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Defect in dissemination of fish breeding and other related technologies raise a question of sustainability to the aquaculture sector of three eastern states of India

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ABSTRACT

Through the implementation of induced breeding technology into farming condition, fish production from inland sector increased substantially from 0.9 million tones in 1977-78 to 1.54 million tones in 1990-91, as the major hatcheries in Bengal has come up in 1980's. Following the Bengal, the fish breeders of Assam and Bihar started establishing hatchery after getting primary training from Bengal breeders. Within very short period of introduction of technology, the greedy and ignorant farmers of the three states started practicing improper breeding practices like mixed spawning, use of small number of breeding population and indiscriminate hybridization for their profit and convenience.

Mixed spawning leads to hybridization inadvertently and ultimately affect the native gene pool. Maintenance of small number of founder population leads to inbreeding and the obvious genetic consequences are the increased fry deformities (37.6%), decreased food conversion efficiency (15.6%) and fry survival (19%). Again the undesirable hybrids when find their way into natural system results in "genetic intermixing" and affects the genetic biodiversity of the native fish fauna. Along with these the fish breeders are introducing alien fishes almost every year without maintaining any code of practice. This alien introduction and repeated use of unauthorized drugs and feeds (composition totally unknown) severely affecting the native biodiversity and unless checked early it may lead to the extinction of some of the prized fishes of India.

Keywords: Mixed spawning; Genetic intermixin; inadvertent hybridization; prized fishes.

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Introduction

Indian carps are seasonal breeders and gonadal recrudescence in these fishes occurs at vernal equinox i.e. on 22nd March prior to breeding seasons. These fishes develop eggs within but can not shed them in captivity. To overcome the demerits of natural collection of spawn, the technologies of Induced breeding otherwise known as hypophysation was developed in experimental condition. The technique later transferred to field condition which revolutionized the fish seed production and trade in Bengal in particular.

It is observed that Bengal fish seed producer/Hatchery owners, being illiterate and totally unaware of the scientific basis of the technology; inadvertently use the technology only for profit making purpose. In most cases the farmers learn the technology from neighboring farmers and there is complete absence of any institutional transfer or training programe and follow-up action. The Bengal farmers adopted the technology very well and shouldered the responsibility to produce more than 70% fish seed requirement of the country. At the same time, the farmers modified and refined the technology time to time with their innovative approach.

Now, with the standardization of the technology and entry of more and more entrepreneurs and business sector, a competitive approach developed among the fish seed producers. This led the farmers to adopt some unfair means and use the technology for profit making purpose. This includes mixed spawning, indiscriminate hybridization and introduction of alien species from neighboring countries. Added to this the farmers out of ignorance never considered potency of the gland and started using immature fishes due scarcity of fishes during breeding seasons. This entire phenomenon resulted in serious genetic consequences like inbreeding, drift and genetic introgression. The obvious consequences are the negative impact on stock integrity and genetic biodiversity of the native fish fauna. Target oriented research programe, need to be initiated to check the further loss in biodiversity and maintaining sustainability.

Materials and Methods

The study conducted involving the leading hatchery owners in some of the major seed producing districts of West Bengal. A questioner schedule was prepared and detailed on field information was accounted based on the schedule. Fish breeders were interrogated and detailed information were documented regarding the present mode of the application of the technology. The data were compiled and presented in the text. The photographs presented in the text were taken during the field study.

Results and discussion

Inducing Agent

All most all the Fish breeders of the state of West Bengal and Bihar use carp pituitary extract (CPC) as the only inducing agent, but the fish breeders of Assam state use synthetic inducing agents like Ova prim, Ova tide and Wova-FH etc. In most cases the fish breeders use the pituitary extract as its cost is six times less then that of the synthetic product and due to its easy availability. Besides the fish breeders believe that CPC is better, may be due to its organic origin. Potency of the gland is never considered as the farmers are totally unaware about how varied potency may cause reduction in ovulation in female brood fishes, which ultimately results in reduction in population size (Padhi et al, 1994). Again a considerable number of the fish breeders used the Crude pituitary extract instead of supernatant produced by centrifugation. As we known that the fish breeders received the supply of gland from gland collectors who in turn collect the gland from dead and preserved fishes from the market. Often batches of these glands are rotten and fall short of desired potency. Again, the crude extract contains pathogenic microorganisms causing infection to fishes. Moreover, pituitary GTH is a glycoprotein, which is very much sensitive to temperature denaturation (S. Bhattacharya, 1999). The farmers select the glands which are light brown in color for extract preparation.

