Reprint **ISSN 1923-7766 (Web Version)**

International Journal of Experimental Agriculture

(Int. J. Expt. Agric.)

Volume: 7	Issue: 1	January 2017

Int. J. Expt. Agric. 7(1): 1-8 (January 2017)

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ISSN-1923-7766 (Online)
Int. J. Expt. Agric. 7(1):1-8(January 2017)

GROWTH RESPONSE OF THREATENED *Labeo calbasu* (Hamilton) FINGERLING BASED ON STOCKING DENSITY IN PONDS

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Accepted for publication on 5 December 2016

ABSTRACT

Samad MA, Chowdhury P, Chatterjee SK, Rahman MT, Barman SC (2017) Growth response of threatened *Labeo calbasu* (Hamilton) fingerling based on stocking density in ponds. *Int. J. Expt. Agric.* 7(1), 1-8.

The research work was conducted to study the fingerling (large fry) production technique of threatened *Labeo calbasu* based on stocking in ponds for a period of 60 days from September, 2015 to October, 2015 in experimental ponds (mean area of 0.0020 hector and water depth of 1 m) under Department of Fisheries, University of Rajshahi, with three treatments each having three replicates. The stocking density was maintained at 34580 fishes/ha (T_1), 39520 fishes/ha (T_2) and 44460 fishes/ha (T_3). The physico-chemical characteristics of pond water and growth parameters were measured fortnightly. Minimum and maximum values of water temperature, transparency, DO, pH, alkalinity and NH_3-N were found 30.42±0.01ºC (T_2) and 30.49±0.01ºC (T_3); 32.76±0.08 cm (T_1) and 36.01±0.08 cm (T_3); 5.22±0.02 (T_3) and 5.25±0.03 (T_2) mg/l; 7.53±0.05 (T_1) and 7.55±0.01 (T_3); 112.30±1.97 (T_3) and 119.49±0.25 (T_1) mg/l; 0.015±0.002 (T_1) and 0.020±0.001 (T_3) mg/l , respectively among which only transparency and alkalinity were significantly varied with three different treatments. Significant difference was found for the mean values of growth parameters. The minimum value and maximum value of final weight, final length and SGR were 21.53±0.31 g (T_3) and 30.33±0.25 g (T_1); 10.46±0.25 cm (T_3) and 14.33±0.25 cm (T_1); 3.02±0.02% (T_3) and 3.59±0.035% (T_1), respectively. The highest survival rate of *Labeo calbasu* was 95.53±0.25 (T_1) and the lowest was 82.57±0.40 (T_3). The minimum and maximum net production (kg/ha) were found 634.79±3.16 (T_3) and 881.0±2.46 (T_1), respectively. The production of *Labeo calbasu* fingerlings were significantly ($p<0.05$) different among three treatments. The maximum and minimum CBR were 1.45±0.01 (T_1) and 0.60±0.01 (T_3), respectively. Treatment T_1 was proved best in terms of production and economics of threatened *Labeo calbasu* fingerlings culture in ponds.

Key words: *fingerling, production, threatened, Labeo calbasu, stocking density*

INTRODUCTION

Kalbaus, *Labeo calbasu* (Hamilton 1822), is an important carp fish in aquaculture, next to the three Indian major carps, catla (*Catla catla* Hamilton), rohu (*Labeo rohita* Hamilton) and mrigal (*Cirrhinus mrigala* Hamilton), considering its growth potential and high consumer preference. It is an important indigenous fish and at several places is referred to as the 'Black rohu'. It is a very tasty and fast growing well suited in farming ponds and lakes. Further, it is an important game-fish in the tanks where it is stocked and is cultivated along with other species. It thrives better in tanks and lakes than in running water; can tolerate slightly brackish water also (Talwar and Jhingran, 1991).

Labeo calbasu (Hamilton 1822) is distributed throughout India except Kerala (Jayaram 1999), Bangladesh, Pakistan, Nepal, Myanmar, Burma, Thailand, Yunnan and also South China (Day 1878). It inhabits in all natural water bodies such as rivers, beels, haors, baors and lakes (Jayaram 1999; Talwar and Jhingran, 1991; Alam *et al*. 2000).

