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Impacts of Thai silver barb *(Puntius gonionotus* Bleeker) inclusion in the polyculture of carps

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Abstract

The impact of inclusion of Thai silver barb, *Puntius gonionotus* (Bleeker) in the polyculture with two major Indian carps, *viz., Labeo rohita, Catla catla* and common carp *Cyprinus carpio* has been studied in seasonal ponds for 115 days. The presence of silver barb decreased the growth of Indian carps while increased that of common carp. A significantly higher ($P<0.05$) fish yield (1793.65 Kg/ha/yr) was observed in the four species polyculture system containing silver barb when the combined yield of all species was compared.

Key words : *Puntius gonionotus*, Indian major carps, Polyculture

Introduction

The development of polyculture system has proceeded as elsewhere in this region on an adhoc basis with continued addition of exotic species. Earlier studies by Dewan *et al* .(1991), Wahab *et al.* (1991) and Wahab and Ahmed (1992) clearly indicated that the dietary overlap (competition for food) among silver and bighead carps and the native species, catla over rohu was very high, and growth and production of the later were significantly reduced in polyculture. This suggests that inclusion of any exotic fish within a native species based polyculture should not be encouraged without evidence of strong economic benefit.

Thai silver barb or Thai sharpunti *(Puntius gonionotus),* a herbivorous species (Phaohorm 1980), was introduced into Bangladesh in 1977 and has become increasingly popular owing its bright silvery appearance and good taste. Introduction of sharpunti in the polyculture of native carps increased overall fish yields although it had a slight antagonistic effect on growth and production of native carps (Wahab *et al.* 1995). The compatibility of sharpunti in mixed (native carps and exotic carps) pond polyculture system, however, remains largely unknown. If the species proves environmentally benign and has no adverse effect on native and exotic species then it may be an excellent candidate for pond polyculture. Considering the need for a thorough investigation with the most favoured and biologically compatible species for the pond polyculture, the present study has been designed with the objectives to assess the compatibility of Thai silver barb in the carp polyculture and to compare the production performance with or without addition of this species in the fish pond.

Materials and methods

The experiment was carried out for a period of 115 days in the Agricultural University campus, Mymensingh, Bangladesh. A series of six earthen ponds each of 0.01 ha with an average depth of 1.5 m were used for this experiment. Ponds were rain fed and free from aquatic vegetation, completely independent and well exposed to sunlight. These ponds had no inlet and outlet.

Seven days before to stocking of fish, ponds were fertilized with cowdung, urea and TSP at the rate of 50 kg, 1 kg and 1.5 kg per pond respectively, and the fertilization was continued throughout the experimental period at 15 day's interval. Fish were fed with rice bran at the rate of 3% body weight and quantity of feed application was adjusted fortnightly on the basis of fish biomass.

Two treatments were tried in this experiment. In treatment-I (T_1), fingerlings of rohu (*Labeo rohita*, 2.13 g), catla (*Catla catla*, 2.36 g) and common carp (*Cyprinus carpio*, 1.38 g) were stocked at 100 fish per pond in the ratio of 1 : 1 : 1. For treatment-II (T_2), equal number and ratio of rohu, catla and common carp fingerlings and an additional 25 sharpunti fingerlings (1.28 g) were stocked.

The water quality parameters such as temperature (^{0}C), secchi disc depth (cm), pH, total hardness (mg/l), dissolved oxygen (mg/l), total ammonia(mg/l), nitrate (mg/l), orthophosphate (mg/l) and chlorophyll-a (mg/l) were monitored fortnightly following standard methods (APHA 1992).

Fish growth was monitored fortnightly throughout the experimental period. Sample of five fish from each species of every pond was collected from two treatments at each sampling day by a cast net. Growth of fish was determined by measuring fish length (cm), using centimeter scale and fish weight (g) by a electronic balance. Fish were harvested at the end of the experiment by a seine net and following pond drainage the remaining fishes were picked up and were measured and weighed.

One way Analysis of Variance (ANOVA) was used for statistical analysis using STATGRAPH statistical package. Statistical significance was assessed using a probability level of P= 0.05

Results

Water quality parameters

The water quality parameters are summarized in Table 1. During the experimental period the water temperature varied from 28.2 to 31 ^{0}C in reatment-I and 27.2 to 31.6 ^{0}C in treatment-II. There was no significant difference between two treatments. Highest temperature was recorded 31.6^{0}C in the month of July. Transparency values showed variation with sampling date ranged from 21.2 cm to 36.0 cm in pond no. 5 and pond no. 1 respectively both were belonged to treatment-II. Highest transparency (31.5 cm) was observed in August. There was no significant difference between two treatments.

