www.ijbtjournal.com
International Journal of Biological Technology (2012) 3(1):20-24.
ISSN: 0976 – 4313

Original Article

Captive breeding and nursery rearing of *Labeo bata* (Hamilton-Buchanan) through low cost technology

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Published: 15, April, 2012; Vol. No. 3(1):20-24; Online:www.ijbtjournal.com/documents/ijbt150412104.

Abstract

Induced breeding and larval rearing of a less abundant species, *Labeo bata* was carried out in captive condition using low cost technology. Spawning commenced from 11.5 -12.5 hours after injection and was completed in 13.2 hours. A total of 55,811 numbers eggs were collected from 12 female brooders. About 94.6- 95.4% fertilized eggs were collected through hapa breeding using ovatide as inducing agent. Hatching was found started 16-17 hours after fertilization. In 16.00 to 17.00 hours after fertilization, twisting movement increases gradually and finally embryo hatched out. Newly hatched larva was measured 4.5mm in total length without mouth and pectoral fin. In 36.00 hours after fertilization, hatchlings were developed into free swimming one with having 6 mm in total length.

Key words: Captive breeding, *Labeo bata*, hatchlings, ovatide.

International Journal of Biological Technology

Introduction

Labeo bata locally called *bhangon bata* or *bata*, is a small indigenous fish (SIF) belongs to the family Cyprinidae under the order Cypriniformes. It is a non migratory fish and remains in one habitat throughout its life (Mathur 1973). According to Sarkar and Lakra, (2010), small indigenous freshwater fish species (SIF) are defined as fishes which grow to the size of 25-30 cm in mature or adult stage of their life cycle. It is one of the most popular and favorite food fish among minor carps and it has high market value for its excellent taste (Miah *et al.*, 2009). The most identifying characteristic of the fish is the presence of small black spot on 5th and 6th scales on the lateral line (Rahman, 1989). However, the species are reducing day by day from natural water resources of N. E. India. Already it has been declared as a less abundant species. The major threats are loss of natural habitats, use of small mesh sized gears, dewatering, use of insecticides and pesticides, industrial and domestic pollution, siltation of water bodies, invasion of exotic fishes (Sarkar and Lakra, 2010). Captive breeding and the release of captive bred individuals into the wild are among the techniques used for conservation of rare and endangered fish species (Sarkar *et al.*, 2006).

Labeo bata breeds in floodplains during rainy season as Indian major carps (Anon, 1996). The fish can also be induced to breed in captive condition using artificial hormone. Though culture, breeding and larval rearing technology of the major carps has been available for decades, however, other minor carps of commercial importance have been largely ignored (Sarkar *et al.*, 2004). The present study was undertaken to understand the breeding performance of *Labeo bata* in order to develop suitable low cost breeding as well as seed production technique.

Materials and methods

Collection and management of brooders

The fingerlings (length: 5-7 cm) were collected from River Brahmaputra with the help of local fishermen. They were transported in well oxygenated polythene bags to the Goalpara College pond. Brooders were reared and managed followed after Hussain, (1997). They were fed with mixture of Rice bran and Mustard oil cake at the rate of 1:1 ratio twice daily for a period of one year.

Brooders selection

Gonadal maturity was observed in 11 month from the date of release of fingerlings. The female fishes can be distinguish easily by bulging abdomen, soft ventral abdominal region, comparatively larger size, felt pectoral spine, smooth pectoral fin and swelling anal rim with reddish colour. On the other hand, the male

counterpart can be distinguished by normal abdomen; milt comes out with gentle pressure on the abdomen; serrated pectoral spine, and rough pectoral fin.

Induced breeding

Induced breeding operation was carried out followed after the methods of Hossain *et al.* (2007); Sarkar *et al.,* (2004) and Das, (2003). The experiment was conducted in the pond (Latitude 26^0 $10^/$ $11^{//}$ N and Longitude 90^0 $37^/$ $37^{//}$ E) located inside the Goalpara College campus, Goalpara, Assam, India. Brooders were induced by injecting synthetic hormone ovatide at the rate of 0.4 ml/kg body weight to male and 0.5 ml/kg body weight to female. One dose of hormone was given to each of the male and female in the afternoon (4.30PM - 5.30PM) at 27.5^0C. Spawning were carried out in hapa (135 cm x 90 cm x 130 cm in size) placed in pond with continuous water shower. After spawning, water harden eggs were collected and measured using measuring cylinder. They were transferred to flow through system pre arranged with six plastic tubs (40 liters capacity) for incubation. Fertilized eggs were identified on the basis of transparent in appearance with cell divisions while the translucent ones with milky colour were considered as unfertilized. The fertilization and hatching percentage were also calculated followed after the method of Hossain *et al.,* (2007).