Kalibaus was of great commercial importance like 3 other ICMs (Rohu *Labeo rohita*, Catla *Gibelion catla*, and Mrigal *Cirrhinus cirrhosus*) during the early 1980s, but fish farmers lost interest due to the unavailability of seeds from either natural or artificial sources. Gradually the abundance of the species seriously decreased in nature due to overfishing, habitat degradation, aquatic pollution, and several other anthropological reasons. Presently, kalibaus is regarded as threatened (IUCN-Bangladesh 2010) and in need of immediate measures to protect and conserve it.

Over the years, there has been a distinct reduction in its population as evident from catches from open waters (Chondar 1999; Chaudhary and Jugal, 2003; Mahapatra 2003). Constructions of barriers in the form of check dams across river stretches and overexploitation of natural. Stocks have significantly lowered the natural recruitment process of the species (Mahapatra 2003). Further, poor seed survival in natural waters has significantly restricted their population only to a few regions. Although the species possesses the potential for inclusion into carp polyculture systems, attempts to culture it have been restricted to experimental trials (Aravindakshan *et al.* 1999; Tripathi *et al.* 2000). Despite success in induced breeding of the species, rearing from spawn to fry and fingerling has not received due attention. Rearing of spawn in nurseries is an important and crucial step in fish culture. The adverse conditions and improper management may often lead to severe consequences resulting in mortality of fry to an extent of 90-98% (Alikhunhi *et al.* 1964).

Stocking density has direct effect on growth, survival and production (Backiel and LeCerns, 1978). Stocking at higher densities not only results in higher production but also minimizes the total land requirement and water usage. The high stocking density, however, may exert adverse effects on growth (Trzebiatowski *et al.* 1981) and survival (Lakshmanan *et al.* 1967; Jhingran 1991). Therefore, it is necessary to predetermine and standardize the optimum stocking density for each species in order to obtain the best possible output. Keeping the above facts in mind, the present study was undertaken to evaluate the fingerling production technique of *Labeo calbasu* based on stocking densities during rearing in ponds.

MATERIALS AND METHODS

Study period and site

The experiment was conducted for a period of 60 days from September, 2015 to October, 2015 in experimental ponds under the Department of Fisheries, University of Rajshahi. The average area and water depth of the ponds were 0.0020 ha and 1m respectively. All the ponds were rain fed and well exposed to sunlight.

Experimental design

Three (3) different treatments of stocking densities of *Labeo calbasu* namely T_1, T_2, T_3 each with three replications were tested in this experiment. The treatments assignment was as follows-

T_1: 140 fishes/dec (34580 fishes/ha)
T_2: 160 fishes/dec (39520 fishes/ha)
T_3: 180 fishes/dec (44460 fishes/ha)

Pond preparation, stocking and feeding

Aquatic weeds were removed from all the experimental ponds manually**.** Unwanted fishes and other predatory species were removed through repeated netting from the ponds. Liming was done in all the ponds at rate 1 kg/decimal before 7 days of fertilization. Seven days after liming, Urea and Triple Super Phosphate (TSP) were applied at the rate of 100g/decimal and 100g/decimal respectively. All the ponds were stocked with *Labeo calbasu* after 7 days of basal fertilization. The mean initial stocking weight and length of fish fry was 4.5 g and 5.5 cm respectively. The stocked fry were fed 2 times in a day with fish meal (20%), rice bran (20%), wheat bran (20%), maize bran (18%) mustard oil cake (20%) and vitamin premix (2%). These feed was applied at the rate of 10% with fish body weight (Table 1).

Table 1. Composition and protein (%) of feed ingredients used to prepare feed

Ingredients	Percentage	Protein (%)
Fish meal (56% protein)	20	11.2
Rice bran (11% protein)	20	2.2
Wheat bran (13% protein)	20	2.6
Maize bran (14% protein)	18	2.52
Mustard oil cake (30% protein)	20	6
Vitamin premix	2	-
Total protein concentration (%)		24.52

Monitoring of water quality parameters

The different water quality parameters of the ponds were monitored in each fortnight from 8.30-9.30 A.M. The temperature of water was recorded by dipping the thermometer at the depth of 20 to 30 cm below the surface. A secchi disc was used for the measurement of water transparency. The dissolved oxygen concentration, pH, ammonia-nitrogen, alkalinity of water were determined by the help of a water quality test kit (HACK kit, FF-2, USA).

