Prospects of breeding and seed production of Stinging Catfish, Heteropneustes fossilis (Bloch)

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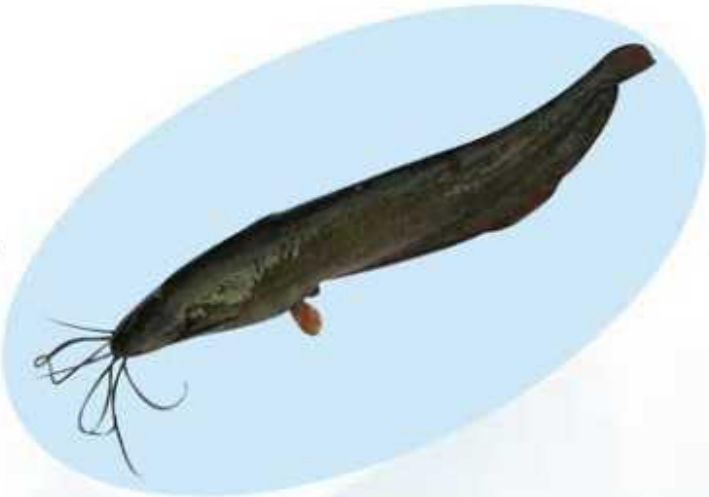
About the stinging catfish

The Indian catfish,Heteropneustes fossilis (Bloch), is commonly known as the stinging catfish or singhi. The singhi is considered as one of the most highly demanded freshwater fish species in the Indian subcontinent and Southeast Asian region. It belongs to the sub-order Siluroidei and the family of Sacchobranchidae. The range encompasses from India, Thailand, Bangladesh, Pakistan, Nepal, Sri Lanka, Myanmar, Indonesia, and Cambodia. It is also considered one of the very popular and highly prized freshwater food fish species due to its tender and delicious meat. It has good consumer preference due to its nutritional and medicinal.



Recently, the farming of singhi catfish and other air breathing fishes has gained much importance among the Indian fish farmers. Further inherently they are hardy fish, resistant to diseases, handling stress, ability to tolerate a wide range of environmental parameters and high stocking densities under culture conditions, fast growth rate, fewer intramuscular spines, and good quality. They possess accessory air-breathing organs which allow them to breathe atmospheric oxygen. Besides, the fish can thrive in harsh environmental conditions in muddy, turbid, and oxygen-depleted water bodies. Due to these adaptive abilities, they thrive in all kinds of shallow freshwater habitats such as marshes, paddy fields, swamps, streams, lakes, and irrigation canals. Generally, they are carnivorous and feed on insects, plankton, and snails in the natural water bodies. Hence, it is one of the ideal fish species available for successful low-cost farming for small-scale fish farmers.

Any successful small-scale fish farming requires simple breeding and seed production methods and culture practices. It is easy to breed and grow under captive conditions and does not require high technology. The main constraint in the expansion of catfish culture in India is the lack of an adequate and reliable supply of catfish fry and fingerlings for fish culture.They are highly cannibalistic when substantial differences in size occur. Hence it is apparent that simple protocols covering induction of egg production, egg hatching, and particularly larval rearing techniques that enhance fry and fingerling survival need to be further simplified to ensure a sufficient supply of catfish seed. This article presents a simple and low-cost seed production technology for Singhi catfish, Heteropneustes fossilisfor small-scale fish farmers. The breeding and feeding techniques are very simple and theycan be adopted and practiced by any fish farmers.

Reproductive biology

Catfish breed naturally during the southwest monsoon and northeast monsoon seasons in flooded rivers and ponds in southern parts of India but, the absence of the monsoons often limits seed production. It attains sexual maturity at one year of age when the male is generally 5.5 cm and the female is 12 cm in size in the natural habitat. It spawns one or two times a year in the natural environment in flood plains during the rainy seasons. The fry collection from the wild is unreliable and limited to the rainy season. Although stinging catfish reproductively mature in captive conditions, they rarely spawn naturally in captivity and hence to overcome these problems, induced spawning is thought to be the only alternative method for quality seed supply and production. Sexes are separate in catfish and visible and easy to identify male and female fish. Males have elongated urino-genital papillae near the anus region, whereas females have a simple round opening. Morphological features like a bulging abdomen, and slightly reddish and protruded genital papilla-like structures with blunt tip can help in determining the maturity of female fish. The fecundity of the species is higher than other freshwater fishes which ranges from 2000 to 5000 eggs per female with body weight ranging from 75 – 250 g respectively.