Nursery rearing

Nursery rearing was performed in the same plastic container used for eggs incubation up to 30 days. They were reared in two hapa (400cm x 200cm x 100cm) fixed at the pond for another 20 days. Than they (fingerlings) were released in rearing pond. Egg diameter was calculated by taking average from the total length of ten randomly selected eggs. Pond water was filtered twice before entering the rearing units and one piece of plankton net was also tied in the inlet to prevent entry of planktons. There were two holes each for inlet and outlet to maintain the desired level of water during the rearing period. Another flow adjustment screw was fitted with the inlet pipe to maintain the desired water speed in different stages of larval rearing. In the outlet, a piece of mosquito net was fitted to check the escape of larvae through it.

Water management

For frequent monitoring of the water temperature, one portable water thermometer was attached on the side of each rearing tub. Estimation of pH was performed manually by a digital pH meter (Model: HI-96107, HANNA Instrument). Other physico-chemical parameters *i.e.* DO, Free CO_2, alkalinity, hardness and chloride was estimated followed after Trivedi and Goel,(1986) and APHA,(1989). The foreign substance, dead larva (if any) and egg shells were siphoned out from the rearing tub carefully with a soft brush (no-12).

Results and discussion

A total of four breeding trials were performed in two subsequent years *i.e.* 2009 and 2010. Breeding performance of *Labeo bata* in both the year are summarized in Table-1. The data showed comparatively better result in the year 2010 in terms of fertilization as well as hatching rate. Spawning commenced from 11.5 -12.5 hours after injection and was completed in 13.2 hours. Ovulation took place naturally within 5:30-6:00hrs after the injection of female at 27-28^0C in all the generations (Hossain *et al*., 2007). A total of 55,811 numbers of eggs were collected from 12 female brooders. The fertilization rate was 94.6- 95.4%, of which maximum was in the year 2010. In *Cirrhinus reba*, a total of 35 liters of eggs were collected from 50 individuals in which the fertilization rate was 90 to 95% (Sarkar *et al.,* 2004). In another similar experiment, highest percentage of fertilization (87.00%) and hatching (84.00%) was reported by Hossain *et al*., (2007). Das (2003) reported 93% fertilization and 88% hatching rate when ovaprim was used as inducing agent in *Labeo rohita.* The size of the eggs(at the time of fertilization) were 0.9 mm in diameter, however, Miah *et al.* (2009) reported fertilized eggs of *Labeo bata* having a size of 0.7 to 0.8 mm in diameter. Chakraborty and Murty (1972) observed that the egg diameter ranged between 4.1 and 4.8 mm with an average 4.4 mm in *Labeo rohita*. In the present investigation, hatching started in 16-17 hours after fertilization. Hatching percentage was 82.2% and 83.7% in the year 2009 and 2010 respectively. Naeem *et al.,* (2005) have reported fertilization percentage (91.01%), hatchling percentage (67.50%), average number of egg Kg^{-1} (67670), average number of fertilized egg Kg^{-1} (61620) and average number of hatchling Kg^{-1} (41584) in *Catla catla*. Newly hatched larvas were found vertically lying at the bottom of the container for sometimes and then swims repeatedly to the surface.