Table 1. Mean (± SE) values of water quality parameters of different ponds under two treatments

Treatments	Treatment-I				Treatment-II			
Pond No.	3	4	6	Mean	1	2	5	Mean
Temp. (^{0}C)	29.73±0.42	29.63±0.41	29.68±0.41	29.68±0.02	29.58±0.47	29.80±0.51	29.83±0.40	29.73±0.42
Trans. (cm)	30.93±1.48	29.04±0.88	29.05±1.21	29.63±0.51	30.85±1.60	28.25±5.99	27.15±1.13	28.75±0.89
pH	7.57±0.22	7.37±0.11	7.26±0.10	7.40±0.07	7.17±0.09	8.31±0.16	8.14±0.24	7.87±0.29
DO (mg/l)	6.41±0.21	7.14±0.67	6.10±0.39	6.55±0.25	6.24±0.63	7.85±0.90	7.21±0.54	7.10±0.38
Total hardness (mg/l)	56.00±3.80	96.70±2.77	69.71±3.00	74.13±9.76	110.0±2.44	80.57±1.82	62.14±3.22	84.23±11.38
Total ammonia (mg/l)	0.12±0.01	0.12±0.03	0.10±0.02	0.11±0.00	0.07±0.00	0.08±0.00	0.09±0.01	0.08±0.00
NO_3 (mg/l)	0.90±0.10	0.98±0.17	0.83±0.40	0.90±0.02	0.82±0.02	0.89±0.06	0.87±0.04	0.86±0.01
PO_4 (mg/l)	1.14±0.25	0.86±0.07	0.61±0.05	0.87±0.12	1.16±0.10	1.28±0.26	0.71±0.04	1.05±0.14
Chlorophyll-a (mg/l)	37.12±6.25	101.58±33.09	39.60±3.74	59.43±21.08	137.8±56.58	213.8±33.85	127.4±32.0	159.7±27.22

Table 2. Mean (± SE) abundance of plankton (cells x 10^4/l) of different ponds under two treatments

Treatments	Treatment-I				Treatment-II			
Pond No.	3	4	6	Mean	1	2	5	Mean
A. Phytoplankton								
Bacillariophyceae	3.64±0.4	4.05±0.2	3.55±0.3	3.75±2.2	11.5±2.2	11.6±2.3	9.04±1.1	10.7±0.8
Chlorophyceae	33.94±2.6	35.77±4.9	34.35±5.5	34.69±0.6	51.02±5.9	52.68±10.2	48.24±3.6	50.65±1.3
Cyanophyceae	4.69±0.7	5.69±1.7	6.17±1.8	5.52±0.4	9.56±2.1	9.23±00.9	9.67±3.6	9.48±0.1
Euglenophyceae	8.97±1.9	11.57±5.6	10.1±1.8	10.2±0.8	12.52±5.7	9.30±01.2	10.23±4.8	10.67±1.0
B. Zooplankton	4.94±0.6	4.9±0.8	5.8±0.5	5.22±0.3	5.42±1.1	6.16±00.8	6.01±1.0	5.88±0.2

Throughout the study period, p^H of water of the ponds were found to be approximately neutral or slightly alkaline and ranged from 7.17 to 8.31. Dissolved oxygen contents of the ponds under T_1 were within the range of 5.3 to 9.2 ppm and the range of the ponds under T_2 were 3.3 to 10.66 ppm. It was found that DO decreased while temperature value increased, so there was an inverse relation between DO and temperature. There was no significant difference between treatments. Total hardness was significantly higher ($p<0.05$) in treatment-II as compared to treatment-I with mean values of 84.23±11.38 ppm and 74.13±9.7 ppm respectively.

Phosphate- phosphorus of the ponds of both treatments fluctuated (0.61 to 1.28 mg/l) throughout the experimental period. The ranges of nitrate-nitrogen and total ammonia measured over the experimental period were 0.86 to 0.9 mg/l and 0.08 to 0.11 mg/l respectively and were within the limit suitable for fish production.

