Pengba, *Osteobrama belangeri* – a candidate species for diversification in aquaculture

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Adult Osteobrama belangeri, locally known as pengba in Manipur, Northeast India.

With the emphasis on diversification of major carp polyculture systems in India, attempts have been made to incorporate other potential candidate species into the system. Diversification also offers the opportunity to contribute to conservation. *Osteobrama belangeri*, locally known as pengba, a highly esteemed minor carp which is listed as "near threatened" by IUCN has a high market demand due to its better taste and meat quality. Therefore, this species is considered one of the most suitable candidate fish species for aquaculture. Considering its suitability and compatibility with the major carps, it can be incorporated into the carp polyculture system thus enhancing the yield as well as utilising the wetlands of Manipur for a profitable venture. However, the species is faced with constraints such as non-availability of a suitable, nutritionally well-balanced feed for culture, and its susceptibility to bacterial infections at higher densities. This article summarises the culture aspects and technologies adopted as well as the prospects for pengba as a potential species for the diversification of polyculture, extra income, and livelihoods.

Pengba – a brief introduction

The State fish of Manipur, penga is a highly esteemed minor carp endemic to Manipur in Northeast India. Its natural distribution is restricted to Yunnan Province of China, Myanmar, and the eastern parts of Manipur. During the early monsoon season, *O. belangeri* has been reported to migrate from Myanmar's Chindwin River to the upstream areas of Imphal River and its tributaries in Manipur for breeding in the floodplains[1]. Wild populations of this species have declined significantly, resulting in its being listed among the 91 endangered fish species of India.[2] According to IUCN Red List status, it is categorised as 'extinct in the wild'[3]. In a survey conducted by the Loktak Development Authority, Manipur, it was found in Loktak lake[4] and hence, it was reclassified as 'near threatened'[5]. Due to the construction of the Ithai barrage on the Imphal river for the supply of water to the Loktak Hydro-Electric Project[6], a decline in the fishery of Loktak has been observed, owing to obstruction of breeding migration. Another possible reason was the introduction of the exotic common carp into the lake. Pengba has a great demand in the state of Manipur due to its value in the social and cultural life of the Manipuri people. The price of the fish ranges from ₹ 400-800 (US$5-10) per kg in the market of Manipur depending on the season. 93% of fish farmers had an annual income up to ₹ 50,000 (US$625) exclusively from Pengba fish farming[7]. Due to the conservation status of this endemic species and its contribution to farmer income, its culture practices need to be popularised.

Food and feeding habits

Pengba has an omnivorous feeding habit and consumes algae, small insects, aquatic plants, zooplankton, and diatoms.[8] According to Behera et al.[9], this species is suitable for pond culture because it is mainly herbivorous and thus, can be included in composite fish culture in place of grass carp. Based on the study made by Basudha and Viswanath[10], the fish showed herbi-omnivorous feeding habits where it feeds on a variety of food items with aquatic macro-vegetation being the predominant food item. However, the juveniles prefer zooplankton and other animal matter such as insects and worms. With the increase in the size of the fish, a higher preference is given to plant food items (leaves, stems, and roots) with aquatic plants constituting a major portion i.e., 40-60% of the gut content. It is also observed that the fish prefer *Wolffia* sp., a plant of duckweed family Lemnaceae, commonly called watermeal. Pronounced feeding activity was found during October to April whereas the feeding activity was low during the monsoon seasons (June to August).

Breeding biology

Pengba is a seasonal and riverine spawner and it normally spawns during the monsoon season (June-July).[11,12] Sexual maturity is attained in 2+ years[13] when it reaches a size of 200-250 g. Males mature earlier than females and peak breeding season has been found to be of short duration ie., the first week of July to the second week of August in the mid-hill condition. However, reproduction occurs in higher temperature conditions, with less precipitation, and a long duration of sunshine. Mature fish showed distinct sexual dimorphism as in males, the body is more elongated with no bulging of the abdomen. Alike major carps, pengba

Advanced pengba fingerling.

also exhibited secondary sexual characteristics during the breeding season such as in males, the roughness of the pectoral fins whereas fully mature females exhibit bulging of the abdomen. In accordance with Angel et al.[14], female fish are comparatively larger in the fully mature stage than their male counterparts. The relative fecundity has been recorded to be approximately 330,000 eggs kg^{-1} of body weight of a female brooder thus indicating that the fish is a prolific breeder. It breeds in riverine conditions during the southwest monsoon season however, it is not able to breed in confined waters without hormone injection[15]. Several trials have been made on induced breeding by ICAR,[13,15,16,17,18] and subsequently, ICAR-CIFA has succeeded in commercialising its captive breeding technology.

