively. High values of water transparency were observed in T_3, probably due to decreased concentration of plankton whereas comparatively low values in T_1 and

Table 1: Mean±SD and ranges of water quality parameters in different experimental ponds over the 90-day experiment

Parameters	T_1	T_2	T_3
Temperature (°C)	29.43±2.80 (22.00-35.00)	29.36±2.83 (22.50-34.00)	29.28±2.91 (20.00-34.00)
Transparency (cm)	26.37±12.61 (8.00-61.00)	23.82±9.15 (10.00-51.00)	20.71±4.52 (12.00-29.50)
Dissolved oxygen (DO, mg L^{-1})	6.40±1.11 (3.80-10.50)	6.37±0.90 (4.30-9.50)	6.29±0.82 (3.70-9.40)
Hydrogen-ion concentration (pH)	8.10±0.67 (6.48-9.85)	8.09±0.51 (6.89-9.23)	7.78±0.54 (6.94-9.81)
Nitrate-nitrogen (NO_3-N, mg L^{-1})	0.74±0.28 (0.20-1.40)	0.66±0.23 (0.20-1.20)	0.65±0.30 (0.10-1.30)
Phosphate-phosphorous (PO_4-P, mg L^{-1})	1.27±1.01 (0.21-3.85)	0.90±0.78 (0.21-3.04)	0.58±0.45 (0.19-1.59)
Total alkalinity (mg L^{-1})	97.43±57.60 (18.00-197.00)	96.00±60.87 (15.00-200.00)	95.43±65.66 (14.00-222.00)
Chlorophyll-a (µg L^{-1})	134.19±77.61 (68.3-380.56)	111.09±44.48 (53.55-224.91)	107.19±57.71 (67.12-348.19)

T_2 indicate inverse situation. 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 40.0 cm or less. The mean DO levels were 6.40±1.11 (T_1), 6.37±0.90 (T_2) and 6.29±0.82 (T_3) mg L^{-1} with a range between 3.7 and 10.5 mg L^{-1}. Similar trends were also reported by Ali *et al.* (1982), Paul (1998) and Uddin (2002) in various fish culture ponds. The mean level of dissolved oxygen (DO) in all the experimental ponds was within the acceptable range for fish culture. In this experiment, pH ranged from 6.48 to 9.85, indicating the ponds were conductive for fish culture. Swingle (1967) considered pH values of 6.5 to 9.0 as satisfactory level for fish culture. The findings of the present study also agree well with those observed by Hossain *et al.* (1997) and Kohinoor *et al.* (1998, 2001). Total alkalinity contents of the ponds under three treatments were within the range of 14.0 to 222.0 mg L^{-1}. Mairs (1996) considered a total alkalinity of 40.0 mg L^{-1} or more to be productive than water bodies with lower alkalinity. Rahman *et al.* (1982) reported total alkalinity to be 38.2-95.6 mg L^{-1} in two comparatively productive ponds and 8.5-71.9 mg L^{-1} in two unproductive ponds. Uddin (2002) reported total alkalinity values between 45.0 and 180.0 mg L^{-1}. In the present study, the alkalinity levels in water were within the productive range as stated by Rahman *et al.* (1982), Hossain (2002) and Uddin (2002). The availability of phosphate-phosphorous (PO_4-P) is considered as one of the most important element in aquatic productivity. The phosphate-phosphorous ranged between 0.19 and 3.85 mg L^{-1}, which was more or less similar to those reported by Mumtazuddin *et al.* (1982), Rahman (1992), Hossain (2000) and Uddin (2002). In this study, the phosphate-phosphorous level was within the productive range for fish culture. The amount of nitrate-nitrogen (NO_3-N) was 0.01 to 1.4 mg L^{-1} and was found to be more or less similar throughout the experiment. Ali (1998) reported the range of NO_3-N from 0.06 to 2.50 mg L^{-1} in six earthen ponds at the Field Laboratory of the Faculty of Fisheries, BAU, Mymensingh. The chlorophyll-a contents in the experimental ponds were from 53.55 to 380.56 µg L^{-1}. The chlorophyll-a values showed a wide variation during the experimental period, may be due to the abundance of phytoplankton by regular pond fertilization. Comparatively high chlorophyll-a value was found in T_1 may be due to the presence of higher concentration of phytoplankton in pond water, which agrees with Khatrai (1984), who found a positive relationship between phytoplankton and chlorophyll-a in the ecosystem of Lakhotia Lake in Rajastan. The chlorophyll-a values recorded in the present study were more or less similar to those reported by Nirod (1997) Paul (1998) and Kohinoor *et al.* (2001).