Estimation of growth, survival and yield

In each fortnight 10% of the stocked fishes were caught from each pond with the help of a cast net for the study of growth performance of fish. The following parameters were used to evaluate the growth performance of fishes under different treatments.

Final weight (g)

Final weight (g) = Weight of fish at harvest

Weight gain (g)

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

Final length (cm)

Final length (cm) = Length of fish at harvest

Length gain (cm)

Length gain (cm) = Mean final length – Mean initial length (cm)

Specific growth rate (SGR, bwd^{-1})

SGR (% bwd^{-1}) = (Ln final weight – Ln initial weight) / Culture period × 100
(Brown 1957)

Average daily gain (ADG, g)

ADG (g) = (Final weight – Initial weight)/culture period

Survival rate (%)

Survival rate (%) = (No. of fish harvested / No. of fish stocked) × 100

Yield

Yield (kg/ha) = Fish biomass at harvest – Fish biomass at stock

Economics analysis

Simple cost-benefit analysis was followed to study the economics of different treatments for the present study. Data on both fixed and variable costs were recorded to determine the total cost (Tk/ha). Total return determined from the market price of fish expressed as Tk/ha, Net benefit calculated by deducting the total return from total cost was expressed as Tk/ha. CBR was calculated as follows-

CBR = Net benefit / Total cost

Statistical analysis

All the collected data were subjected to ANOVA (Analysis of Variance) using a computer software SPSS (Statistical Package for Social Science). The mean values were also compared to see the significant differences through DMRT (Duncan Multiple Range Test) After Zar (1984).

RESULTS AND DISCUSSION

Water quality parameters

Environmental parameters have a great influence on the maintenance of a healthy aquatic environment and production of food organisms for the cultured fishes. Growth, feed efficiency and feed consumption of fishes are normally governed by a few environmental factors (Fry 1971). So suitable level of all water quality parameters (Table 2) should be maintained during culture of fishes especially for fry or fingerling culture.

Water depth of the ponds was 1 m. Rahman (1992) stated that pond should not be shallower than 1 m and deeper than 5 m and optimum depth should be 2 m.

The mean value of water temperature in the study pond during the study period were 30.43±0.01^{o}C (T_1), 30.42±0.02^{o}C (T_2) and 30.49±0.03^{o}C (T_3) respectively. Ali *et al.* (1982) observed water temperature of ponds 20.50 to 36.50^{o}C which was suitable for fish culture. DoF (2008) recorded temperature ranges from 26 to 32.44°C in pond water. Sahu *et al.* (2007) also recorded the mean value of water temperature of 30.9-31.1^{o}C. These findings are more or less similar to the present study.

Transparency is an important water quality parameter, which indicates the productivity of a water body. The mean values of water transparency of the ponds under the treatments were 32.76±0.08 (T_1), 33.12±0.06 (T_2) and 36.01±0.08 (T_3) cm, respectively. The present finding agreed with Kohinoor (2000) who recorded water transparency from 15 to 40 cm in fish poand. Rahman and Rahman (1999), Rahman *et al.* (1999), Uddin *et al.* (2007), Chowdhary *et al.* (2008) and Kabir *et al.* (2009) observed almost similar transparency values of pond water in their experiments.

The mean values of dissolved oxygen content recorded in the present experiment under the treatments were 5.23±0.07 (T_1), 5.25±0.03 (T_2) and 5.22±0.02 (T_3) mg/l respectively. DoF (2008) recorded a dissolved oxygen level of 1.19-7.74 mg/l. Kohinoor (2000) also recorded DO ranged from 2.0-7.4 mg/l. These findings are similar to the present study. Nirod (1997) found dissolved oxygen from 3.4-8.97 mg/l. From the above findings, it is concluded that the oxygen content of the experimental ponds was within the good productive range.

The mean values of pH recorded in the present study under the different treatments were 7.53±0.05 (T_1), 7.54±0.02 (T_2), 7.55±0.01 (T_3) respectively. DoF (2008) recorded suitable pH ranges 5.66-7.44 in pond water. The present findings are also more or less similar to the results of Rahman and Rahman (1999), Rahman *et al.* (1999), Uddin *et al.* (2007) and Mazid (2009).

