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Article

Present status of Indian major carp broodstock management at the hatcheries in Jessore region of Bangladesh

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Abstract: The present study was carried out to access on the present status of Indian major carp broodstock management, suggests some guidelines to control negative selection and inbreeding in hatchery stocks in Jessore, Bangladesh. The survey was conducted in 20 hatcheries at Chacrha in Jessore from November, 2013 to October, 2014. Information showed that brood fish selection for induced breeding was done on the basis of their experience. The sources of brood fish were mainly own and other sources were Halda River, Padma River, Govt. brood bank, world fish center and BFRI. Feed ingredients used as rice bran (39%), mustard oil cake (29%), vitamin and mineral premix (3%), wheat flour (7%), fish meal (13%) and soyabean flour (5%). Nutritional compositions of feed were protein (20-30%), lipid (10-12%), carbohydrate (25-35%) and fat (7-11%). Fertilizer such as TSP (0.484 kg/decimal), urea (0.242 kg/decimal), cowdung (6.5 kg/decimal), poultry dropping (3 kg/decimal) and MP (0.181 kg/decimal) were used. Hatching rate was 85-91% and deformed hatchlings were 5-7% in the hatcheries. Both positive (63%) and negative (37%) selection were identified. Anchor worm (*Lernaeasis*) disease was the most harmful problem of which solution was not given by them. Hatcheries owners assumed that if they would use wild brood fish, inbreeding could be removed and thus survival and growth of fry could be increased.

Keywords: Indian major carps; broodstock; management; hatchery; jessore

1. Introduction

Bangladesh is blessed with numerous inland water bodies which are very rich in diversity of aquatic species (Samad *et al*., 2013a). Over the last two decades or so Jessore areas of Bangladesh have experienced an intense growth of fish breeding industries. The success of hatchery mainly depends on improved brood rearing technique entailing pond management, including liming, fertilization and feeding and water quality management. Four endemic major carp species principally (*Catla catla, Labeo rohita, Cirrhinus cirrhosus* and *Labeo calbasu*) and six introduced or exotic species (*Ctenopharyngodon idellus, Hypophthalmichthys molitrix, Aristichthys nobilis, Mylopharyngodon piceus,* and *Cyprinus carpio*) are being used for major seed production in these hatcheries. In the recent past, the natural stock of these species has become threatened by habitat destruction, etc. which is likely to cause a gradual loss of genetic diversity. Most of the government hatcheries have own broodstock and around 25 percent recruitments take place in every year. On the other hand, few private hatcheries have their own stock and maintain them more or less scientifically but there are many private hatcheries that do not have the required number of broods. During breeding season they instantly buy broods

from others and produce fry from them to fulfill their target (Sarder, 2002). The main available species in Jessore region was that breed in these hatcheries were commonly rohu, catla, mrigel, silver carp, grass carp, common carp, thaiputi, pangus, kalbaus, bata and often black carp, bighead carp, koi and tilapia (Asif *et al.*, 2014). For brood pond preparation liming was depended upon pH of the pond water, most of the hatchery owners are not aware of it. They usually spread lime over the pond bottom 5-6 times in a year. The feed of brood fishes were maintained very sensitively. Some brood takes 3 to 4 year to breed. When a brood are ready to breed then it is selected for breeding and make a separation from other. The brood fishes were transferred to the rectangular tanks for conditioning for 6-7hours respectively. During conditioning, the male and female were kept separately, prior to administration of the inducing agents. The brood ponds should be free from weeds and predators and should be enriched with manures and fertilizers (Shabuj *et al*., 2016). The doses were found to be ranged from 1000- 1200 gm/dec (Rahman *et al*., 2015). The present study is conducted to investigate the present status of Indian major carp brood stock management at the hatcheries in Jessore region of Bangladesh.