Broodstock management

The establishment of catfish farming requires a consistent supply of good quality seed, necessitating captive breeding; careful broodstock management, and suitable larval rearing techniques. Catfish broodstock can be obtained from natural water bodies, rivers, ponds, and fish farms. For best breeding performance, brood fish should be more than 1 year old at least and should be more than 75 g body weight for both males and females. Brood fish should be collected several weeks in advance of spawning to minimize stress and transportation injury. They can be stocked in circular or rectangular cement and plastic tanks at a stocking density of 10-20 fish square meters. A minimum water depth of 60 cmis recommended for catfish. A weekly water exchange of 50–75% can be made to maintain the water quality parameters within the favorable ranges.The quality and quantity of feed, as well as the feeding regime, are important for spawning as well as egg quality. They are carnivores and mainly feed on small bottom-dwelling animals in natural conditions, but animal bio wastes, trash fishes, and formulated feeds can be offered as feed.

Broodstock can be fed with a commercial formulated diet with 35- 40% protein levels twice daily at ad libitum. Larger mature females produce more eggs than smaller females. Proper care and acclimation of bloodstock will improve egg quantity and quality.

Induced spawning and seed production

The two sexes can easily be distinguished by the shape of the belly and by the form of the genital papilla. Milt can not be squeezed from males as with other freshwater fish species like carp. Milt from 2 males with a body weight of 100 g can fertilize the eggs of ten females of similar ages and sizes. Final maturation of eggs and sperm and release of eggs from the female ovary are induced by injection of both males and females with appropriate dosage of spawning agents. Several inducing agents and dosages have been studied and reported in catfish. Based on our previous experience 0.4 ml of synthetic hormonal preparation (ovaprim or ovatide) per kg body weight of fish is sufficient to stimulate the final maturation of eggs and sperm. Fishes are removed from the holding tank and thebody weight is measured immediately for determination of hormone dose. For hormone injection and handling the fishes can be immobilized by partial wrapping of the body in soft-textured cloth or tissue papers.

The selected fishes are administered intramuscularly. The administration of hormones to the fish must be injected in the muscular region just below the anterior part of the dorsal fin and just above the lateral line. Immediately after hormone administration, the male and female fishes are separately released into the cement tanks or circular plastic tanks until the recommended latency period of 10 to 12 hrs at 28–30 °C. The broodfish holding tanks should be covered with plastic nets. After 10-12 hours of hormone injection male and female fishes arecarefully collected from the tank for eggs and sperm collection. The body moisture of fish is blotted with a paper towel or cotton cloth and the water should not drip into and mix with egg mass while striping of eggs. Eggs are striped manually from females by applying slight pressure on the abdomen toward the genital pore and then eggs are collected in a dry circular plastic container. The testes are surgically removed and placed into a petri dish.

Testes tissues are cut or chopped into small pieces using a scalpel or single-edged razor blade, mixed with about 5-10 ml tap water, and then macerated to obtain sperm suspension. The suspension is then added to the eggs immediately upon preparation and evenly mixed for fertilization. The egg mass with sperm is swirled gently to mix properly. After 10 – 15 seconds, water is added to cover the eggs to stimulate the motility of the sperm and fertilize the eggs. After five minutes the eggs were subsequently washed thoroughly with clean chlorine free aged tap water. During this time any testis debris and tissue particles need to be removed from the mixture. The eggs are transferred to a glass aquarium/cement tank for hatching, with constant aeration. The eggs began to hatch after 20 – 24 hrs hours at 28–30 ºC (Fig A-D).

Larval rearing

The Catfishlarvae are very delicate and require utmost care for their growth and survival during hatchery rearing. The hatched larvae are separated from unfertilized and dead eggs. The newly hatched larvae are 2.0- 3.0 mm in length. They are released in rectangular glass aquariumsor circular polythene pools or cement tanks for further rearing. The tanks are filled with chlorine free clean tap water with gentle aeration. During this time the larvae migrate to the corner of the rearing containers and aggregate in patches. Initially, the water level of containers needs to be maintained at 5 – 10 cm and gradually increased to 20 – 30 cm after one week. Water levels need to be adjusted at different stages of rearing to minimize the stress on larvae. On the third day, the yolk sac is fully absorbed and the mouth is well formed and readily accepts exogenous feed. From day three onwards, the larvae can be fed with small live plankton harvested from earthen ponds and/or Artemia nauplii and frozen moina until day 15. Boiled egg paste or artificial crumble feed can be used as a feed for larvae from the 10th day after exogenous feeding until day 20.The supply of live plankton can be withdrawn gradually during the rearing period of 10-15 days. This mixed feeding not only enhances growth but also ensures a higher survival rate. The early larvae are sensitive to light and hence few plastic pipes need to be provided in the rearing tanks to give shelter for the larva. Higher stocking density in the larval rearing phase will affect growth and survival due to overcrowding stress. From day 20 onwards until day 30, the fry can be fed ad libitum with commercial feed crumbles containing 30 – 35 % protein and 7 % lipid. The daily feed ratio should be best divided into three to four meals a day