Table-1: Results of Captive breeding and larval rearing of *Labeo bata*

Year	Size of male		Size of female		Latency period (hrs)	No. of eggs spawned	Fertilization (%)	Fertilized eggs	Hatching (%)	No. of hatchlings
	L(cm)	Wt(gm)	L(cm)	Wt(gm)						
2009	22.5-24.7	233-254	22.4-24.9	258-268	12.0-12.5	26,568	94.6	25,133	82.2	20,659
2010	23.8-25.1	247-262	23.5-25.2	266-274	11.5-12.0	29,243	95.4	27,897	83.7	23,349

The embryonic and larval development of *Labeo bata* is essential to know from the study of its history, culture of fry and fingerlings for nursery and to protect this species from extinction (Hossain *et al.*, 2007). In the present study, embryonic and larval development stages of the larvae are given in Fig. 2 (B-M). According to Miah *et al.*,(2009), this variation is due to fluctuation of temperature, the higher the temperature and the quicker is the development. In 45 minutes after fertilization, blastodisc was found prominent with transparent cytoplasmic regions. Yolk plug stage was observed in 4.45 hours after fertilization. Yolk mass were found almost covered leaving a pore behind the vegetative pole at this stage. Anterior and posterior end of the embryo were found become distinct and it was appeared pea shaped at six hours after fertilization. In 7.15 hours after fertilization, head and tail rudiment was found separated from yolk mass and embryo transformed into C shaped form. Tail and head was found prominent and size of the embryo gets elongated in 10.30 hours. Hossain *et al.*, (2007) observed similar changes at 14 hours after fertilization. Head and tail rudiments were found completely free from yolk mass at 12.00 hours after fertilization. Twisting movement was found initiated, yolk mass differentiated into yolk bulb. Embryo was found more active with frequent twisting movement at 14.00 hours after fertilization. Mouth was not developed in this stage. In 16.00 to 17.00 hours after fertilization, twisting movement increases gradually and finally embryo hatched out. Newly hatched larva was measured 4.5 mm in total length without having mouth and pectoral fin. Sarkar *et al.*, (2004) observed that hatching started in 10-12 hours after fertilized and hatchlings were measured 3.2 mm in length in *Cirrhinus reba*. The length of the newly hatched larvae of *Labeo bata* was reported as 2.5 ± 0.05 mm (Miah *et al.*, 2009). Mookerjee (1945) reported that the newly hatched larvae of *Catla catla* were measured 4.2 to 4.7 mm in length. It was found vertically lying at the bottom of the hatching container for a while and then swim repeatedly to the surface. In 36.00 hours of fertilization, hatchlings were developed into free swimming one with having 6 mm total length. The yolk sac was absorbed between 34:00-38:00 hours after hatching with having water temperature of 28 ± 1.2^{0}C. Similar observation was also made by Hossain *et al.*, (2007) where, the yolk sac absorption required 34:00-38:00 hours after hatching in water temperature of 27-28^{0}C.

Nursery rearing under controlled environment was performed for 30 days by using various diets in different developmental stages. Feeding of hatchling was initiated after five hours of complete absorption of yolk sac *i.e.* 48 hours after hatching. For the first three days boiled chicken egg and filtered plankton were used as food for the newly hatched larva. The yolk of a chicken egg was grind in tiny particles and given to the larva @ 50 - 60% of total body weight thrice daily (early morning, noon and evening time). On the other hand, filtered plankton was given along with the egg yolk @ 10 ml/kg body weight. From the fourth day, mixture of rice polish & mustard oil cake (1:1) was used @ 8 - 10% of total body weight twice daily (morning and evening) up to 15 days. After this stage, larvae were fed with formulated pellet of mixed silk worm pupae and rice polish @ 100 to 150 gm/kg body weight twice daily till 30 days old. From the 31st day, larva were reared in hapa; fed with formulated food (rice bran 55%, mustard oil cake 30%, molasses 10% and dry fish powder 5%) daily @ 45 to 50gm/kg body weight for another 20 days. All the residual food was siphoned out from the rearing tub before giving fresh food. This was only to maintain good water quality which will reduce larval stress. In *Labeo bata*, the highest growth (length: 19.37 mm and weight: 57.67 mg) and survivability (63.33%) was achieved with mixed diet *i.e.* rice bran and mustard oil cake at 1:1 ratio (Hossain *et al.*, 2007). The 50 days old fingerlings were further

reared at stocking pond fed with normal feeds as used for adult one.