2. Materials and Methods

The study was conducted for a period of 12 months from November, 2013 to October, 2014. A total of 20 private hatcheries (about 123 ponds in hatchery) in Jessore district of Bangladesh were brought under survey. Due to importance of fish fry trade at Chachra of Jessore Sadar Upazilla was taken as the main study area. Data were collected through a structured questionnaire. Relevant data were collected by interviewing the hatcheries operators, the hatchery owners and the farmer's directly. In order to minimize errors, data was collected in local units. These were subsequently converted into appropriate units. The final questionnaire included the question of procedure of brood stock pond preparation, stocking density of brood fish, management of water quality, feeds and feeding, fish disease and health management, selection of brood fish, breeding technique, procedure for maintaining of fry quality, types of ponds and tanks that were used for influencing breeding, production of brood fish, ownership, hatching rate and others information which are related above these. The secondary data were collected from Bangladesh fisheries research institute (BFRI), Jessore; department of fisheries (DoF); BRAC; world fish and others government and non-government organization, different books, journals and websites. All the collected information were accumulated and analyzed by MS-Excel and then presented in textual, tabular and graphical forms to understand present status of Indian major carp brood stock management and genetic improvement at the hatcheries in Jessore region.

3. Results

3.1. Physical and chemical condition of pond

3.1.1. Area of pond

Field survey showed that the areas of pond of different hatchery of Chachra varied from 33.33 decimal to 400 decimal and the shape of brood pond was rectangular, square and irregular. Number of pond according to area and shape are given in Table 1 and Table 2 respectively.

Table 1. Ponds according to area.

Area (Decimal)	No. of pond
<33	6
33-66	13
66-100	19
100-133	32
133-166	20
166-200	11
200-233	7
233-266	6
266-300	5
>300	4
Total	123

Table 2. Ponds according to shape.

Shape	No. of pond
Square	22
Rectangular	74
Irregular	27
Total	123

3.1.2. Water color

In the study area 9% of pond water color is gray and 7% is transparent. 84% of Pond water is green different watercolors are shown in Figure 1.

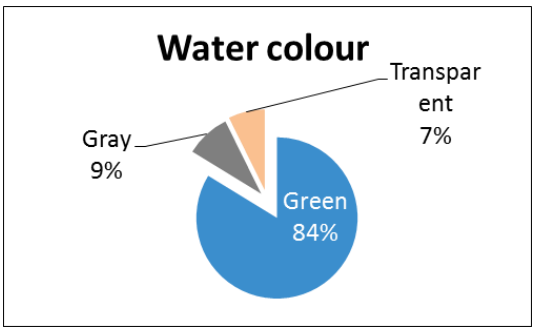

Figure 1. Water color of brood ponds.

3.1.3. Water depth during rainy season

The average depths of pond water during rainy season was below 6 feet to 12 feet. The depth of study area's pond are presented in Table 3.

Table 3. Depths of pond during rainy season.

Depth(ft)	No. of pond
<6	25
6-7	41
7-8	45
8-12	12
Total	123

3.1.4. Water quality parameters of different hatcheries

The range of pH, DO, transparency and temperature are 6-8, 3.5-5.25, 17-25 cm and 24-31˚C. These are shown in Figure 2.

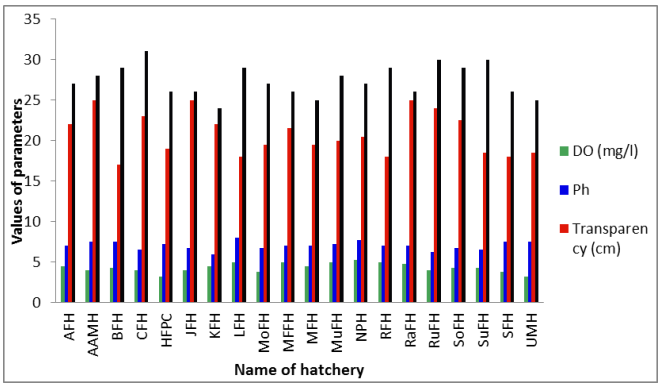

Figure 2. Comparison of water quality parameters of different hatcheries.

3.2. Pond drying

Most pond retained water round the year but some ponds were completely drained out by pumping and allowed to dry by sunlight for 7-10 days. Figure 3 shows the dryness condition of surveyed ponds.

3.3. Liming

Though liming rate depends upon the pH of soil but farmers never follow it. The liming rate in the study area was 0.5 to 1.2 kg/decimal and varies from pond and soil quality. Liming rate of different hatcheries has been given below in Table 4.