Phytoplankton population mainly consisted of 27 genera in four groups viz., Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae while the zooplankton population comprised of 12 genera including nauplii under two groups viz., Crustacea and Rotifera. The mean abundance of total phytoplankton and zooplankton populations were recorded to be $90.10\pm41.53\times10^3$ and $13.22\pm4.13\times10^3$, $87.10\pm38.81\times10^3$ and $12.71\pm3.83\times10^3$ and $86.56\pm50.54\times10^3$ and $12.61\pm3.75\times10^3$ cells L^{-1} in T_1, T_2 and T_3, respectively. The higher abundance of plankton in T_1 might be due to the lower stocking density of fish than in T_2 and T_3. It seems likely consumption of plankton by the fishes was also high in ponds where stocking density was high (Table 2). The phytoplankton population in all the treatments was consistently higher than zooplankton. Similar results were also observed by Islam and Saha (1975), Kohinoor *et al.* (1999) and Rahman *et al.* (2005) in various carp and barb rearing ponds and lakes. Paul (1998) recorded phytoplankton and zooplankton numbers ranging from $53.41\pm9.11\times10^3$ to $68.37\pm10.694\times10^3$ and $3.22\pm0.74\times10^3$ to $3.38\pm1.10\times10^3$ cells L^{-1}, respectively, in carps and small

Table 2: Mean±SD and ranges of plankton abundance ($\times 10^3$ cells L^{-1}) in different experimental ponds over the 90-day experiment

Plankton group	T_1	T_2	T_3
Phytoplankton			
Bacillariophyceae	10.81±10.21	11.91±4.95	11.95±5.63
Chlorophyceae	33.51±4.43	34.77±4.68	31.85±10.71
Cyanophyceae	32.06±11.36	26.81±23.19	31.18±21.32
Euglenophyceae	13.72±5.53	13.61±6.16	11.58±6.75
Total	90.10±41.53	87.10±38.81	86.56±50.54
Zooplankton			
Crustacea	3.81±0.93	3.52±1.15	3.10±1.31
Rotifera	9.42±3.16	9.19±2.35	9.51±1.67
Total	13.23±4.13	12.71±3.83	12.61±3.75

indigenous fish (mola) polycuture ponds. Wahab *et al.* (1994) recorded phytoplankton numbers between 2×10^5 and 8×10^5 L^{-1} and zooplankton between 2×10^4 and 3.2×10^4 L^{-1} during examining the effects of fertilization on the pond ecology and growth of fishes. Kohinoor *et al.* (1998) found phytoplankton density of 21.67×10^4 cells L^{-1} and zooplankton of 5.2×10^4 cells L^{-1} in polyculture of carps with mola (*Amblypharyngodon mola*), which were higher than that of the present study. This might be due to the fact that the rate of fertilization was higher than those used in the present study.

Growth performance of fish in Table 3 showed that the mean weight gained by rohu, catla, mrigal silver carp and Thai sharpunti were 130.73, 173.96, 75.94, 249.85 and 69.03 g in T_1, 106.36, 153.15, 92.90, 211.79 and 62.92 g in T_2 and 121.15, 161.76, 109.26, 202.27 and 63.63 g in T_3, respectively (Table 3). Weight gains of rohu, catla and Thai sharpunti were found to be highest in T_1 followed by T_2 and T_3. The reasons behind this might be due to lower stocking density, optimum species combination and proper utilization of both natural and supplementary feeds. In case of mrigal, T_3 showed highest weight gain followed by T_2 and T_1. No significant differences in weight gain for silver carp and Thai sharpunti were recognized between T_2 and T_3, while the same for catla was significantly higher ($p<0.05$) in T_1 than in T_2 and T_3. Growth in term of final weight also followed the same trends as weight gain. Haider (1996) reported that sharpunti competes for food with rohu and catla to a greater extent. Wahab *et al.* (1998) reported that *B. gonionotus* competes for food with major carps in polyculture conditions. Haque *et al.* (1998) noted that the presence of silver barb decreases the growth of Indian carps. In case of bottom feeder mrigal, the highest weight gain was obtained in T_3 might be due to good food production and no or less competition with Thai sharpunti for food and habitat.

