Recent trends in seed production of stinging catfish, *Heteropneustes fossilis*, in India

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The search for potential new aquaculture species for pond culture has been continuing under different aquaculture research and development programs. These studies gather knowledge about candidate fish species and their performance during production. Many times, hatchery owners and farmers have faced failure after adopting a new fish for production without adequate knowledge of its needs and characteristics. It is essential to know the habit, habitat, feeding and effective husbandry practices of a species before attempting commercial culture. Successful research on new candidate species should be followed by training and demonstration, as key activities during the broad adoption of any species for aquaculture in India.

India is considered a "carp country" due to its sizable carp aquaculture production, owing to effective research and development programmes undertaken over the last four or five decades. In addition, the wild harvest of different varieties of prawns, air-breathing fishes and catfishes also represent a considerable share of the total freshwater fish production of India. Catfishes are in high demand among Indian consumers, but due to cumbersome management, many species are yet to be adopted by farmer communities even after successful research and demonstration. The wide adoption of *Pangasianodon hypophthalmus* and tilapia in recent years has been facilitated by their high growth and production from the pond culture. The indigenous *Clarias magur*, *Heteropneustes fossilis*, *Ompok bimaculatus* and *Mystus* spp. are also coming up to a lesser degree. The demand for *H. fossilis* seed is increasing as it is a good fish species with high protein and less fat. Many hatchery owners that produce *C. magur* are also producing the seed of *H. fossilis* following a similar procedure pertaining to captive production of *C. magur*. However, seed production is sub-optimal without complete knowledge of *H. fossilis*. Hence, this article summarises what is known of its biology and effective husbandry, to improve production of seed of this valuable catfish.

Healthy broodstock of H. fossilis.

Stripping of female for the collection of eggs.

Brief biology

H. fossilis is distributed throughout many Asian countries including India, Pakistan, Bangladesh, Nepal, Burma, Sri Lanka, and Cambodia. This freshwater catfish inhabits ponds, tanks, swamps, paddy fields and low-lying impoundments. It is a dark purplish brown in colour with a small head that is greatly depressed. The mouth is small and terminal with vomerine teeth. The dorsal fin is small and without spine, and present just opposite the pelvic fin. The pectoral fin is serrated and dreaded for its poisonous nature. The anal fin is continuous and extends up to the caudal fin. Respiration can be achieved via a combination of the gills, skin and through an accessory respiratory organ, which is a tubular structure extending from gills to the dorsal side of the body. This catfish is omnivorous in nature and feeds on insects, worms, small fish, and fish remains, plants, and organic debris. It grows to 20-30 cm during 2-4 years of life. It is considered to be a monsoon breeder and matures in its first year both in nature and in captivity. Sexual dimorphism is prominent during the spawning season.

Broodstock management

The production of healthy broodstock is an important activity for successful breeding of any fish. Breeding failure is minimised due to sufficient knowledge of maturation, type and dose of hormone used, time needed for stripping and so on during induced breeding operations. The researchers or farmers raise the broodstock in confinement after collecting wild or stocking hatchery produced juveniles. Care must be given to avoid injury during transportation. Similarly, high-density transportation may be discouraged to avoid stress during post-stocking. The chance of disease incidence in stressed or injured fish cannot be ruled out after few days of release in the rearing tank or pond. It is always better to rear the fish in an indoor system for few days before final release to the broodstock pond for rearing. The broodstock are reared in cement tanks or earthen ponds at a population size of 3-4/ m^2. High density rearing may invite feeding disparity among the fish and has an adverse impact on water quality. These conditions contribute to disease outbreaks during the winter months.

The catfish needs at least 30-32% protein it its feed. Sinking feed in the pelleted form is provided through feeding baskets in multiple places to avoid crowding. This feeding method also reduces the wastage of feed to a larger extent. Feeding once @ 2-3% of body weight or twice daily with a divided meal is sufficient to raise healthy broodstock. We have also often observed that left over feed and faecal matter will cause the water quality to deteriorate, so intermittent water changes are necessary to maintain good conditions.