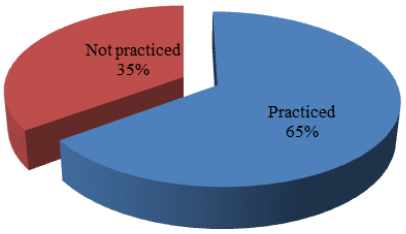

Figure 3. Dryness condition of surveyed ponds.

Table 4. Liming rate of different hatcheries.

Amount (kg/decimal)	No. of pond
0.5-0.6	12
0.6-0.7	12
0.7-0.8	30
0.8-0.9	37
1-1.2	32
Total	**123**

3.4. Predator control

Most farmers control predators before stocking fertilized egg in the pond by rotenone powder. Outdoor nursery ponds where the post larvae and fry were susceptible to predation not only by predatory fish but also insect larvae, amphibians like frogs etc. A few farmers used fostoxin, dimochrome, endrin in the pond (Figure 4).

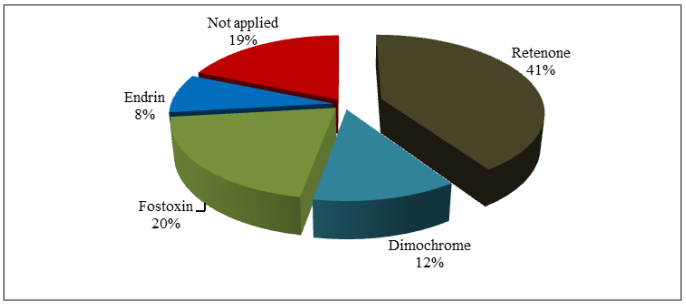

Figure 4. Variation of usage of pesticides for predator control.

3.5. Fertilization

Farmers were generally applied different type of fertilizer. They also used different company's fertilizer products. Among different fertilizer, Urea, triple super Phosphate (TSP), organic cow drop and poultry manure are used. Sometimes they used to apply murate of potash fertilizer. Amount of fertilizer used in the ponds in a season by farmer in different pond are shown in Figure 5.

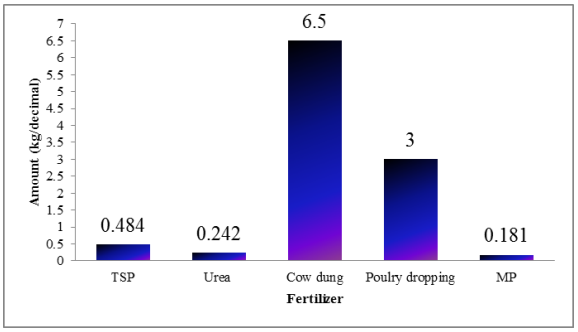

Figure 5. Usage of fertilizer (kg/decimal).

3.6. Sources of brood

The main sources were world fish center, BFRI, Haldariver, Padma river, govt. brood bank. The percentages of source of brood are presented in Figure 6.

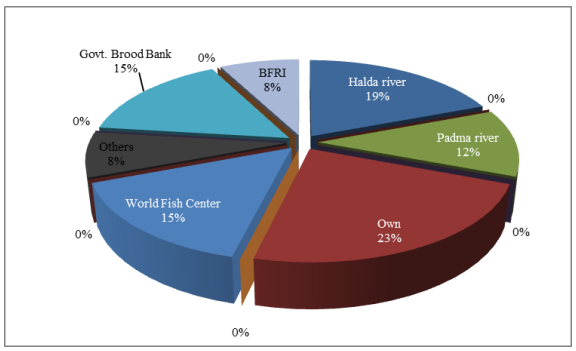

Figure 6. Source of brood.

3.7. Selection of brood

The fry were selected on the basis of colour, size and swimming activities. The weight varied from 3 kg to 8 kg.

3.7.1. Stocking time

Generally stocking of fertilized eggs varied from April to May. The fries those hatched from eggs tried to sell all of them by farmers. Fry selling continues from May to September. Then the unsold fry were stocked in the pond for grower fish. They never follow stocking rate of carp given by fisheries specialist. The fry which to be made as brood were identified at first and keep them separate from other fry. The peak period of fry selling is June. Grower fish season continued from mid-September to March. They never released egg at high temperature.

3.8. Food and feeding

3.8.1. Food ingredients used in brood ponds in Jessore region

Generally rice bran, mustard oil cake, wheat flour, fish meal, vitaminand mineral premix, soyabean flour have been given in different amount (Figure 7).