The concentration of chlorophyll-a was significantly ($P<0.05$) higher in T_2 than that of T_1 with mean values of 159.66±27.22 mg/l and 59.43±21.88 mg/l respectively.

Total phytoplankton ranged from 3.784±0.154 to 50.645±1.296 cells/l (Table 2). Among the four groups of phytoplankton, Chlorophyceae showed the quantitative dominance over other groups in both treatments. The mean abundance of zooplankton was 5.223 0.305×10^4 cells/l in T_1 and 5.877 0.233×10^4 individuals/l in T_2 (Table 2). Plankton population was significantly higher ($P<0.05$) in T_2.

Growth performance of fish

There was no variation among the initial weight of various species between the two treatments. Among all species included in this study, the weight gain of common carp was significantly ($P<0.05$) higher in treatment-II, four species polyculture system. It showed maximum gain per fish among the species and varied significantly between two treatments with mean weights of 218.95 ±1.327 g in T_2 and 188.17±1.386 g in T_1 (Table 3). Catla ranked second with a higher mean weight of 148.31±1.558 g in T_1 and lower mean weight of 140.78±0.9814 g in T_2. Rohu showed the gain per fish with a higher mean value of 136.33± 2.02g in T_1 and lower mean weight of 131.38±1.79 g in T_2. Gain per individual fish of silver barb was 128.34±1.23 g in treatment-II. The survival rate of fish was estimated after total harvesting of fish. The survival rate of various species in two treatments were fairly high and ranged from 88.88% to 93.33 %. All species had a similar trend of survival in both treatments. The lowest survival rate was observed in catla (88.88%) in treatment-I and rohu (88.89%) in treatment-II respectively (Table 3).

Table 3. Yield parameters of different species of fish in two treatments

Treatments	Treatment-I			Treatment-II			
Species	Rohu	Catla	Common carp	Rohu	Catla	Common carp	Sharpunti
No. stocked/ha	3,300	3,300	3,400	3,300	3,300	3,400	2,500
Mean no. of fish at harvest	3,066	2,933	3,100	2,933	3,000	3,133	2,333
Survival (%)	92.91	88.89	91.17	88.88	90.91	92.14	93.32
Av. initial wt. (g)	2.13	2.36	1.38	2.13	2.36	1.38	1.28
Av. final wt. (g)	138.46	150.67	189.55	133.51	143.14	220.33	129.87
Gain in wt. (g) per fish	136.33	148.31	188.10	131.38	140.78	218.95	128.59
Net yield (kg/ha)	417.98	434.80	583.33	385.34	422.40	685.90	300.00
Total (kg/ha /115 days)		1436.30[a]			1793.65[b]		

Total yield of fish was significantly higher ($P<0.05$) in four species polyculture system due to an increased yield of common carp and an additional yield of sharpunti. Total production of fish as appeared in Table 3 showed that there was a significant ($P<0.05$) difference in total production with higher yield of 1793.65 Kg/ha/115days in treatment-II and a lower yield of 1436.30 Kg/ha/115days in treatment-I. When species-wise comparison was made, it revealed that rohu and catla had significantly higher ($P<0.05$) net yield in treatment-I and common carp had significantly higher net yield in treatment-II. Total production of catla were 434.8 kg /ha and 4.22.40 kg/ha in treatments-I and II respectively. Total production of rohu was 417.98 Kg/ha, 385.34 Kg/ha in treatment-I and treatment-II respectively. Whereas that of common carp was 583.33 kg/ha and 685.90 kg/ha in T_1 and T_2 respectively.

Discussion

In polyculture, co-inhabiting species of different feeding habits are cultured in the same pond, so that the food niches are utilized without detriment to one another. Transparency indicates the presence and absence of food particles and productivity of a water body, which is influenced by the suspended materials, silt and micro-organisms. Dewan *et al.* (1985 and 1991) observed an inverse relationship between Chlorophyll-a and secchi depth values in the pond of Mymensingh area. In the present observation, the highest transparency was recorded after heavy rainfall during August. Lowest transparency was observed after fertilization which might be due to the presence of higher phytoplankton population and suspended organic matter.

Chlorophyll-a value was significantly higher in treatment-II than treatment-I due to the higher concentration of plankton in ponds under treatment-II. The

results showed an inverse relationship between chlorophyll-a and transparency. Ahmed (1993) also reported similar relationship between transparency and Chlorophyll-a.