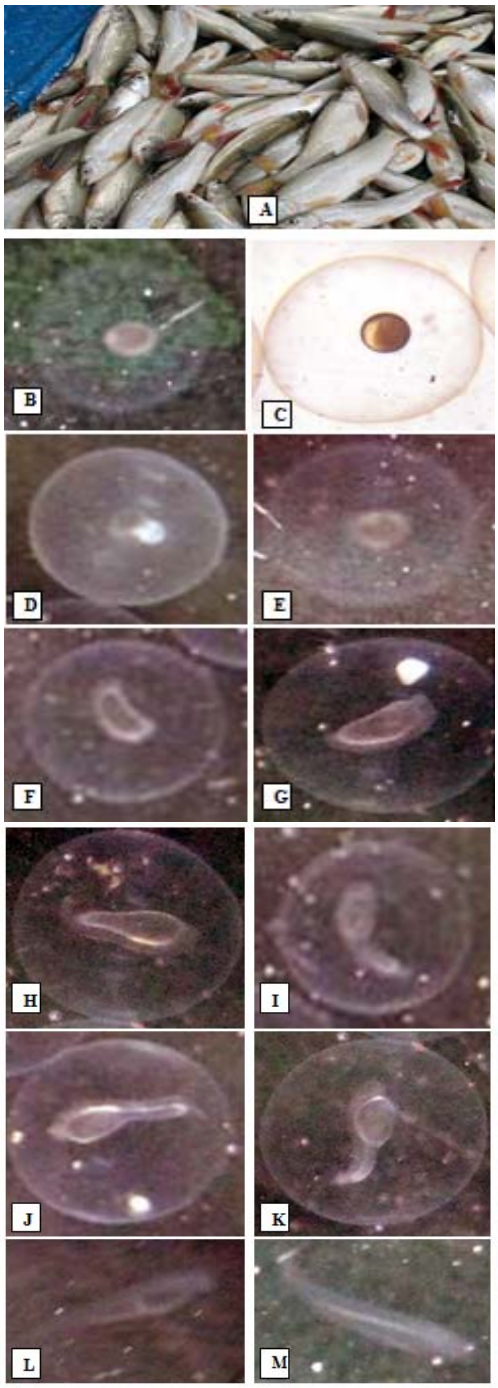

Fig. 2: A. haul of *Labeo bata*
B. Blastodisc formation (45 minutes after fertilization); C. Morula stage (2:20 hours after fertilization); D. Invasion of yolk mass (3:18 hours after fertilization); E. Yolk plug stage (4:45 hours after fertilization); F. Kidney shaped stage (7:15 hours after fertilization); G. Enlarged embryo (9:25 hours after fertilization); H. Tail elongation (10:30 hours after fertilization); I. Tail & head developed (12:00 hours after fertilization) J. Twisting movement (14.00 hours after fertilization); K. Just before hatching (About 15.45 hours after fertilization); L. Newly hatched larva (16-17 hours after fertilization); M. Full swimming larva (36:00 hours after fertilization).

Water quality for both the incubation and nursery rearing unit was analyzed to adjust suitable environment for embryonic as well as larval development. Amongst the water quality parameters, water temperature and pH were found most sensitive to the larvae. In the present investigation, water temperature and pH observed between the ranges of 28.0 to 31.6 ^{0}C and 7.9 to 8.3 respectively. Dwivedi and Reddy,(1986) opined that the environmental parameters like temperature, oxygen, pH, water current enhanced the fish breeding and hatching and in addition to that the spray and shower not only increase the dissolved oxygen, but also keep their environment cool and simulate natural conditions. The water quality parameters like DO (10.57-12.41 mg l^{-1}), FCO_2 (3.3-4.4 mg l^{-1}), alkalinity (85-95 mg l^{-1}), hardness (54-60 mg l^{-1}) and chloride (9.24-10.51 mg l^{-1}) were suitable for fish seed production (Table-2).

Table-2: Physico-chemical parameters managed during experimental period

Sl. No.	Parameter	Nursery rearing unit
1	Temperature (^{0}C)	28.0 ± 1.2
2	pH	7.9 ± 0.5
3	DO (mg l^{-1})	10.57 ± 2.7
4	FCO_2 (mg l^{-1})	4.4 ± 0.2
5	Alkalinity (mg l^{-1})	85 ± 9
6	Hardness (mg l^{-1})	54 ± 7
7	Chloride (mg l^{-1})	9.24 ± 1.3

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Manuscript Progress Date

Received : 10 .02.2012
Revised : 16.03.2012
Accepted : 28.03.2012