Significantly ($p<0.05$) higher SGR value of Thai sharpunti was in T_1 (2.28%) than those in T_2 (2.17%) and T_3 (2.15%) but the variation between T_2 and T_3 did not significantly differ ($p>0.05$) (Table 3). The mean SGR values in rohu varied from 2.49 to 2.60%, catla from 2.67 to 2.78%, mrigal from 2.08 to 2.53% and silver carp from 1.94 to 1.79% in T_1, T_2 and T_3, respectively. Similar results were also obtained by Hossain *et al.* (1997) when mixed culture of fishes was practiced in seasonal ponds through fertilization and feeding. Kohinoor *et al.* (1999) observed the SGR value of Thai sharpunti to be between 1.33 and 1.35% in polyculture with carps using low-cost feed, which were much lower than those in the present study, might be due to higher numbers of fish stocked.

The survival of Thai sharpunti varied from 71.83 to 84.87% (Table 3). T_1 showed significantly ($p<0.05$) higher survival than T_2 and T_3. There were no significant ($p>0.05$) differences between the survival rates of mrigal and silver carp among the three treatments. In general, T_1 showed the highest values followed by T_2 and T_3. The survival of rohu and catla ranged from 80.81 to 92.10% and from 81.58 to 91.52%, the differences of which in respective fishes were significantly higher in T_1 than those in T_2 and T_3,

Table 3: Growth performances, survival and production of fish in different treatments over 90 days of rearing

Parameters	T_1	T_2	T_3	±SE
Initial weight (g)				
Rohu	13.98^a	13.07^a	14.49^a	±0.41
Catla	15.48^a	15.21^a	15.23^a	±0.09
Mrigal	13.74^a	13.29^a	12.48^a	±0.37
Silver carp	52.85^a	52.63^a	53.04^a	±0.11
Thai sharpunti	10.18^a	10.42^a	10.71^a	±0.15
Final weight (g)				
Rohu	144.71^a	119.43^b	135.64^a	±8.10
Catla	189.44^a	168.36^c	176.99^b	±4.31
Mrigal	89.68^c	106.19^b	121.74^a	±7.70
Silver carp	302.70^a	264.42^b	255.31^b	±4.60
Thai sharpunti	79.21^a	73.34^b	74.34^b	±0.36
Weight gain (g)				
Rohu	130.73^a	106.36^b	121.15^a	±7.30
Catla	173.96^a	153.15^b	161.76^b	±4.30
Mrigal	75.94^c	92.9^b	109.26^a	±8.18
Silver carp	249.85^a	211.79^b	202.27^b	±4.70
Thai sharpunti	69.03^a	62.92^b	63.63^b	±0.36
Specific growth rate, SGR (%/day)				
Rohu	2.60^a	2.46^a	2.49^a	±0.04
Catla	2.78^a	2.67^a	2.73^a	±0.03
Mrigal	2.08^c	2.31^b	2.53^a	±0.13
Silver carp	1.94^a	1.79^b	1.75^b	±0.06
Thai sharpunti	2.28^a	2.17^b	2.15^b	±0.04
Survival (%)				
Rohu	92.10^a	86.50^b	80.81^c	±3.26
Catla	91.52^a	87.61^b	81.58^c	±2.89
Mrigal	86.23^a	88.58^a	88.51^a	±0.77
Silver carp	85.11^a	82.81^a	80.14^a	±1.44
Thai sharpunti	84.87^a	74.26^b	71.83^b	±4.00
Production (kg/pond/90 days)				
Rohu	1.33^a	1.03^b	1.09^b	±0.09
Catla	1.73^a	1.48^b	1.44^b	±0.09
Mrigal	2.32^b	2.82^b	3.23^a	±0.26
Silver carp	6.44^a	5.47^b	5.12^b	±0.39
Thai sharpunti	13.45^c	16.39^b	21.36^a	±2.31
Total production (kg/pond/90 days)	25.27^c	27.19^b	32.24^a	±2.08
Total production (kg/ha/90 days)	$1,248.34^c$	$1,343.19^b$	$1,592.67^a$	±102. 6 9

