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Grow-out Production of Pabda (*Ompok bimaculatus*) in Earthen Ponds under Low Stocking Density

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ABSTRACT

The growth and survival of *Ompok bimaculatus* (pabda) was evaluated in earthen ponds (0.03 ha; 1.0 m) over a period of 6 months under low stocking densities to see its production potential. The fish were stocked at the rate of 4000 (T1), 5000 (T2) and 6000 fingerlings ha^{-1} (T3). During stocking, all the fish were of same age group with an average size of 3.36±0.08cm in length and 0.83±0.02g in weight. The fish were fed on formulated feed (18% CP) daily at 2 to 4% of biomass. After 6 months, the fish grew to a size of 64.66g in T1, 65.66 g in T2 and 65.33g in T3 which was not significantly different ($p \geq 0.05$). The production of the fish was 295.07 kg ha^{-1} in T3, 247.26 kg ha^{-1} in T2, 197.26 kg ha^{-1} and significantly different ($p \leq 0.05$). The survival of the fish was 76.23% in T1, 75.33% in T2, 75.26% in T3 and significantly different ($p \leq 0.05$). Feed conversion ratios in T1 (2.2), T2 (2.3) and T3 (2.2) were not significant different ($p \geq 0.05$). Water and soil quality parameters and plankton showed normal fluctuations and remained within the ranges suitable for fish culture. The study concluded with the recommendation that there is scope for enhancing the production of pabda through stocking fingerlings exceeding 6000 ha^{-1}.

1. Introduction

Ompok bimaculatus, popularly known as Indian butter catfish or *pabda* is an indigenous catfish known for excellent taste. The price of the fish fluctuates between Rs. 500/- to 1500/- a kilogram and highly demanded particularly in the States of Eastern and North-Eastern parts of India. The fish has ornamental value. In international ornamental fish trade, it is known as '*two-spot glassy catfish*'. Like many tropical catfish, it breeds in rivers, streams and floodplains during monsoon but due to indiscriminate fishing and various ecological changes, its wild population declined steadily (>50%). This species is now endangered and facing high risk of extinction (Lakra, 2010). In aquaculture, pabda did not receive much attention due to insufficiency of gravid stocks for experimentation and shortage of information regarding its breeding, rearing and culture technology.

Recently, pabda prioritized for aquaculture diversification in India. Aquaculture of the fish may provide quality broodstocks for breeding and conservation programs (NBFGR 2011). A suitable culture method for nursing and rearing of *O. bimaculatus* is therefore very necessary to ensure reliable and regular supply of the fish and to maintain the stock of the fish at a level of conservation and rehabilitation. Growth and survival of fish during production depends on number biotic and abiotic factors. Improper care and lack of understanding about these factors may cause mass mortality (Jhingran and Pullin 1985). Stocking density in particular is an important aspect when ranking families or progeny groups for growth performance. Stocking density affects the growth and survival of fish besides food supply and its quality, genetics and environmental conditions (Khattab *et al*., 2004). In many cultured species, growth is inversely related to stocking density and this can be attributed to social interactions (Irwin *et al*., 1999).

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Rearing fish at inappropriate densities may impair growth and reduce immune competence due to social interactions and deterioration of water quality, which can affect both feed intake and conversion efficiency of the fish (Ellis *et al.,* 2002). To maximize economic return it is necessary to stock the fish at optimum densities for desired growth and survival of fish. A number of research have been done to see the effect of stocking density on growth and survival of fish (Malik *et al.,* 2014) but works on *O. bimaculatus* are limited. Debnath et al. (2015) evaluated pabda at high stocking densities. However, ensuring quality seed adequately is a serious issue in case of pabda. Mass-scale seed production is yet to achieve in pabda. Therefore, during inadequate availability of pabda seeds, the fish may be suggested for low-density farming considering its high demand and price (Debnath and Sahoo, 2013). Therefore, in the present study, *O. bimaculatus* was evaluated in earthen ponds under low-stocking density to see its growth and production performance under low-input management.