Wolffia sp., a free-floating aquatic plant preferred by pengba.

Culture aspects

Pengba has a high potential in composite culture practices depending on its compatibility as well as the types of feeding habits of the fishes. Its fingerlings are being reared along with the Indian major carps in ponds and the survival rate in these fingerling rearing systems ranges from 60-70%. Hence, the production of table-size fish is not sufficient to fulfil market demand. High survival (94.5%), as well as growth rates (784.8 kg ha^{-1}), have been reported in three months of culture with supplementary feeding[19]. Varying levels of *Azolla* in the feed preparation for the species have been tried and a promising survival and growth rate have been achieved. [10, 20, 21] Annual production of 14-15 tons ha^{-1} can be achieved by adopting the scientific carp culture procedure. Grow-out culture of pengba is mainly confined to earthen ponds and 92.9% of the fish farmers followed extensive or traditional pengba farming practices[7]. The general practice of pengba culture in Manipur is similar to a standard carp culture practice, which includes the general pond preparation such as control of predatory and weed fishes; stocking of fingerlings at a combined density of 4,000-10,000 ha^{-1}, pond manuring and fertilisation with organic manure like cattle dung or poultry droppings and inorganic fertilisers; feeding with a supplementary feed prepared from a mixture of rice bran and mustard oil cake, fish health monitoring and water management. The grow-out period is normally one year, during which it can attain a weight of 200-500 g, however, it can grow further up to 800 g in 8-10 months depending on the management level. In certain cases, the farmers carry out partial harvesting of market size groups (>200g) at intervals. Another common practice followed in Manipur is stocking of large-sized pengba fingerlings (12-15 cm) in combination with 2-3 major carp species @4,000-10,000 ha^{-1} density for single stocking and harvesting and at 10,000- 15,000 ha^{-1} density for single stocking and multiple harvesting.

Pengba culture technology

Pen

Despite the vast fisheries resources of Manipur in the form of beels, derelict waters, reservoirs, tanks/ponds, and rivers/ canals, the present fish production from these resources is far below their potential. The present productivity of wetlands stands at 75 kg ha^{-1} $year^{-1}$ against the potential productivity of 1,000 kg ha^{-1} $year^{-1}$ [2]. Most of the wetlands are being encroached on for agriculture and allied activities, hence, with improvement measures such as habitat restoration and fish stock enhancement following scientific methods, the productivity of such wetlands can be enhanced. Rational stocking of such wetlands with suitable fingerlings (>10 cm) in adequate numbers (3,000-3,600 ha^{-1}) will help to boost fish production as well as livelihood support[22]. However, major constraints such as the non-availability of fingerlings of the desired size, high costs, and mortality associated with long-distance transportation stress arise. Hence, to increase fish production, pen aquaculture can be a suitable technological option, especially for fingerling production to be subsequently released into wetlands.

A study has been conducted by Yengkokpam et al.[23] to assess the feasibility of culturing pengba along with Indian major carps and exotic carps in net pen enclosures in the Takmu pat, a part of Loktak Lake in Manipur, under the administrative control of the Department of Fisheries, Manipur with a water area of 500 ha in Bishnupur District. A square-shaped pen of approximately 0.1 ha area (31.62 m × 31.62 m) of nylon net (25 mm mesh size) was used. The pens were stocked @ 5 fingerlings m^{-2} maintaining a species ratio of 40% surface feeders (catla and silver): 20% column feeder (rohu): 30% bottom feeders (mrigal and common carp): 10% macrophyte feeders comprising of grass carp and pengba

Pond for semi-intensive polyculture of pengba and Indian major carps.

following the observations of Basudha and Vishwanath[24] so that all the ecological niches were occupied and ensured submerged aquatic macrophytes properly controlled. The results were that pengba attained the highest SGR and weight gain % attributed to the natural lake environment as well as the presence of submerged macrophytes. In pond aquaculture systems, pengba has poor growth and survival compared to Indian major carps[9]. Considering the economic performance, the BCR was estimated to be 1.37 depicting pengba as a potential species for carp polyculture in net pen enclosures, and one of the profitable culture options.