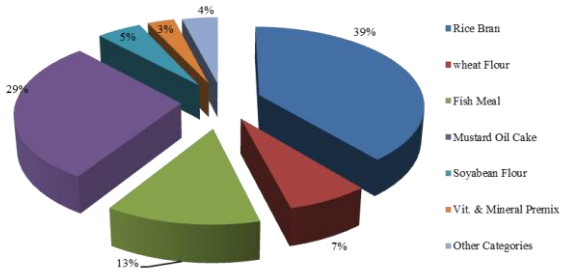

Figure 7. Food ingredients used in brood ponds in Jessore region.

3.8.2. Nutritional composition of food

Proximate compositions of food that were used in brood ponds in Jessore region are presented below in the Table 5.

Table 5. Nutrition composition of food stuff used in Jessore region.

Nutrition	Amount (%)
Protein	20-30%
Carbohydrate	25-35%
Fat together with phosphorus, Calcium, Vitamins and minerals	7-11%
Lipid	10-12 %
Moisture	10-15%
Others	5-10%

3.9. Injection of hormone

Hormone treatment to the Indian major carp broodstock at the hatcheries has been given below in Table 6.

Table 6. Hormone treatment to the Indian major carp broodstock.

Species	Sex	1st dose of PG (mg/kg body weight)	Interval (hours)	2nd dose of PG (mg/kg body weight)	Ovulation (hours after 2nd dose)	Hatching time (hours after 2nd dose)	Mode of ovulation
Rui	Female	0.5-1.0	5-6	5-7	6-8	15-20	Hand stripping
	Male	------		1-2			
Catla	Female	0.5-1.0	5-6	5-7	6-8	15-20	Hand stripping
	Male	------		1-2			
Mrigal	Female	0.5-1.0	5-6	5-7	6-8	15-20	Hand stripping
	Male	-------		1-2			
Calbasu	Female	0.5-1.0	5-6	5-7	6-8	15-20	Hand stripping
	Male	--------		1-2			

3.10. Hatching rate

Hatching rate of different species of Indian major carp at the hatcheries has been given below Figure 8.

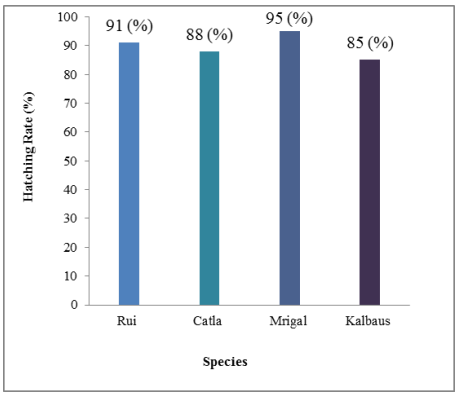

Figure 8. Hatching rate of different species of Indian major carp.

3.11. Deformed hatching

Deformed Hatching rate of different species of Indian major carp at the hatcheries has been given below Figure 9.

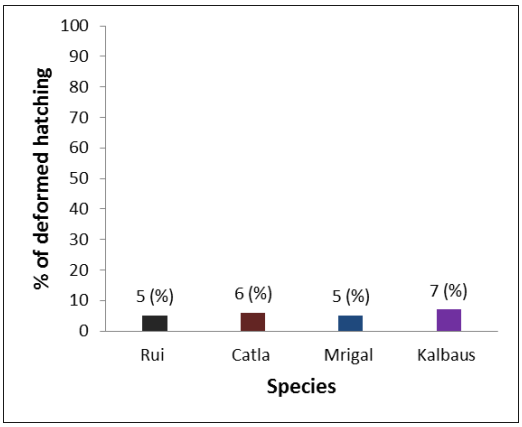

Figure 9. Percentage of deformed hatching of Indian major carp.

3.12. Broodstock selection process

Both positive and negative selection was found during the survey. In study area the negative selection of brood was found 37% and positive selection was found 63% (Figure 10).