Table 2. Variations in the mean values of water quality parameters under different treatments during the study period

Parameters \ Treatments	T_1	T_2	T_3
Water temperature (°C)	30.43±0.01^{a}	30.42±0.02^{a}	30.49±0.03^{a}
Transparency (cm)	32.76±0.08^{c}	33.12±0.06^{b}	36.01±0.08^{a}
DO (mg/l)	5.23±0.07^{a}	5.25±0.03^{a}	5.22±0.02^{a}
pH	7.53±0.05^{a}	7.54±0.02^{a}	7.55±0.01^{a}
Alkalinity (mg/l)	119.49±0.25^{a}	119.52±0.25^{a}	112.30±1.97^{b}
NH_3-N (mg/l)	0.015±0.002^{a}	0.018±0.001^{a}	0.020±0.001^{a}

- Figure in the same row having same superscripts are not significantly different ($p>0.05$)

The mean values of alkalinity recorded in the present study under the different treatments were 119.49±0.25 (T_1), 119.52±0.25 (T_2), 112.30±1.97 (T_3) respectively. According to Boyd (1990) total alkalinity should be more than 20 mg/l in fertilized ponds as fish production increases with the increase of total alkalinity in fertilized ponds. Apu *et al.* (2012) also found alkalinity ranged from 96-127 mg/l. Nirod (1997) observed total hardness of 79 to 220 mg/l. These findings are more or less similar to the present study. So, the experimental ponds were within the good productive range.

The average values of NH_3-N recorded in the present study under the different treatments were 0.015±0.002 (T_1), 0.018±0.001 (T_2), 0.020±0.001 (T_3) respectively. According to BAFRU (1990), ammonia should be less than 0.025 mg/l in culture pond.

From the above findings water quality parameters are suitable for the culture of kalbaus (*Labeo calbasu*).

Growth performance

Growth parameters in terms of final length, length gain, final weight, weight gain and specific growth rate of fingerlings of *Labeo calbasu* was significantly higher (Table 3) in T_1 where the stocking density of fry (34580 ha^{-1}) was low compared to those of T_2 (39520 ha^{-1}) and T_3 (44460 ha^{-1}) although the same food was applied at an equal ratio in all the treatments. This may be happened due to competition for food and habitat due to higher number of fish. Stocking density had previously been observed to have a direct effect on the growth of fish (Haque *et al.* 1993 & 1994; Kohinoor *et al.* 1994; Islam 2002; Islam *et al.* 2002; Rahman and Rahman, 2003; Rahman *et al.* 2004; 2005). Sahu *et al.* (2007) evaluated the growth of kalbasu at stocking densities of 5, 10 and 15 million spawn ha^{-1} in nursery rearing in concrete tanks of 50 m^2, each for a period of 25 days and found that the growth and specific growth rate were inversely related to the stocking density and varied significantly among the three densities.

Table 3. Mean growth performance of *Labeo calbasu* under three different treatments after 60 days

Treatments / Parameters	T_1	T_2	T_3
Initial weight (g)	3.5±0.1[a]	3.5±0.1[a]	3.5±0.1[a]
Final weight (g)	30.33±0.25[a]	26.63±0.25[b]	21.53±0.31[c]
Weight gain (g)	26.83±0.15[a]	23.13±0.15[b]	18.03±0.21[c]
Initial length (cm)	5.1±0.1[a]	5.1±0.1[a]	5.1±0.1[a]
Final length (cm)	14.33±0.25[a]	12.9±0.20[b]	10.46±0.25[c]
Length gain (cm)	9.23±0.15[a]	7.8±0.1[b]	5.37±0.15[c]
SGR (% bwd^{-1})	3.59±0.035[a]	3.38±0.03[b]	3.02±0.02[c]
ADG (g)	0.45±0.002[a]	0.38±0.003[b]	0.30±0.07[c]
Survival rate (%)	95.53±0.25[a]	87.4±0.45[b]	82.57±0.40[c]
Gross yield (kg/ha/60 day)	1002.0±5.72[a]	919.89±4.33[b]	790.40±7.37[c]
Net yield (kg/ha/60 day)	881.0±2.46[a]	781.58±1.88[b]	634.79±3.16[c]