2. Materials and Methods

The experiment was conducted at the experimental ponds in ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra over a period of 6 months. Ponds uniformed in shape, size, depth, basin conformation, contour and bottom type were used for this study. The ponds were dewatered, freed from aquatic weeds and exposed to sunlight. The inlet and outlet facilities of the ponds were properly designated before initiating the experiment. Pre-stocking pond fertilization included liming at 500 kg ha^{-1}, cowdung 3000 kg ha^{-1} and single super phosphate (SSP) at 30 kg ha^{-1} before stocking of fish. Intermittent fertilizations were carried out on alternate weeks with cowdung at 500 kg ha^{-1}, urea at 10 kg ha^{-1} and SSP at 15 kg ha^{-1} to maintain the pond fertility. Intermittent liming was also carried out at 100 kg ha^{-1} at 3-month intervals except the higher dose (200 kg ha^{-1}) used before the commencement of winter months. Seepage and evaporation loss were compensated periodically to maintain the desire water depth in ponds. Total nine ponds (each of 0.03 ha in area and 1.5m in depth) were used in completely randomized design for testing 3 different stocking densities, *i.e.,* 4000 (T1), 5000 (T2) and 6000 fingerlings ha^{-1} (T3) in replicates. Seeds of same age group were used for stocking. Before stocking, all fish were acclimatized in a hapa for a week. The size of fish during stocking was 3.36±0.08cm/ 0.83±0.02g. Mixture of mustard oil-cake (MOC) and rice bran (RB) at 1:1 was used for feeding the fish. The feed contained protein 18.2%, lipid 4.84%, crude fibre 9.68%, minerals 19.55% and nitrogen free extract 44.13%. Feeding was done daily at the rate of 2-4% of total biomass. Monthly sampling was done using a seine net to observe the growth of fish and to adjust the feeding rate. The length and weight of fish was measured in every sampling to estimate the growth of the fish. General pond condition and fish health were monitored regularly. Water quality parameters of the ponds were monitored on 15-days intervals. Temperature (°C) was noted directly by using a graduated thermometer. The dissolved oxygen (mgL^{-1}) content of water was estimated by Winkler's method and pH by a digital pH meter. Transparency was measured by Secchi disc. Total alkalinity was estimated by the method of APHA (1998). Inorganic nutrients such as ammonia, nitrite, nitrate and phosphate was measured in a spectroquant (Nova 60, Merck) using kits. Sediment samples were collected twice, at the beginning and end of culture. Composite sample was dried in a hot air an oven at 60°C and analysed for pH, available nitrogen, available phosphorus and organic carbon following standard protocols.

Fifty litres of water, collected from different locations and depths of each pond fortnightly between 07:00 and 08:00 hours were filtered through bolting silk net (No. 25, mesh size 64 µ) to obtain a 50 mL sample for plankton analysis.
Ten individuals, sampled randomly from each pond on monthly intervals were analysed for growth in terms of length, weight, specific growth rate (SGR) and food conversion ratio (FCR). Food conversion ratio (FCR) and specific growth rate (SGR) were calculated using the equations: FCR = Wdt/ (W2–W1); SGR = 100 x (lnW2–lnW1)/t, where, Wdt was the dry weight of food, W1 and W2 were the initial and final weights of fish, respectively and t is the time in days.

Table 1. Growth of pabda (*O. bimaculatus*) in ponds under different stocking densities after 6 months of culture

Parameters	**Treatments**		
	T1	**T2**	**T3**
Length at harvest (cm)	18.23±0.12^{a}	18.26±0.11^{a}	18.33±0.15^{a}
Weight at harvest (g)	64.66±0.006^{a}	65.66±0.004^{a}	65.33±0.003^{a}
SGR (% day^{-1})	2.41±0.05^{a}	2.42±0.03^{a}	2.42±0.026^{a}
Food conversion ratio	2.20±0.12^{a}	2.3±0.12^{a}	2.2±0.15^{a}
Survival (%)	76.23±2.05^{a}	75.33±0.90^{a}	75.26±0.85^{a}
Total production (kg ha^{-1})	197.26±21.29^{a}	247.26±13.33^{a}	295.07±15.19^{a}

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

After 6 months, all fish were harvested and live fish were counted and weighed individually to calculate and compare the survival (%) and production (kg ha^{-1}) of fish under different treatments. The data were analysed through one-way ANOVA using SPSS v11.2 to find out whether any significant difference existed among the treatment means. The level of significance was set at 5%. Data expressed as mean±S.D.

3. Results and Discussions

The growth parameters of *O. bimaculatus* in different treatments (T1, T2 and T3) in terms of mean weight gain, SGR, FCR, survival (%) production (kg ha^{-1}) are presented in Table 1. There was variation in growth among the treatments, however, that did not differ significantly ($p<0.05$). The length of the fish during harvest was 18.23 cm in T1, 18.26 cm in T2 and 18.33 cm in T3 with no significant difference. The weight of the fish at harvest was 64.66g in T1, 65.66 g in T2 and 65.33 g in T3 with no significant difference among the treatments. The specific growth rate of the fish was varied from 2.41 to 2.42 with no significant difference among the treatments. The food conversion ratio was varied from 2.2 to 2.3 with no significant difference among the treatments. Survival rate was highest in T1 (76.23), followed by in T2 (75.33) and in T3 (75.26), however, that did not differ significantly among the treatments. Total production of the fish was highest in T3 (294.2 kg ha^{-1}) followed by in T2 (247 kg ha^{-1}) and T1 (197.5 kg ha^{-1}). The overall production of fish was significantly different among the treatments.