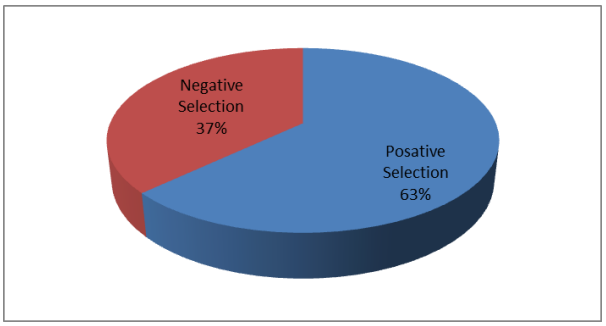

Figure 10. Selection of Indian major carp brood.

3.13. Disease

The most harmful disease that was found in the hatcheries in Jessore was *Lernaeasis* which was known as "Anchor worm". No effective treatment was known to the farmers for this disease. *Lernaeasis* affected all types of brood fish in the hatcheries and especially fry and fingerling were affected more seriously.

4. Discussion

During the survey it was found that the ponds were varied according to size and shape. The area of ponds varied from 33 decimal to 300 decimal. The areas of pond of different hatchery of Chanchra were varied from 33.33 to 400 dec. (Samad *et al.*, 2013b). Among 123 surveyed ponds only 6 ponds area were less than 33 decimal and 4 ponds were more than 300 decimal. Most of the ponds areas were between 66 decimal to 200 decimal because of the management system of these ponds are more suitable. Among 123 ponds, 103 ponds water colour were green while 11 were gray. Some turbidity occurs after fishing by nets but it stays just for few minutes and does not affect fish production. The visual colour of the pond water is a simple but important reflection of the basic production processes (FAO, 2003). The trading pond is 69% perennial pond and 31% ponds are seasonal pond. The average size of the pond is 15 decimal to 30 decimal. The average depth of pond in the study area was found 2.45 meter (Asif *et al.*, 2014). Sometimes turbidity occurred after fishing by nets but it stayed just for few minutes and did not affect fish production. Water of pond had high light penetrating capacity (Samad *et al.*, 2013b). Pond water has high light penetrating capacity. Water color in different region of Bangladesh mainly varies from light green to gray except few ponds which color was black and turbid that is similar to Das (1993) study.

The average year-round water depth is about 2 m. (FAO, 2003). Depth of water in the pond during rainy season varied from 6-12 feet while water depth at dry season varied from 3.5-7.0 feet which is similar to the study of Mollah (1996).

Water temperature ranged between 24^0C to 31^0C during the experiment period. The temperature of hatching jar ranged between 27^0C to 29^0C. The values of dissolved oxygen varied from 3.5 to 5.25 mg/l in ponds. The dissolved oxygen value of hatching jar ranged from 4.0 to 5.5 mg/l during the whole study period. The water pH ranged from 6 to 8 in brood pond and 7.5- 7.9 in hatching jar. The water transparency of different hatcheries varied from 17 to 25 cm. These observations were similar with the study of Hossain (2000) and Ahmed (1997)

Most of the ponds retained water round the year but some ponds were completely dewatered bypumping and allowed to dry by sunlight. Drying out before stocking and dried varied from 7-10 days (Samad *et al.*, 2013b). About 65% ponds were dried and 35% were not dried. The ponds which were not dried, varies types of pesticides were used in the ponds. These were as rotenone powder 41% ponds, fostoxin 20% ponds, dimochrome 12% ponds, endrin 19% ponds at different hatcheries. No published report has been found in these areas (FAO, 2005).

Rate of liming varied hatcheries to hatcheries from 0.5 to 1.2 kg/decimal. Farmers usually spread lime over the pond bottom 4-6 times in a year. But liming rate depends upon pH of soil but farmers never follow it. Though the rate of liming was depended upon pH of the pond water, most of the farmers are not aware of it. They usually spreaded lime over the pond bottom 5-6 times in a year. The doses were found to be ranged from 500-1200 gm dec-1 in the present study. Farmers mostly applied lime at the time of drying the pond (Samad *et al.*, 2013b). Similar observation has been reported by Mazid (1992) and Chakrabarty (1979).