Monoculture and polyculture (species and feed fed)

Pengba farming can be done either in monoculture or polyculture as one of the components with the major carps. Better taste as well as a higher growth rate in ponds of the plain area[25] coupled with its good appearance to attract consumers makes it one of the potential candidates for introduction into the culture system. Ponds in the plain area are mainly utilised to culture the Indian major carps, which have a higher growth rate as compared to pengba. Hence, this species can be established in the plains by culturing along with the major carps rather than substituting any of the component species of the group. Pengba production in a short duration culture in five different locations of Imphal valley for seven months at an inclusion level of 10-15% of the total number of fish seeds stocked as demonstrated by Basudha et al.[26] reported a good growth rate (0.3-0.8 g day^{-1}) with a survival rate of 80-85% and a total production of 400-800 kg ha^{-1} in seven months. A series of experiments on the compatibility of pengba with catla and rohu as well as finding the ideal incorporation level with the three species of Indian major carps were conducted by Das et al.[3] in CIFA. In study I, pengba was stocked either with catla or rohu at a combined stocking density of 6,500 fingerlings ha^{-1}. Improved growth in catla and rohu was observed and indicated a lesser competition from pengba. Further, higher growth was observed in pengba in combination with catla thus revealing better compatibility in comparison with rohu. In study II, pengba was included at 20% with major carps (catla, rohu and mrigal) in grow-out ponds at stocking density of 6,500 fingerlings ha^{-1} and reared for 11 months, good growth and survival rate was obtained with a doubling in the biomass yield. In both the studies, the fishes were fed with a mixture of rice bran and groundnut oil cake (1:1) at approximately 5% of the biomass during the initial two months then weaning to extruded floating pellet feed (28% protein) at approximately 3 and 2% of the biomass in the subsequent months.

Future prospects – potential culture and researchable issues

Pengba forms an important component of carp culture serving as an extra source of income, hence seed production of pengba in captive conditions can be achieved on a commercial scale through induced breeding using pituitary gland extract, Ovaprim, Ovatide, and Wova-FH. Also, the consumer market for pengba is expanding gradually and research on standardising the culture technology is underway in R&D insti-

Experimental pengba culture tanks.

tutes of northeastern India and elsewhere[27]. An experimental setup of pengba culture at the College of fisheries, Central Agricultural University, Lembucherra is shown below.

One of the major issues of concern is the non-availability of a suitable, nutritionally well-balanced feed for culture as the detailed nutritional requirement of the species is not fully understood yet[27]. Another constraint faced is that pengba is susceptible to ulcers and columnaris diseases when it is stocked at higher densities as compared to carps thus, causing mass mortalities and thereby lowering production. Epizootic ulcerative syndrome caused by *Aphanomyces* and *Aeromonas* infections are commonly occurring diseases in pengba[8]. In addition, pengba is more susceptible to handling stress thereby complicating the seed transportation process[27].

Conclusion

Species diversification can be accomplished by exploiting new culture species and in this regard, the local species can be a good candidate. Diversification of species offers dual benefits in aquaculture viz., biological and economic. From the biological point of view, a wide variety of species availability allows the fish farmers to practice crop rotation (fish) thus allowing the pond to recover from unfavourable changes resulting from the culture of single species. Economically, more species favour more choices for consumer demand and thus help in the expansion of the market. Diversification brought many advantages such as less dependence on the wild stocks as well as the development of scientific techniques that help to optimise the yield i.e., polyculture using the native species like pengba thereby enabling the high yield with low inputs. Further research on modification of production technology as well as the development of breeding and culture technologies of other indigenous fish species are encouraged to sustain the aquaculture production along with improving the livelihoods of the people in the region.

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