- Figure in the same row having same superscripts are not significantly different (p>0.05)

Initial weight and length were 3.5±0.1 g and 5.1±0.1 cm in the present study and maximum final weight and weight gain were 30.33±0.25 g and 26.83±0.15 g in the treatment (T_1) respectively. Chakraborty and Mirza, (2007) conducted an experiment on the effect of stocking densities on the growth, survival and production of *L. bata* in nursery rearing. Where the mean initial weight and length were 0.011±0.002 g and 1.01±0.04 cm respectively. They found highest growth and weight gain were 6.77±0.66 g and 6.76±0.66. This finding is lower than the present study. This is because the initial weight of fishes is much higher in the present study than they stocked.

In the present study SGR (%) were found 3.59±0.035 (T_1), 3.38±0.03 (T_2) and 3.02±0.02 (T_3). Apu *et al.* (2012) carried out an experiment on carp fishes under three treatments each with two replications. Fish population density was 80 fish per decimal under treatment-1, 120 fish per decimal under treatment-2 and 160 fish per decimal under treatment-3. They found specific growth rates in treatments 1, 2 and 3 were 2.94%, 3.07% and 3.02% respectively. The findings of the present study were more or less similar with their findings. Kohinoor *et al.* (1994) observed the SGR value of olive to be 0.02% under monoculture system, which was much lower than this study. Kohinoor *et al.* (1999) obtained the SGR values of 1.33-1.35% in thai barb when they were with carps. Rahman *et al.* (2011) estimated SGR values of rahu, catla and olive barb were 1.55-1.63%, 1.56-1.58% and 0.87-0.97% respectively. These values were lower from the present study, which might be because of higher stocking density of fishes in their study.

In the present study the survival rates were found 95.53±0.25 (T_1), 87.4±0.45 (T_2) and 82.57±0.40 (T_3). Bhandari (1998) found survival rate of 75-90% in carp culture. The similar type of survival rates were also observed by Haque (2005) who recorded the survival rates of 89.50% and 90% under treatment-1 and treatment-

2 respectively. Kohinoor *et al.* (1993) obtained survival rates of 86 to 94% in the monoculture of Thai sarpunti. In another study, Kohinoor *et al.* (1999) observed the survival of Thai sharpunti ranged between 88.53 and 92.23% in polyculture with carps. Rahman *et al.* (2011) reported that the survival of rahu, catla and olive barb were 77.60-90.00%, 86.50-90.50% and 76.35-89.50% respectively in polyculture at different stocking density. Wahab *et al.* (1995) found the survival rate higher than 80% in poly culture of Thai barb with native major carps. All these findings are more or less similar with the present study. In the present study the higher survival rate was also found in the treatment with lower stocking density (34580 fishes ha^{-1}) than other treatments. The survival rates decrease in these treatments due to higher stocking density of fishes as well as competition for food and space in the experimental ponds. This agrees well with the findings of Uddin *et al.* (1988), Saha *et al.* (1989), Haque *et al.* (1993; 1994), Kohinoor *et al.* (1994) and Rahman *et al.* (2005) during fry/fingerling rearing experiments of various indigenous/exotic carp and barb species. Sahu *et al.* (2007) also recorded that the survival of fry was density dependent and significantly higher (54.5%) at 5 million ha^{-1} than those at 10 million ha^{-1} (50.1%) and 15 million ha^{-1} (46.9%). Rahman and Rahman (2003) also recorded that the survival of fry was significantly higher (74.9%) at 6 million ha^{-1} than those at 8 million ha^{-1} (64.59%) and 10 million ha^{-1} (55.27%) in spawn culture of kalbaus which were lower than the present study, which might be due to high stocking density of fries.

