Recent Trends in Breeding and Seed Production of Pengba, with Special Reference to Northeast India

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The freshwater aquaculture sector of many South Asian countries has been diversifying in recent years, with incorporation of several new species into culture systems. Development strategies need to promote diversification of aquaculture through production of locally available fish species. Carps, catfish, prawns, mollusks and ornamental fish provide options for diversification of species cultured. Inclusion of some of these species has resulted in greater production (Das and Mishra 2016) and has expanded the species scope for fish farmers and consumers. In addition, new indigenous and exotic species can expand the scope of the culture system to increase fish yield and farmer income.

Pengba *Osteobrama belangeri* is a medium-sized cyprinid that has gained importance relating to its superior taste, excellent nutritional profile, soft bony structure and high commercial value. It is distributed in the rivers and lakes of Asian countries like China (Yunnan Province), India and especially Myanmar. It has made an important impact on the fisheries of Loktak Lake of Manipur and in the northeastern states of India. However, wild populations of the fish are under severe threat due to habitat loss, construction of dams, introductions of invasive species, indiscriminate pesticide and herbicide use, loss of breeding grounds and overfishing of broodfish from the wild. It is considered "extinct in the wild" in Manipur and is classified as "near threatened" by the IUCN (IUCN 2010, Vishwanath 2010). To promote its conservation, pengba has been declared the "state fish" of Manipur by the state government.

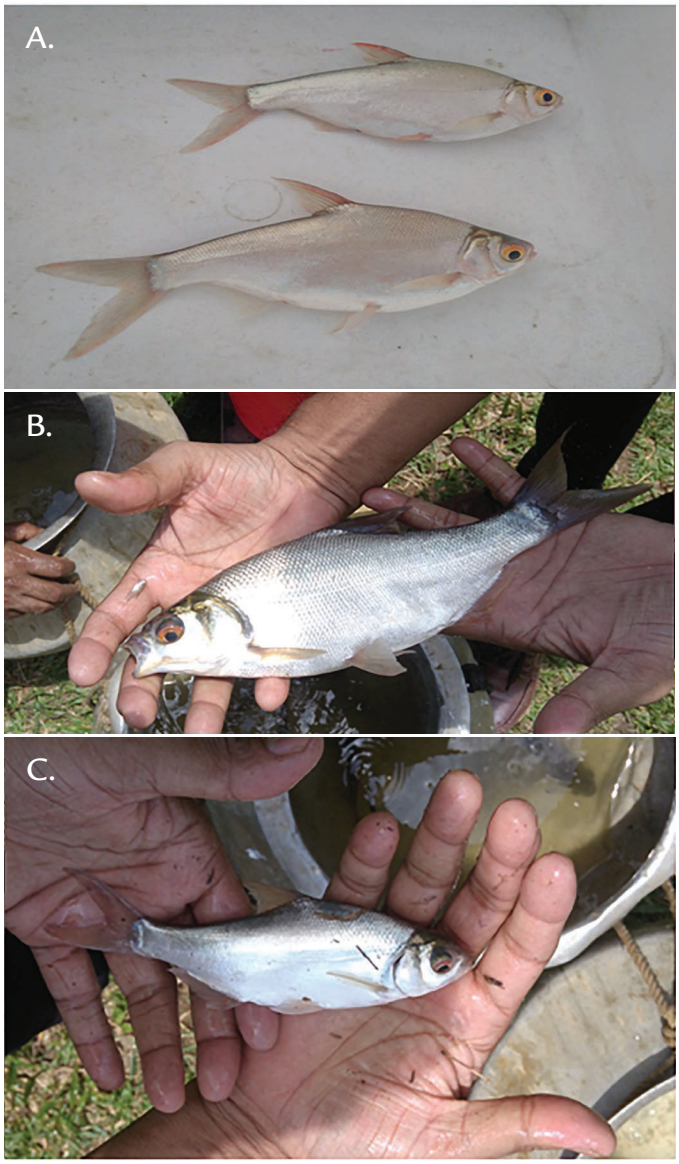

FIGURE 1. *Broodfish of pengba (A), female (B) and male (C).*

Pengba is an omnivorous fish that feeds mainly on zooplankton and algae as juveniles and macrovegetation as adults (Basudha and Vishwanath 1999). The fish is suitable for culture in ponds, with its lower trophic level food and feeding habits, through natural food and supplementary artificial feed. Recently, the fish is considered as potential candidate species for diversification of carp culture related to its high commercial value, better taste and good flesh quality. The Aquaculture Division, College of Fisheries, Central Agriculture University (COF-CAU), Agartala, Tripura and other research institutions have developed breeding, seed production and grow-out technology for pengba. A brief account of pengba hatchery and grow-out technology developed by COF-CAU is discussed here.