Application rate of fertilizer varied from hatchery to hatchery. Fertilization rate of poly culture is applied in lower dosage of 2-2.5 kg/decimal. The organic manure application is 3-3.5 kg/decimal wet weight/month. Fertilizer were used as TSP 0.484 kg/decimal, urea 0.242 kg/decimal, cow dung 6.5 kg/decimal, poultry dropping 3 kg/decimal, MP 0.181 kg/decimal. They spread out inorganic fertilizer whole of the pond 5-6 times

in a year (Samad *et al*., 2013b). The average doses of organic fertilizer were 2,801 kg.ha-1.y-1 and inorganic fertilizer was 97 $kgha^{-1}$year. Hassanuzzaman (1997) found similar result in Jessore region.

The main sources of brood Indian major carps were world fish center 15%, BFRI 8%, Haldariver 19%, Padma river 12%, govt. brood bank, 15%, own 23% and others sources 8%. The main purpose of collecting brood from different sources was to avoid (or reduced) inbreeding and produced quality seed. Preferably 1 to 3 years weighing about 3.5 kg to 8 kg old mature males and females should be collectedfrom the natural sources (rivers, lakes, and reservoirs) as broodstock (Sarder *et al.*, 2002). These observations were relatively similar with this study of Samad *et al*. (2013b).

The brood fish feeding were done with homemade feeds in Jessore. Generally rice bran 39%, mustard oil cake 29%, wheat flour 7%, fish meal 13%, vitamin and mineral premix 3%, soya bean flour 5% etc. are used for formulating homemade feed. For pellet preparation, the oil cake was soaked in water over the night before preparation. The dry ingredients were mixed with soaked oil cake and molasses and extruded into pellets. The pellets were sun dried before application. Then the soaked feed materials were made into dough with dry fish meal and thrown into a definite point of the pond. Haque (1991) reported similar practices of feeding of Indian major carps.

The proximate composition of food were maintained as protein 20-30%, carbohydrate 25-30%, lipid 10-12%, moisture 10-15%, Fat together with phosphorus, Calcium, Vitamins and minerals 7-11%. The reasons of maintaining this composition might be due to the Indian major carps require 30% protein and 8-11% lipid. Current study was similar with the study of Tripathi (1990); Haque (1991) and Samad *et al*. (2013b).

The fishes were fed at 3-4% of body weight, 5-6 days in a week. These rates were followed in the initial stage of brood preparation, however, as the breeding season approached, the rates were decreased to 1-1.5% of body weight, 3-4 times per week. Present finding has the similarity with the finding of (Samad *et al*., 2013b).

Hormone were injected to Major carps with a preliminary dose of 0.5-1.0 mg gland/1kg body weight and 5-6 hour after, a second dose of 5-7mg/1kg body weight were injected to the female first. The first dose is called primer dose and second dose is called booster. The male on the other hand, receive a single dose of 1-2mg/1kg body weight at the time of second injection to the female. First dose of female was similar and only one dose of male was nearly similar with the finding of Samad *et al*. (2013b) and Ali *et al.* (2015).

Hatching rate of Indian Major Carp of different hatcheries ranged from 85 to 95% and deformed hatchlings are about 5 to 8%. It was showed the better result than the study of (Kabir, 2009). These are indicating the proper management of hatcheries including broodstock selection although both positive selection (63%) and negative selection (37%) were found.

The most harmful disease that has been found in the hatcheries was *Lernaeasis* which is known as "Anchor worm" a parasitic disease. No treatment has been effective for this disease. Length of this parasite was 0.5 to 1.0 inch that was visible by nacked eye. The optimum temperature for this disease was 25 to 30°C however the parasite unable to survive at the temperature below 15°C. The main problems of hatchling production in the Jessore region is Argulus diseases. 95% of hatchlings mortality is caused by Argulus disease (Sharif and Asif, 2015).

5. Conclusions

Many hatcheries in Jessore rear their own broodstock and usually do not recruit broodstock from natural sources (rivers) although some may obtain broodstock from other aquaculture sources. For that in genetically closed hatchery systems, potential selective pressures exerted on finite and often small culture populations by various farm management practices such as the selection of founder stock, number of breeders maintained, method used for replenishing broodstock, stocking density, feeding regime, etc. can result in "indirect" or negative selection, inbreeding and genetic drift. Few of the hatchery operators have no knowledge of simple broodstock management practices and do not follow any principles or guidelines in selecting adequate sized breeders, injecting hypophysation dosage and mating unrelated male and female spawners.

Conflict of interest

None to declare.

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