Mixed Spawning

Induced breeding of carps generally undertaken in breeding pool. During breeding season the fish breeders perform breeding operations of these Indian carps in the same breeding pool as it is not possible to provide such huge masonry structure for individual species. The ignorant fish breeders inadvertently adopt ‘mixed spawning for sake of their convenience and profit (Plate.1).

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Plate.1, Mixed spawning of Labeo gonius and Grass carp

Mixed spawning leads to hybridization inadvertently and as a result inter-specific and inter-generic hybrids are produced as in nature (Natarajan et.al, 1976). Natural hybridization in fishes may be attributed to genomic plasticity and external fertilization (Padhi, B.K., 1987). These hybrids are then distributed to diverse geographical region as well in natural habitat.

Purposeful Hybridization

Besides mixed spawning the fish breeders also undertake indiscriminate hybridization only for profit, convenience and to compromise with the demand from farmers. In all cases the hybridization is mainly undertaken by stripping (Plate.2).The non-availability of brood fish may be the one reason but knowingly the fish breeders adopt hybridization, as the hybrids are more potent to overcome the stock of transportation. By supplying these hybrids they not only befouled the farmers but inviting alarming genetic consequences on native fish

Plate.2, Stripping of C.mrigala ♂ x Labeo bata ♀

fauna. This type of inadvertent hybridization of Indian major carps and back crossing of hybrids with parent would certainly invite genetic introgression and contamination in gene pool of these native fish fauna. Genetic introgression already demonstrated in the hybrids of Tilapia (ICLARM, 1991) and cutthroat trout (Gyllensten et.al, 1985). One sad experience of purposeful hybridization is of the domestic common carp (Cyprinus carpio) with its wild living ancestor, wild carp. These resulted in contamination and deterioration of economically important traits of both (Fig.1a and 1b; Kirpichnikov, V.S., 1981). Another such example is the hybridization of Acipensor sturio (giant sturgeon or beluga) with Acipensor ruthenus (Starlet). Though these hybrids inherited useful cultural traits from both the parents (Nikoljukin, N.I., 1971) but would cause considerable contamination of the sturgeon stocks (Kipichnikov, V.S., 1981).

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Domesticated Cyprinus carpio x Wild Carp

⇩

Contamination in wild & domestic carp

⇩

Deterioration of economically important trait

Fig. 1a, Examples of purposeful hybridization in cyprinus

Acipensor sturio x Acipensor ruthens

⇩

F 1 ⇒ Besters (posse's useful properties)

⇩

Released into rivers

⇩

Causes contamination of sturgeon stock in wild

Fig.1b, Examples of purposeful hybridization in sturgeon

Till date the following hybrids (both inter-specific & inter-generic,) are produced in farming situation.

Rohu male X Catla female – Nadeem (Plate.3).

Plate .3, Nadeem (hybrid of Rohu male and Catla female)

Catla male X Labeo rohita female (Plate, 4)

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Plate.4, Hybrids of Catla male and Labeo female

Rohu male X Mrigal female – Bullet. (as they are known locally)

Silver carp male X Bighead female – Siluri (as they are known locally)

Bata female X Mrigal male – Hybrid appears like bata.

Japani Punti male X Common carp female – Hybrid morphologically Common carp like.

Rohu female X Mirror carp male – Cultural traits:

Mouth and body Rohu like.

Growth rate less than Rohu.

One middle row of scale.

Blackish in color (Plate.5).

Fertile.

Plate .5, Hybrid of rohu female and mirror carp male

Catla female X Mirror carp male – Cultural traits:

Mouth and body like Catla

Only One middle row of scale (Plate.6).

Plate.6, Hybrid of Catla female and Mirror carp male

Out of the said hybrids 'Nadeem' and the hybrids of Rohu and Catla female with Mirror carp male has some cultural traits but other hybrids are not much useful from the cultural point of view. This inadvertent hybridization indicates that hybrids inherit more character from the male parent than the female one. When these hybrids are radioassyed, the vertebrae are found to be deformed, sometimes at the tail region (scoliosis; Plate.8) and sometimes the entire vertebra,known as lordosis (Plate.7) like human being .