Fish should be harvested from the pond just prior to the breeding season to avoid problems in obtaining broodstock during the monsoon months. The greater height of water in ponds during the monsoon months and bottom dwelling nature of the fish may make it difficult to collect sufficient broodstock for breeding operations. Hence the harvest of broodstock during the pre-monsoon time and rearing them in tanks can avoid such problems.

Induced breeding

H. fossilis is a monsoon breeder. The species is found gravid in the wild during July-September. The sexes are well differentiated morphologically during breeding season. Suitable females and males are distinguished by a bulging abdomen with round genital papilla, and slender abdomen with pointed papilla, respectively. The uniform size of intra-ovarian eggs collected through catheter also indicates the maturity of females. Researchers have successfully bred the fish by injecting pituitary extract, commercially available synthetic hormone (Ovaprim/Ovatide/Wova-FH), LHRHa and pimozide, 17α-hydroxy-progesterone and 17α, 20β-dihydroprogesterone. Hatchery owners try to use a synthetic hormone easily available on the market as inducing agent. An injection of up to 1 ml/kg body weight is sufficient to induce ovulation and the female is ready for stripping 10-11 hours post-injection. The male of this species does not ooze milt freely. Hence, sperm suspension is prepared by the maceration of dissected testes with normal saline solution. The ovulated eggs with sperm suspension are mixed with the addition of a little freshwater for fertilisation. Sperm suspension from one male is sufficient to fertilise the eggs produced by two females similar in weight to the male.

H. fossilis is a highly fecund fish, with10-15 thousand eggs obtained from 100-150 g fish. The eggs are deep green in colour and range in size from 1.4-1.6 mm. Eggs are incubated in containers with stagnant or slowly running water. Containers with stagnant water may be provided with a shower to avoid oxygen depletion during incubation. The fertilised eggs reach morula stage after about two hours of incubation and frequent twitching, or movement of the embryo is visible after 14-15 hours of incubation. Hatching starts after about 16-17 hours, when the water temperature ranges 27-28˚C. The newly hatched larvae are 2.5-3.0 mm size.

Operated testes before collection to prepare sperm suspension.

Feeding of larvae with compound feed during larval rearing.

Healthy fry before stocking into fingerling tanks.

Natural breeding

Natural breeding under hatchery conditions is possible in this catfish, in addition to induced breeding by stripping. This benefit of this method is that it avoids sacrifice of the males to fertilise the stripped eggs. Good broodstock of both the sexes are selected as described earlier. Males and females of similar weight are usually chosen during pairing and kept at a 1:1 ratio. The females are injected with synthetic hormone in the same manner as induced breeding. The males are injected with hormone at half the dose of the female fish. Use of additional males may not be of much benefit in in increasing the fertilisation or ovulation rate during peak breeding season. The same male can be used for breeding again after 15-20 days.

The fecundity in natural breeding usually ranges between 8 to 13 thousand eggs in females of 90 to 160 g. Winter breeding (November - January) of this fish is also possible and has been verified during hatchery breeding, but fecundity is reduced compared to fish bred during the normal breeding season. Females of 80-140g usually lay 4,000-9,000 eggs through natural breeding during the winter period. Hatching is also reduced during the off-season, which is an unacceptable factor for farmers as the net output of seed is low. We have observed that the larval growth and survival are drastically reduced due to low water temperature of <20˚ C during the winter months. The fish do not respond to attempts to induce breeding during February. While verifying the cause of failure, we observed that the ovary size was considerably reduced with the accumulation of fat in the abdomen of female.

Natural breeding has an advantage of not having to wait to strip female fish and not having to sacrifice the males for the preparation of sperm suspension to fertilise the eggs. Females were also observed laying eggs completely. Hence this method may be better for farmers to save time and may also be utilised for different aquaculture related works. Many farmers are undertaking breeding by this method. The eggs laid by the females in the tank are not disturbed further and the incubation of eggs continues till hatching. However, the spent male and females are taken out from the breeding tank after egg release. The water is reduced and renewed with water introduced by a showering method to maintain oxygen, helpful during embryonic development.

