Article Id
AL04479

BREEDING AND FARMING OF STRIPED CATFISH (*Pangasianodon hypothalamus*, Sauvage 1878): SUSTAINABLE PRACTICES FOR GLOBAL AQUACULTURE

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Pangasianodon hypophthalmus also known as striped catfish or iridescent shark and, plays a vital role in food security across many Asian countries, including Bangladesh, Thailand, Vietnam, India, and Malaysia. This catfish is ideal for inland aquaculture because it proliferates and is in high demand in European markets. Pangas is native of Mekong basin of Indochina. Its fast growth, strong market, and well-established farming methods have made it the third most farmed freshwater fish in India. This species was introduced into India clandestinely through Bangladesh around 1997 and began to be cultured in West Bengal. In India, about 300 to 500 million pangasius seeds are produced in West Bengal, with a significant amount sent to Andhra Pradesh for farming. Other states involved include Karnataka, Bihar, Chhattisgarh, Kerala, Rajasthan, and Uttar Pradesh. This species is widely cultivated in various aquaculture systems, including ponds, cages, and raceways, particularly in Southeast Asia. Pangasius is popular because it can reach 1.5 kg in six months, lower production costs, and thrive in varying oxygen levels. Consumers appreciate pangasius for its tender flesh and fewer bones.

In 2009, the Government of India officially recognized pangasius farming by establishing guidelines for its cultivation. Commonly referred to as the tiger shark, iridescent catfish, or Siamese catfish in the ornamental fish industry, *P. hypophthalmus* is highly valued for its attractive shape and graceful movement, particularly at the juvenile stage. Various fingerling varieties, including striped and albino, are cultivated for the aquarium trade. In their juvenile stage, they are primarily carnivorous and exhibit cannibalistic behavior. However, as they mature, their diet shifts to omnivores, predominantly comprising algae, plant matter, zooplankton, insects, fruits, crustaceans, and smaller fish. In aquaculture, the production of *P. hypophthalmus* is significant, ranging from 7 to 20 tonnes per hectare per year, and the average production is higher than carp production in the same areas, so farmers can get higher

production in the lower areas with low cost of production and also it will increase the economics of the farmer.

Maturity, Breeding, and Seed production

P. hypophthalmus usually matures after three years in the wild, but it can reach maturity in captivity as early as two years. The sexes can be easily differentiated. Females have large, soft, and swollen bellies that are reddish-pink, while males have reddish genital openings and release milt when their abdomens are gently pressed. Breeding occurs from April to mid-September, and a single brooder can be used at least twice during the same season. After hormone injection (Ovatide, Pituitary extract, or Ovaprim), the fish release eggs within 12-13 hours, which are then fertilized or by striping method. The fertilized eggs are rinsed in a milk powder solution in an aluminum 'hundi' to remove the adhesive gelatinous coating. After fertilization, the eggs go through water hardening within 20 minutes. The "blastodisc stage" developed at approximately 25 minutes' post-fertilization, followed by the "morula stage" at 3 hours and 45 minutes. The "blastula stage" was observed at 5 hours and 30 minutes post-fertilization. Twitching movements began between 24 and 26 hours after fertilization, while hatching occurred between 34 and 36 hours post-fertilization.

The newly hatched larvae measured about 3.80 mm in length, with a slightly bent head and a compact, yellowish yolk sac. Between 5 and 10 days of age, the pectoral, caudal, ventral, and dorsal fins began to develop. Boiled egg yolk supplemented with multivitamins was recognized as an optimal initial feed, introduced approximately 40 hours post-hatching at intervals of 3–4 hours. Between 60 and 96 hours post-hatching, the gradual incorporation of freshly filtered zooplankton (Rotifer and Artemia nauplii), in combination with diluted boiled egg yolk, administered at 3–4-hour intervals, resulted in enhanced larval growth. From the fourth day post-hatching until days 12–14, larvae were provided with a diet of diluted boiled chicken liver enriched with multivitamins. Furthermore, the administration of a combination of live *Tubifex* and Artificial Plankton Rotifer (APR) at 3–4-hour intervals between 36 and 40 hours post-hatching was found to be more effective than blended *Tubifex* alone, yielding significantly lower larval mortality rates.