In this study, Chlorophyceae showed the quantitative dominance over other plankton groups in both treatments. Wahab and Ahmed (1992) found that Cyanophytes dominated in the ponds containing Indian major carps. In the present experiment, the plankton population was high in both treatments but comparatively higher in treatment-II. The highest phytoplankton number of $62.85x10^4$ cells/l was recorded in the month of July and the lowest was $4.69x10^4$ cells/l was recorded in the month of September. Similarly the highest zooplankton number $6.9x10^4$ individuals/l was recorded during the month of July and lowest zooplankton $4.9x10^4$ individuals/l was observed in September. Wahab *et al.* (1994) observed the phytoplankton number ranging from $2x10^5$ to $8x10^5$ cells/l and the Zooplankton of $2x10^4$ to $2x10^5$ individual/l in their study.

The mean survival rate for various fish in different treatments in the present study varied between 88.89 to 93.93% which were higher than the survival rates reported by Wahab *et al.* (1991) for Indian major carps in polyculture. Laksmanan *et al.* (1971) observed survival rate of 80% with seven species composite culture of Indian and Chinese carps where ponds were fertilized with both organic and inorganic manures. In the present experiment, the highest survival rate was observed in case of sharpunti (93.93%). Kohinoor *et al.* (1993) obtained survival rate of 86 to 94% in the monoculture of sharpunti. Wahab *et al.* (1995) also found survival of all fish including sharpunti was higher than 80% in polyculture of native carps.

Weight gain (g/fish) of rohu, catla, common carp was 136.33, 148.31 and 188.17 in treatment-I and 131.38, 140.78, 218.95 in treatment-II respectively. Weight gain of sharpunti was 128.59 (g) in treatment-II. From the results, it was evident that the highest weight gain (g/fish) was observed in case of common carp in both treatments but significantly higher in treatment-II. Weight gain of rohu and catla was higher in T_1 than that of T_2. In both treatments common carp ranked first position in production when the species-wise production was observed with net yield of 583.33 and 685.9 Kg/ha in T_1 and T_2 respectively. The production of catla ranked second position in both treatments but higher production was obtained from T_1. Production of rohu possessed third position, was lower in T_2 in comparison to that of T_1. This might be due to antagonistic effect of sharpunti inclusion in the polyculture. The overall production of T_2 (including sharpunti) was significantly higher than the treatment T_1 (without sharpunti) with total production of 1,794 kg/ha /115 days and 1,436 kg/ha/115 days respectively. In both treatments, supplementary feed and fertilizers were used regularly to obtain higher production of fish. Murty *et al.* (1987) demonstrated a high production of 4,096 kg/ha/ yr from composite fish culture using Indian and exotic carp species applying supplementary feed and

nitrogenous fertilizers. Hussain *et al.* (1987) obtained production of 1952 kg/ha/5 month of *P. gononotus* with only supplementary feed. Wahab *et al.* (1995) also observed 5,294-5,670 kg/ha/yr production in the polyculture of carps with sharpunti.

By including sharpunti, synergistic interaction has resulted from faecal input of sharpunti. The excreta has enriched the bottom of the pond with essential food materials edible for common carp. This has helped to increase the growth and production of common carps. By stirring up the mud, the common carp recirculates the nutrients into the water and help to increase phytoplankton population. The excreta of herbivorous sharpunti reported to influence the growth of common carp (Phaohorm 1980, Dev 1994). Shahabuddin *et al.* (1994) also found positive effect of sharpunti on the growth of common carp. The overall increase in total fish production may have been due to the confounding effect of additional numbers of sharpunti which help to increase the growth of common carp and also have decreased the availability of food materials for other con-inhabiting major carp species. Thus, addition of sharpunti slightly affected the growth of rohu and catla. Similar negative effects of silver carp and bighead carps has been observed by Dewan *et al.* (1991) and Wahab and Ahmed (1991).

From the present study it may be concluded that the inclusion of Thai silver barb or sharpunti in the traditional carp polyculture has overall increased fish yields although it has exerted an antagonistic effect on growth and production of major carps. It has clear synergistic effect on the growth and production of common carp which may be important for the future development of polyculture technology in Bangladesh or elsewhere in the region. Thus Thai silver barb has appeared to be an appropriate candidate for polyculture with carps.

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