Broodstock Inherent size variation and cannibalism are also one of the problems of the culture of this fish species. Frequent size grading is advisable to avoid cannibalism and increase the survival rate in the larval rearing stage. Fry can be further reared in cement for anothbe fed with a commercial formulated diet with 35- 40% protein levels twice daily at ad libitum. Larger mature females produce more eggs than smaller females. Proper care and acclimation of bloodstock will improve egg quantity and quality.

Cement tanks may be used for nursery rearing. Rearing of fry in earthen pond conditions may not give a good survival rate due to natural mortality or predation by predators. Small sized cement tanks of 10-20 m2 are preferred to monitor the survival rate and to avoid predation. These cement nursery tanks are provided with a 2-3 cm soil base and a water level of 10-20 cm. To promote the natural algal and plankton production a single dose of cow dung 2-3kg are applied for this size of tanks. The tanks are then inoculated with plankton collected from earthen ponds. After 4 days of preparation, the fry can be stocked. The fry should be stocked after the development of a plankton bloom in the nursery tanks. The sizes of 50- 60 mg fry are suitable for initial stocking in nursery tanks. They are reared at a density of 100-200 fry/m2. Increasing stocking density usually results in stress (aggressive behaviour, dominance) which leads to size variation in growth among the fingerlings and also reduces the survival rate at harvesting. During these periods the fry should be fed with pellet feed at the rate of 5% body weight twice daily. The feed ratio needs to be increased by a weekly sampling of fish biomass. Appropriate feeding is very important because an inadequate food supply has a direct impact on fish growth and production costs. The excess unconsumed feed and waste matter during nursery rearing pose problems for maintaining water quality. Therefore, once in two weeks water must be exchanged for good growth and survival. Growth heterogeneity has been associated with cannibalism and therefore with mortality. Hence size grading of fingerlingshas to be routinely performed to minimize growth variation and reduce cannibalism. The nursery cement tanks should be covered with nets to prevent birds and other predators. The fingerlings thus produced can be harvested depending on the demand. Usually, the fish grow up to 2 - 5 g in size within 30 days of nursery rearing, with a survival rate of 50-80%.

Water quality management during larval rearing

Larvae of catfish are small, sensitive, and delicate and they require a good aquatic environment for their survival. Water quality management is an important aspect during the rearing of catfish larvae. Hence good quality and appropriate water depth during the indoor rearing phases are maintained. Aerial respiration commences after 10-12 days and hence, aeration must be provided to the larval rearing tanks by aerators. Accumulation of metabolites and unconsumed feed in the rearing tanks pollute the environment and ultimately lead to oxygen depletion, disease incidence, and mortality.

Therefore, it is advisable to clean the bottom of the tank and renew 50-60% of the water daily to maintain a 20-30 cm depth. Care should be taken to minimize the stress on the delicate larvae while exchanging water from the tanks. The waste from fry and unconsumed feed in the rearing tanks under high-density rearing produces ammonia and hydrogen sulphide. Ammonia is toxic at low concentrations affecting the gills and accessory respiratory organs, whereas hydrogen sulfide causes stress to the fry. Aeration and frequent water exchange are required to get rid of the above problems.

Conclusion

In India, there is a huge demand for stinging catfish, which also commands a high market price. Numerous farmers have begun to cultivate catfish, and the demand for catfish seed has been steadily rising.The technology for breeding and seedproduction has been developed and the technique is very easy to be adopted by fish farmers. The growth and survival of larvae and fingerlings depend on the careful management of rearing tanks, feeding, and size grading. It has been felt that the production of catfish depends on the availability of high-quality seed and careful control throughout the larval rearing phase. For successful growing and lucrative catfish aquaculture, more concerted efforts and attention must be given throughout the early larvae, fry, and fingerling stages of rearing.

A. 2 cell stage

B. 20 hrs old embryo

C. Newly hatched embryo

D. 48 h old hatchlings