Captive Breeding

In general, pengba breeds in riverine conditions during the onset of southwest monsoon. It does not reproduce naturally in artificial rearing conditions without hormone induction. It is a seasonal and riverine spawner that attains sexual maturity in the second year at 200-300 g body weight. Females are relatively larger than males. During the breeding season, males and females move in shoals and migrate from beels to rivers. Spawning occurs once per year during the monsoon season (June-August), with a spawning peak in July. Unlike many other carps, sexual dimorphism cannot be

FIGURE 2. *Earthen ponds for rearing of pengba broodstock.*

FIGURE 3. *Administration of agent to induce spawning.*

recognized by feeling the roughness of the inner side of the pectoral fin. Mature females have a bulging abdomen, slightly swollen genital aperture and oozing ova when gentle pressure is applied to the abdomen (Fig. 1). Mature males are identified by no noticeable bulging of abdomen and milt oozing freely with gentle pressure on the abdomen.

Broodstock Management

The success of breeding by artificial means depends on a sufficient number of quality broodfish. Broodfish are selected by sex and held in separate ponds or tanks for one week prior to breeding. Identification of male and female brooders is based on the external features described previously. An average weight of 150-200 g is good for breeding. Rectangular ponds of 0.2-0.5 ha with 1.5 m average depth is preferred for broodfish raising (Fig. 2). Broodstock ponds and tanks should be covered with netting. Pengba broodfish should be fed daily with a 25-30 percent crude protein pelleted feed. In certain locations or for various reasons, it is not always possible to obtain and provide a high-protein pelleted feed. As an alternative, a mixture of mustard oil cake, fishmeal, rice bran, and wheat flour can be pulverized, mixed and fed in dough form. Broodfish condition should be examined regularly. Broodfish are harvested by lowering the water level during the breeding season. A day prior to induced breeding, selected broodfish from the earthen pond are held in separate enclosures or hapa nets (3.5 × 1.5 × 1 m) or spawning pools for acclimation and not fed. Constant water flow is maintained to ensure proper aeration. Handling of fish should be done very carefully to avoid possible injury and secondary infection.

FIGURE 4. *Breeding operation in a spawning pool.*

Induced Spawning

Selected brooders should be administered with inducing hormone (e.g., Ovaprim) at 0.5 mL/kg female and 0.25 mL/kg male. Fish are injected intramuscularly on the caudal peduncle or behind the dorsal fin but above the lateral line using a 1-mL syringe (Fig. 3). To achieve successful induced spawning, it is advisable to put together one female with two males when breeding is done in hapas. In an eco-hatchery, the male to female ratio can be 1:1 provided males are of equal size and strength.

After administering the hormone, broodfish are released into the breeding pool (Fig. 4), provided with water flow through a shower head to stimulate natural conditions, and not disturbed. Water inflow to the central outlet (egg delivery pipe) and single inlet must be adjusted in such a manner that it creates a current velocity of 3-5 cm/sec, maintaining the requisite water depth that simulates riverine flow. Within 5-6 hours after hormone injection, broodfish will show chasing behaviour that will continue for one hour. Chasing leads to courtship, locking and finally spawning. When the female releases the eggs, the male ejects milt and fertilization takes place externally.

Egg Incubation and Hatching

Spent brooders are removed and then eggs are collected from the egg collection chamber and transferred to the incubation pool for hatching (Fig. 5). The incubation pool (depth: 1-1.5 m) is circular, with an outer chamber that is 3-6 m in diameter and an inner chamber that is 1-1.5 m in diameter (Fig. 6). The circular wall that separates the outer and inner chamber is made of wire mesh. The inner chamber is wrapped with a nylon cloth that allows water from

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FIGURE 5. *Egg collection after a successful spawning.*

FIGURE 6. *Incubation of fertilized eggs in a spawning pool.*

the outer chamber to the inner chamber.

Fertilized eggs are spherical, translucent and demersal, measuring 2.5-2.8 mm in diameter. Eggs are incubated in the incubation pool at 750-1,000 eggs/L. Hatching takes place 18-20 h after fertilization and hatchlings are visible after 24-26 hours at 26-30 C. Finally, the spawn delivery pipe delivers the spawn to the spawn collection chamber. Newly-hatched larvae measure about 4.5 mm in length and 1.4 mg in weight. Larvae depended on yolk sac reserves for up to 72 h. On the fourth day, hatchlings measure 6.5-7.0 mm in length and are released into a nursery tank for further rearing.