In the present study, significantly higher gross yield (1002±5.72 kg ha^{-1}) and net yield (881±2.46 kg ha^{-1}) of fingerlings were obtained from ponds stocked with 34580 hatchling ha^{-1} than those from the ponds stocked with 39520 and 44460 hatchling ha^{-1}. This finding is more or less similar with Akhteruzzaman and Kaiya (2003) who found a gross production of 1186 to 1737 kg ha^{-1} in culture pond. Rahman *et al.* (2009) found gross production 1099.17 (T_3)-1576.08 (T_1) kg/ha and net production 1568.88 (T_3) - 1099.17 (T_1) kg ha^{-1} during fingerling production of *C. ariza.* This finding is also more or less similar to the present finding. Uddin *et al.* (1994) found a gross production of 3415 kg/ha/yr from polyculture of carps with Thai sharpunti. Kohinoor *et al.* (1999) obtained an average gross production of 2566 kg/ha/6 month in polyculture of Thai sharpunti with exotic carps using low cast feed. In the present study higher gross and net production were found at lower stocking density. Saha *et al.* (1988) and Rahman *et al.* (2004) also obtained maximum gross and net production at lower stocking density.

Economic analysis

In the present study net benefits (Table 4) were 74276-148347 Tk./ha and consistently higher net benefit was obtained from the ponds stocked with 34580 hatchling ha^{-1} than those from the ponds stocked with 39520 and 44460 hatchling ha^{-1}. Rahman *et al.* (2011) obtained net benefits 61639-112265 Tk./ha in carp polyculture with olive barb which is similar with the present study. Kohinoor *et al.* (1993) stated that the total net income of Thai sharpunti under semi-intensive culture was tk. 75098/ha/6 month.

Table 4. Economics analysis of *Labeo calbasu* (during 60 days) in rearing system under different treatments

Inputs \ Treatments	T_1	T_2	T_3
Pond preparation cost (Tk./ha)	5000.00	5000.00	5000.00
Fertilization and liming cost(Tk./ha)	6600.00	6600.00	6660.00
Feed cost (Tk./ha)	33600.00±120^c	37300.00±145^b	39200.00±215^a
Fry cost (Tk./ha)	54460.00	62244.00	70024.00
Labour cost (Tk./ha)	1000.00	1000.00	1000.00
Harvesting cost (Tk./ha)	1500.00	1500.00	1500.00
Total cost (Tk./ha)	102160±120^c	113644±145^b	123324±215^a
Total income (Tk./ha)	250507.00±1431^a	230206.00±1485^b	197600.00±1841^c
Net benefit (Tk./ha)	148347.00±1898^a	116562.00±1484^b	74276.00±1750^c
CBR	1.45±0.01^a	1.02±0.005^b	0.60±0.01^c

- Figure in the same row having same superscripts are not significantly different (p>0.05)

Cost benefit ratio (CBR) in treatment T_1 (1:1.45) in the present study was higher than T_2 (1:1.02) and T_3 (1:0.60) which was more or less similar to the findings of Khan *et al.* (2003). Samad *et al.* (2014) found CBR 1:0.69 (T_1), 1:0.61 (T_2) and 1:0.49 (T_3) during the culture of *L. bata* fry which was more or less similar with the present study.

Finally it can be concluded that the present study revealed that the survival, growth and production of *Labeo calbasu* fingerlings were inversely related to the stocking densities of fishes. So, a stocking density of 34580 fish/ha showed highest growth performances than those obtained at higher stocking densities. The nursery culturist can use this density for rearing of *Labeo calbasu* fingerlings for two months in nursery rearing system. By production of quality seeds by applying the present findings may have important implications towards the protection of kalbaus from extinction as well as for its conservation and stock enhancement.

CONCLUSION

The experiment was conducted to evaluate the fingerling production technique of threatened *Labeo calbasu* based on stocking density under three treatments T_1, T_2 and T_3 with 34580, 39520 and 44460 kalbaus fry ha^{-1} for a period of 60 days in ponds. The mean value of water quality parameters were found suitable for nursery management. Among all the treatments mean values of growth parameters like final weight, weight gain, length gain, SGR, ADG, survival rate and yield were found significantly higher in treatment T_1. CBR was also found significantly higher in treatment T_1 than other treatments. From the study, considering water quality, production and economics, it is proved that the higher growth and survival of *Labeo calbasu* was found in lower stocking density (T_1).

ACKNOWLEDGEMENT

The authors are thankful to Department of Fisheries, University of Rajshahi, Bangladesh for the facility and infrastructure provided to carry out this research work.

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