Larval rearing

The larvae are tiny, slender in appearance and active in nature. Their yolk sac is fully absorbed in the third day of life, which serves as reserve feed. The larvae are ready to accept feed after three days during captive rearing. Mixed zooplankton, *Artemia* nauplii or chopped *Tubifex* larvae remain the best feed during larval rearing. On many occasions we observed that provision of artificial feed after yolk sac absorption did not yield good growth and survival. Early weaning with artificial feed leads to reduced growth rate and high larval mortality, which may be due to improper development of the digestive system as well as lack of digestive enzyme secretion. The continuous feeding of live feed for up to a week followed by the supply of artificial larval feed with the gradual withdraw of live feed, has proven to be the best feeding strategy for the larvae.

Haul of H. fossilis fingerlings.

Low-cost polythene tank constructed by farmer for raising fingerlings.

A good rearing environment also plays a vital role for successful rearing. The larvae are completely dependent on good water quality to survive, and adequate dissolved oxygen levels aid them in respiration during their initial days of their life. There is every chance that water quality will deteriorate as the larvae are reared in stagnant water. The dead live feed and faecal matter of larvae on the tank bottom reduce water quality by lowering dissolved oxygen while increasing levels of toxic nitrite and nitrate. Larvae exposed to this type of environment remain in a stressed condition, which leads to secondary infection. Hence, cleaning of the tank bottom with replenishment of two-thirds of the water every day is very much essential for their further growth and survival.

We have also seen that high density rearing of larvae invites sudden mortality due to stress. This situation usually happens when there are a lot of hatchlings from the breeding operations and a limited number of rearing tanks. In such circumstances, larvae must be thinned out after few days to avoid the chance of sudden mortality. Larval growth is also affected by high density rearing. These weak larvae suffer from high mortality while on grown for fingerling production. Larval density is usually best maintained within 2,000/m^2 for high growth and survival. Many farmers also stock much less to promote high growth, which helps them to obtain a good sale price. Larvae grow to 20 mm in length and 20-25 mg in weight during a two-to-three-week rearing period.

Fry rearing

The fry obtained from larval rearing tanks are utilised for raising fingerlings. Farmers and researchers often rear them in cement or earthen nurseries. Survival is observed to be low in earthen nurseries due to early mortality of tiny fry. Hence farmers prefer to rear them to larger size in a cement nursery. Rectangular or circular nurseries formed from polythene sheets is less costly and is constructed by farmers to rear the fry for fingerling production. Recovery of fingerlings and their growth play a major role on the production and profitability of a hatchery as the fry of this catfish are sold occasionally. Hence it is necessary to stock within 200/m^2 to get good growth and survival.

Good feeding practices also play a crucial role during the rearing of these tiny fry. The tank must be provided with shelter to satisfy their behaviour of hiding. Feed in the form of a sticky dough is provided to fry near their shelters to promote uniform feeding. Many fry do not utilise the shelter and spread in the rearing tank. Hence the dough must be placed in a few places dispersed over the tank, to ensure feed is available to all fry. Dough feeding must be changed to crumbled feed after 8-10 days of rearing.

Shooting growth among the fry is seen after 3-4 weeks. It is better to harvest the shooter fry to avoid unequal feeding between them. The water depth should be kept as low in the range 30-45 cm as this fish has an air breathing nature and comes frequently comes to the surface during the morning and evening hours. Higher depths may cause unnecessary consumption of energy, which may reduce the somatic growth of the fish.

Development of filamentous algae is often encountered in the rearing tanks due to rearing in clear and shallow water. It is necessary to remove algae at regular intervals to avoid oxygen depletion, difficulties in free movement of fish and during feed distribution as the feed can become entangled in the algae.

Observing the management measures described above will maximise growth and survival, and the harvest of healthy fingerlings.

Health management

It is always necessary to provide a good environment to reduce health problems. Stress induced disease incidence is often seen in different life stages of this catfish during their transportation or rearing in captivity. Long exposure in water containing high ammonia also invites disease. During these phases the fish show slow movement and loss of appetite. Hence it is necessary to maintain water quality through regular water exchange. We have observed that the fish are also more liable to get infected during the winter months. Common conditions are wounds on the body, loss of barbels and ventral or tail fins in fingerlings and adults due to bacterial infections. Fish can be treated with CIFAX @ 1L/ha water area, but recovery depends on the severity of the disease.