Fig 1: Pangasius fingerlings (8-10cm)

Grow out Culture

Two types of pangasius fish cultivating are practiced by farmers. One uses monoculture, while the other practices polyculture with carp and other species. Monoculture is often preferred due to its easier maintenance compared to polyculture.

i) Stocking density

In India, fingerlings of ***P. hypophthalmus*** typically range from 4 to 5 inches in length, with corresponding weights between 50 and 100 grams. Farmers commonly stock around 25,000 fingerlings per hectare, with stocking densities not exceeding 30,000 per hectare. To minimize management challenges, most farmers prefer a single stocking of pangus fingerlings. The recommended stocking density for *P. hypophthalmus* culture in cages is about 40nos/ m^3.

Fig 2: 2-Month-old *Pangasianodon hypophthalmus*

ii) Feeding

Farmers use various local ingredients to feed the cultured pangus fish. Most commonly, they provide cooked de-oiled rice bran (DOB) and broken rice at a rate of 5% of the fish's body weight. They also incorporate locally available agricultural waste products and even discarded

potatoes into the feed. Additionally, bag feeding is a common practice among many farmers. Pangasius feed also commercially available in floating feed with 28 to 33% of crude protein (4 mm), where two times morning and evening per day.

Fig 3: Floating pellets for *P. hypophthalmus*

iii) Disease management

P. hypothalamus is a hardy species that can be cultured at high stocking densities. However, it is vulnerable to various microbial and parasitic diseases. Notable among these are bacillary necrosis in pangasius (BNP) caused by *E. ictaluri* and motile aeromonas septicemia (MAS) caused by *Aeromonas* species, primarily *A. hydrophila*. Additionally, as a scaleless fish, Pangasius is particularly susceptible to the protozoan parasite *Ichthyophthirius multifiliis*. To avoid these diseases frequent check-up the fish and reduce the over stocking.

Heavy mortalities have been observed, with affected fish showing symptoms such as off-feeding, circular motions, and other signs of distress. Fish of all sizes, ranging from 5 g to 1.5 kg, have been impacted, leading to significant losses for farmers. Parasitic diseases are prevalent, and occurrences of "red disease" a form of hemorrhagic septicemia, have also been confirmed in *P. hypophthalmus* from grow-out farms. In some cases, swelling of the liver has been noted. Microscopic examinations of the gills using squash preparations from infected fish reveal a moderate presence of *Trichodina* parasitic infection.

Various chemicals have been tested to prevent Ichthyophthiriasis, including malachite green, malachite green combined with salt or formalin, formalin alone, chloramine-T, potassium permanganate, and copper sulfate. Several reports indicate that combining malachite green and formalin is the most effective alternative. Additionally, salt is one of the most commonly used treatments in freshwater tropical fish culture.

iv) Harvesting and Marketing:

P. hypophthalmus weighing over 1.5 kg is preferred for harvest and sale. In some regions, these fish are typically marketed at ages 8 months and 1 year, though farmers may start harvesting as early as 6 months. Many farms implement multiple harvests throughout the year. Chilled storage is the most commonly used active packaging technology, extending the product's shelf life to 20 days.

Fig 4: Harvest

Conclusion

The culture of *P. hypophthalmus* has gained substantial economic importance due to its fast growth, high adaptability, and market demand. Its ability to thrive in different water conditions and its omnivorous feeding habits make it a cost-effective option for commercial fish farming. Economically, *P. hypophthalmus* plays a key role in the global seafood trade. It is a major export product, contributing to employment, food security, and foreign exchange earnings in many countries. The species' affordability and good taste have made it popular among consumers worldwide, additional increasing its market price. Despite its economic welfares, the sustainability of *Pangasius* farming depends on responsible and sustainable aquaculture practices. Ongoing research and improvements in breeding, nutrition, and disease management are going to be key for keeping the industry growing and sustainable.

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