Figures in the same row having the same superscript are not significantly different ($p>0.05$).

Wahab *et al*. (1995) found that the survival rate of all fish including Thai sharpunti was higher than 80% in polyculture with native major carps. Kohinoor *et al.* (1993) observed the survival of Thai sharpunti to be ranged from 86 to 94% in monoculture system. In another study, Kohinoor *et al.* (1999) observed the survival of Thai sharpunti to be ranged between 88.53 and 92.23% in polyculture with carps. Das (1999) reported that the survival of rohu, catla, mrigal and silver carp were 88.64-90.18, 85.81-90.06, 84.93-91.36 and 93.35-96.96%, respectively in polyculture with 6 indigenous and exotic fish species at different densities. However, the findings of the previous studies indicate that the survival rate of Thai sharpunti including major carps was more or less similar to the present study.

The mean total production of fish was 1,248.34, 1,343.19 and 1,592.67 kg/ha/90 days in T_1, T_2 and T_3, respectively. Despite the higher values of individual final weight and survival in T_1, production of fish was significantly ($p<0.05$) higher in T_3 than those in T_1 and T_2 (Table 3), might be due to the proper utilization of natural food and higher stocking density. Mathew *et al*. (1988) obtained the production of 10,183 kg/ha/yr when stocking density was 8,000 fish/ha in six ponds with carp polyculture system. Das *et al.* (1982) also reported the production of 5,556 kg/ha/yr fish at the stocking density of 7,000 fingerlings/ha in carp polyculture system when the fish fed commercial diet (Epic Fish Feed). Uddin *et al.* (1994) found a gross production of 3,415 kg/ha/yr from polyculture of carps with rajpunti. Islam *et al*. (1997) obtained a net yield of 2,966 kg/ha/7 months by culturing silver carp, common carp and tilapia in seasonal ponds through fertilization and supplementary feeding. Mahmud (1998) reported a total gross production of 1,713.4 kg/ha/120 days in a four species composite culture of major carps including Thai sharpunti through the application of fertilizer and supplementary feed comprising of rice bran (60%) and mustard oil cake (40%) daily at the rate of 3% of fish biomass and duckweed (*Lemna minor*) at the rate of 10% of the body weight of Thai sharpunti. Miaje (1999) reported the total production of fish from 2,934 to 3,318 kg/ha/4 months in polyculture of Indian major carps with Thai sharpunti fed supplementary diet containing 20.31% crude protein. Das (1999) reported a total gross production of 2,102.52-4,361.43 kg/ha/yr in a six species polyculture of major carps with the application of fertilizer and supplementary feed consisting of rice bran (75%) and mustard oil cake (25%). The total productions of fish obtained from the present study are similar to those reported by Das *et al*. (1982) and Mahmud (1998), higher than those of Uddin *et al.* (1994), Islam *et al.* (1997) and lower than those of Mathew *et al.* (1988) and Miaje (1999).

CONCLUSIONS

The growth of Thai sharpunti was proportionally related to the stocking density, probably due to intraspecific competition and a synergistic interaction between Thai sharpunti and major carp species. However, considering the highest individual growth rate and survival of fish in T_1, the stocking density of sharpunti in this treatment may be recommended for polyculture in seasonal ponds to attain quick marketable size and to avoid disease risk. Thai sharpunti therefore, merits inclusion in low cost polyculture systems in small seasonal ponds. Further studies are also recommended to find out more appropriate polyculture combinations of Indian major carps with Thai sharpunti.

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