The mean values of the water quality parameters of the ponds under different treatments are shown in Table 2. All parameters measured showed some variations among the treatments however, that was not significantly different ($P \geq 0.05$). Mean temperature ranged from 16.7 to 32.8ºC. Concentration of dissolved oxygen varied from 4.5 to 5.8 mgL^{-1}, pH 7.2 to 7.7, ammonia 0.11 to 0.66 mgL^{-1} and nitrite from 0.011 to 0.043 mg/L. The density of plankton populations varied from 8.36 $x10^3$ to 8.55$x10^3$ cells L^{-1} in different treatments with no significant difference ($P \geq 0.05$) among the treatments. The mean values of soil quality parameters are showed in Table 3. pH, organic carbon, available N and available P contents of the soil in all the treatments were increased with the progress of fish culture.

Discussion

The systems of aquaculture differ widely depending on the species being produced. In the pursuit of sustainable aquaculture major emphasis was laid on fast growing carp species; little interest was spared to consider, explore and exploit the additional opportunity of indigenous fish species like *O. bimaculatus*. Therefore, in the present study, the fish was evaluated in earthen ponds to see its responses under low-stocking densities. Due to non-availability of sufficient pabda seeds presently for farming, the fish was evaluated under low stocking density so that information generated would be useful for developing the production technology for the sustainable production of pabda at the existing levels of fingerling availability considering the demand for the fish. Aquaculture of the fish may provide sufficient quality broodstocks for mass-scale breeding and conservation (NBFGR 2011). There was no significant difference in the size during harvest of fish among the treatments. Similarly, there was no significant difference in survival rate in fish among the treatments. The growth and survival progressively increases as the stocking density decreases and vice-versa which is because a relatively less number of fish of similar size in a pond get more space, food, less competition and dissolved oxygen etc (Narejo *et al.,* 2005). However, no such incidence was noticed in this study indicated that the density levels evaluated in the study was less to assess its effect on growth and survival of the fish. The higher production of fish in T3 is due to higher stocking density (Malik *et al.*, 2014). There is scope for further enhancing the production of the fish by increasing the stocking density if seeds are available adequately.

The water quality parameters recorded during the study were within the acceptable ranges for culturing fish (Debnath *et al.,* 2014). The plankton density is comparable with the findings of Rahman *et al.,* (2011). Similar, the quality of soil showed normal variations. The productivity of the ponds remained in low to medium range. The increase in concentrations of nutrients at the end of culture was probably due to the provision of fertilizers at fortnightly intervals, gradual deposition of metabolites, spillage of a portion of supplementary feed (Debnath *et al.,* 2015).
Finally, the study concluded that, there is scope for enhancing the production of pabda by stocking the fish beyond 6000 fingerlings/ha if seeds are available adequately. The scope of culturing pabda with carps for additional profit deserves attention.

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Table 2. Mean values of water quality parameters of 15-day samples over the 6-month culture experiment

Parameters	T1	T2	T3
Temperature (^{0}C)	27.35±0.008a	27.55±0.02a	27.36±0.03a
Transparency (cm)	47.92±0.15a	48.33±0.17a	48.14±0.62a
Dissolved oxygen (ppm)	5.12±0.003a	5.22±0.006a	5.13±0.003a
pH	7.45±0.02a	7.44±0.005a	7.45±0.003a
Total alkalinity (ppm)	62.05±0.08a	62.42±0.45a	62.20±0.05a
NH3-N (ppm)	0.38±0.008a	0.35±0.002a	0.38±0.004a
NO3-N (ppm)	0.23±0.002a	0.21±0.002ab	0.22±0.001b
NO2-N (ppm)	0.02±0.0002a	0.02±0.00009a	0.02±0.0002a
PO4-P (ppm)	0.22±0.002a	0.22±0.002a	0.21±0.001a
Phytoplankton (×10^3 cells/l)	6.55±0.020a	6.43±0.06a	6.45±0.02a
Zooplankton (x10^3 individual/l)	2.00±0.10a	1.93±0.03a	1.92±0.04a

Figures in the same row having the same superscripts are not significantly different ($p \geq 0.05$).

Table 3. Mean values of soil quality parameters of before and after samples over the 6-month culture experiment

Parameters	T1		T2		T3	
	Before	After	Before	After	Before	After
pH	6.65±0.12^a	7.15±0.05^a	6.80±0.15^a	7.15±0.05^a	6.70±0.10^a	7.16±0.15^a
OC (%)	0.45±0.12^a	1.35±0.11^a	0.52±0.10^a	1.35±0.07^a	0.52±0.08^a	1.32±0.20^a
Available N (mg/100g)	1.76±0.08^a	39.80±6.12^a	1.72±0.07^a	42.20±4.84^a	1.80±0.05^a	42.20±1.24^a
Available P (mg/100g)	0.82±0.05^a	22.21±1.15^a	0.85±0.05^a	25.21±2.22^a	0.80±0.05^a	25.21±2.15^a

Figures in the same row having the same superscripts are not significantly different ($p \geq 0.05$).

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