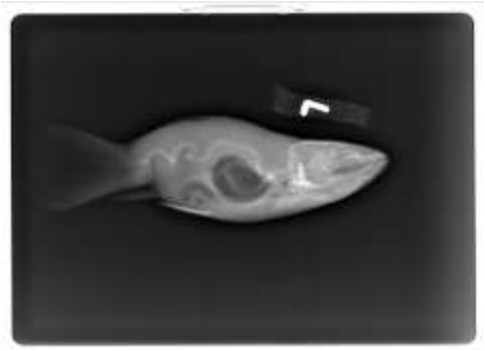

Plate.7, Entire vertebral column is deformed and takes the shape of a Necklace (kyphosis).

KYPHOSIS

Characterized by an abnormally rounded upper back (morethan50◦ curvature) . Kyphotic curves refer to outward curve of thoracic spine (at the level of ribs). Abnormal outward curvature of the upper thoracic vertebrae, known as humpback or round back

SCOLIOSIS Comes from the Greek word meaning crooked. Sideways S- or C-shaped curve of the lumbar vertebrae and may involve thoracic and both thoracic and lumber simultaneously at a time.(8,b) and occur at early stage.

LORDOSIS Lordotic curvature, which occur at all age group, characterized by an abnormal inward curvature of the lumber or lower spine. It occurs at all ages and though primarily effect lumbar spine but cervical is also lordotic.Excessive lordotic curvature is known as sway back,hollow back or saddle back (8, a).

Plate.8, a&b. Sideways curvature at the lumbar vertebrae (lumber lordosis & scoliosis)

Inbreeding and genetic drift

As already mentioned the modern hatcheries are virtually closed to genetic exchange with wild stock (Eknath, A.E., et al. 1991). This is because due to want of brooders the fish breeders use the same population and the offspring rose from it for successive breeding programe. This type of brother-sister and parent-offspring mating resulted in inbreeding. Though a detailed study on the extent of inbreeding has not been done still today, but it ranged from 2-17% in some carp hatcheries in Southern India (Eknath, A.E., et al, 1990). Inbreeding is a cumulative phenomenon and continuous inbreeding results in homozygosity. It produces homozygous stocks of dominant and recessive genes and eliminates heterozygosity from inbreeding population. This would result in loss of variability as well as depression in economically important traits and increased fry deformities (plate. 9).

Other genetic consequences of maintaining small number of inbreeding population is the loss of some alleles resulting in genetic drift, which ultimately reduces genetic variance in a gene pool (Padhi et al. 1994). Loss of genetic variance due to genetic drift has already been demonstrated in AU-Ivory Coast strains of Tilapia nilotica and Channel Catfish (Ictalurous punctatus).

Loss of genetic biodiversity

The inbred homozygous hybrid seeds are transported to diverse geographically territories and through ranching and other natural phenomenon enter into natural system. The farm raised fishes (Culture stock) and hybrids hybridize with native fish fauna resulting in genetic intermixing which may leads to genetic homogenization in the long run.

It is well known that Indian aquaculture activity is practically untouched by the relevant scientific approach of programme and not supported by proper extension activities and or follow-up action. General ignorance and illiteracy on the part of the fish breeders led them to adopt such improper breeding practices, the outcome of which is the series of genetic consequences posing threat to the vary existence of prized fishes of Bengal. Now, there is need for objective study. The genetic consequences of mixed spawning and indiscriminate hybridization should be assessed under experimental condition. The problems of Contamination should be assessed by using modern technologies like isozyme tool and DNA polymorphism (Bentzen, et al. 1991).

Alien Introduction

For the last 15 years or so the north-eastern status of India serves as the gateway for introduction of alien fish species to Bengal from Bangladesh, Thailand and even from South America and Africa. The species introduced are mostly carnivorous Catfishes. The reason may be their adaptability to diverse aquatic condition and better growth rate. The species introduced are African Magur, Clarius gariepineus; Thai-magur, Clarius macrocephalus; Pangasid Catfish, Pangasius sutchi; Pacu, Piaractus brachypomus and many others not known to scientific community.

This type of unauthorized introduction is not only dangerous but it is always unpredictable to determine in advance the long range of effects that the introduction of an alien species will have on local communities. Stock transfer of fish creates detrimental effects on aquatic biodiversity by way of reducing between population variability and within population fitness.

Unauthorized Drugs, Chemicals and Medicines

The fish breeders and farmers of Bengal, indiscriminately use Drugs, Medicines, growth enhancer, oxygen enhancer and many other chemicals to get temporary relief from disease and other uncontrolled conditions and to get faster growth rate. But as the materials are unauthorized and are composed of harmful ingredients these substances, on their subsequent accumulation, create an unhealthy bottom sediment and when these are stacked on the bank or nearby areas, it creates an overall negative impact on the biodiversity of the areas.

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