FIGURE 7. *Outdoor cement tanks for nursery rearing of pengba.*

Larval Rearing and Fry Production

The nursery phase involves rearing 4-d old hatchlings in earthen nursery ponds for 20-25 days until they grow to fry stage (20-25 mm). Generally, smaller seasonal ponds of 0.02-0.1 ha size with average water depth of 1-1.5 m are preferred for rearing. Nursery pond preparation prior to stocking of larvae includes removal of aquatic weeds and predatory fish, followed by liming and fertilization with organic manure and inorganic fertilizer. Aquatic insects are eradicated by the application of a soap-oil emulsion or removed by repeated netting before stocking. The recommended stocking density is 300-500/m^2.

Hatchlings can be fed with a supplementary feed made of a 1:1 mixture of rice bran and groundnut oilcake in powdered form. Powdered feed is broadcast over the water surface for easy availability to the seed. Survival ranges from 30 to 50 percent. Feeding larvae with live organisms, particularly zooplankton, have always proved best. There is a chance of mortality and poor growth of larvae due to a poor environment during pond nursery rearing (Table 1). For this purpose, concrete tanks (50-100 m^2) provided with a soil layer of 15 cm are effective for raising (Fig. 7). A stocking density of 1000-2000/m^2 is considered for good growth and survival in outdoor concrete tanks. Larvae grow to 20-25 mm fry during 20-25 days of rearing. Thinning of the population is required if the seed are to be retained beyond this period to avoid mortality. After that, resulting fry should be transferred to rearing ponds for fingerling production.

Fingerling Production

The rearing phase refers to the rearing of the fry in earthen rearing ponds (0.05-0.2 ha) with 1.2-1.5 m water depth for 2-3 months till they grow to fingerlings (80-100 mm) (Fig. 8). Standard pre-stocking management practices should be taken prior to the stocking of fry. The recommended stocking density is 30/m^2, but higher stocking density can also be used in well-managed ponds with water circulation and aeration. Normally survival of 60-70 percent is achieved in this rearing system. Generally, pengba fry are reared along with Indian major carps in ponds or tanks.

Nutritional requirements can be met through natural food along with a supplementary feed made of a 1:1 mixture of rice bran and groundnut oilcake in powdered form. Moreover, the COF-CAU developed the incorporation of *Wolffia globbosa*, an aquatic fern, as a sole food in fresh and dried form during fry rearing to be ideal owing to better pengba survival and growth rate.

Grow-out Culture

Earthen ponds or cement tanks are suitable for grow-out culture of pengba. A stocking density of 1/m^2 is recommended for culture of this species in monoculture. Fish are fed with pelleted feed (20-25 percent crude protein) at 3-5 percent of their body weight twice daily in two equal parts. Fish reach a market size of about 400-500 g within one year and production of 1.5-2 t/ha can be achieved. The rearing of pengba in grow-out polyculture with major and other carps has gained importance in India.

TABLE 1. Optimum water quality for rearing larvae and fry of *Osteobrama belangerii*.

Water quality parameter	*Optimum range*
Water temperature (C)	24-30
Dissolved oxygen (mg/L)	>4
pH	7.5 - 8.0
Alkalinity (mg/L as CaCO3)	80-120
Hardness (mg/L as CaCO3)	75-150
Ammonia (mg/L)	< 0.05
Nitrite (mg/L)	< 0.02

FIGURE 8. *Harvesting pengba fingerlings for stocking in grow-out ponds.*

Best Management Practices

- Hand nets or scoop nets should be used in the hatchery to handle broodfish.
- Avoid physical stress in broodfish caused during transportation from pond to hatchery.
- The quality of source water should be good and it should be available in sufficient quantity.
- In a breeding operation, post-spawning courtship behaviors can cause physical injury to spent broodfish. Timely separation of sexes should improve the situation.
- Care should be taken during larval rearing to avoid unnecessary mortalities.
- Feeding should be done carefully during cloudy days to avoid low dissolved oxygen concentration in the water body.

Challenges

Although induced breeding of pengba is not difficult, the main problem lies in fertilization, hatching success and early development of the fish. Large-scale mortality occurs in early development stages after absorption of the yolk sac. Proper feeding and water management ensures better production.

Notes

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