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Conservation and Management Approaches of Fish Genetic Resources in India: Present Status and Future Outlook

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Conservation of aquatic biodiversity is important from the fact that significant share of the genetic resources for food is still contribute from the wild due to low domestication level in fisheries sector. Conservation needs must be aimed towards preserving existing biodiversity and also the evolutionary processes that foster the biodiversity. The approaches towards fish genetic resource conservation and management are as follows.

Documentation of Fish Diversity

Knowledge of species, genetic stocks and ecological roles is necessary for the management of ecosystems and habitats as well as to the identification of important genomes and genes. Identification, cataloguing and prioritisation of species are important tasks in conservation. The ICAR-National Bureau of Fish Genetic Resources (ICAR-NBFGR) has developed a database on Indian fish diversity comprising of 2,936 indigenous (1,887 marine, 113 brackish water and 936 freshwater fishes, besides 462 exotic finfishes. In addition, the database is also available with consolidated lists of freshwater fishes found in the Western Ghats and north eastern hill region biodiversity hot-spots. Check-lists of macro-fauna and flora of Gulf of Mannar Biosphere Reserve (3,065 species) and the Ramsar Site-Vembanad Lake (185 species) have been prepared.

In situ Conservation

In situ conservation programmes for fish germplasm resources need the integration of knowledge on fish and habitat diversity, habitat utilisation, biology including genetic structure, life history traits as well as human interference and other socio-economic issues. The *in situ* conservation allow continued co-evolution wherein the wild species may continue to co-evolve with other forms, maintain genetic diversity of species and evolutionary adaptations.

National parks and biosphere reserves provide less expensive protection for the wild relatives than *ex situ* measures. Such conservation efforts can be meaningful only with people's participation through mass awareness programmes and involving the stake holders. In India, the protected area covers about 5.2% of the total land area, including 5,456 sites, and nine threatened fish species inhabiting these areas.

Stock Replenishment and Enhancement

Captive breeding programmes have become the major tool used to compensate the declining fish populations and simultaneously to supplement as well as enhance yields of wild fisheries. Although culture, breeding and larval rearing technologies for the major carps have been developed for several decades, but many non-conventional freshwater fish species having commercial value are yet to achieve the demonstrated status. These include *Chitala chitala, Ompok pabo, O. pabda, O. malabaricus, Labeo dussumieri, Semiplotus semiplotus, Clarias dussumieri, Channa diplogramme, Anabas testudineus, Nandus nandus, Cirrhinus reba, Barbodes carnaticus* and *Puntius sarana*. These captive bred seeds can be used for ranching into natural waters. The programme on mass-scale breeding, seed production and ranching of important threatened endemic fish species through establishment of live germplasm resource centers in three locations, initially, is a significant step forward towards conservation. More regional live germplasm resource centers in different agro-climatic zones may be established in collaborative mode to accommodate more species.

In such stocking programmes, scientific knowledge on the genetic structure of the original wild population is crucial to avoid any long-term negative impact due to mixing with captive bred seed. Therefore, appropriate blood-stock population of genotyped individuals should

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be the source of seed used for ranching. NBFGR, in a joint programme with the Regional Agricultural Research Station (RARS), Kumarakom, Kerala successfully carried out stock-specific, breeding-assisted river ranching of two fishes (*Horabagrus brachysoma* and *Labeo dussumieri*) in Kerala; the landings of *H. brachysoma* after two years increased from 1.8% to 11 % and that of *L. dussumieri* showed an increase from 0.68% to 3.9% of the total-landings from the Vembanad Lake and adjacent rivers in the state.

Concept of State Fish

An innovative approach to fish conservation by declaring a State Fish was adopted for the first time in the country at NBFGR in 2006. This involved integration of the key stakeholders in the conservation plan where 17 states of the country have become partners with NBFGR in developing strategies for conservation and enhancement of their selected State Fish in order to achieve the real time conservation success.

Ex situ Conservation–Cryopreservation of Fish Gametes and Embryos

Storage of fish spermatozoa, eggs and embryos without loss of viability is of considerable value in aquaculture and conservation. In India, NBFGR is the primary organisation carrying out fish sperm cryopreservation for long-term gene banking. The fish sperm cryopreservation needs development of species-specific protocols. Such protocols are developed through experimental standardization of various parameters, after the captive breeding protocol is developed. This becomes a bottleneck due to protracted breeding season and low domestication of most of the aquatic species, especially marine fishes. Nevertheless, in all such cases, time available in a year for conducting experiment is small and determined by breeding cycle of the species. In view of the constraint, it is essential that candidate species for sperm cryopreservation are prioritized. Species-specific sperm cryopreservation protocols have been developed for 28 species.

Fish gamete cryopreservation research still faces an important challenge in the form of long-term storage of fish eggs and embryos except the minute fertilized abalone eggs. Development of fish cell lines, embryonic stem (ES) cells and germ cells from Indian fishes and cloning technology as an alternative to long-term storage of finfish eggs and embryos has been emphasized. Embryonic stem (ES) cells are pluripotent stem cell lines that are derived from early embryo and these cells can differentiate to become any tissue in the body. Successful protocols for grafting of embryonic cells to host embryos, for germline transmission of desired genome, can be instrumental in evolving effective programmes for rehabilitation of endangered species.

Tissue Banking

Tissue banking is a fast mode of storing the biological material for longer durations and it can be used to retrieve genetic information and genetic manipulation studies in future. Nearly, 15,000 tissue accessions of freshwater and marine fish species collected from mainland and island ecosystems are maintained in the tissue bank of NBFGR.

Molecular Tools to Complement Taxonomy and Evolutionary Linkages

DNA based approach to taxon identification which exploits diversity among DNA sequences and can be used to identify fishes and resolve taxonomic ambiguity including discovery of new species. These approaches offer simple, rapid and reliable means of identifying not only whole fish, but fish fragments, eggs and larvae. DNA barcodes (based on Cytochrome Oxidase I) of more than 600 finfish species reported from India so far. Establishing evolutionary linkages using molecular tools could be of immense utility in sustainable exploitation, management and conservation of Indian fish species. However, it is necessary that such effort is intensified through initiation of a mission mode programme to barcode all available finfish and shellfish species available in the country.

Genetic Characterisation

The primary objective of the genetic characterisation is to assess the distribution and pattern of genetic variability at intra as well as inter-specific level populations, through the use of identified genetic markers. The conclusions from genetic diversity data have varied application in research on management and conservation of fish species, to understand the pattern of migration of fish stocks, nature of breeding populations and also in taxonomy/systematics. The choice of markers is crucial in achieving precise information that is useful for desired application. Several marker types soluble proteins, gene products (allozymes), nuclear and mitochondrial DNA markers have been used. Microsatellite DNA markers have been popularly used for the purpose. A concerted

effort made at different ICAR Institutes over last 10 years has provided description of genetic variation and population structure for about 30 prioritized fish and shellfish species from their major range of natural distribution. Distinct population structure was observed in many of these species indicating that propagation assisted restoration programmes must be stock-specific to replenish declining populations.

Exotics and Quarantine

Many introductions of exotic species for fisheries and aquaculture diversification have been successful; but others have resulted in highly publicised failure, generating controversy over protection of native biodiversity, spread of pathogens and diseases. To safeguard our indigenous fish genetic resources from infectious exotic diseases and to develop effective protocols for fish quarantine adequate facilities and expertise have been developed in the country over the years. Rapid diagnostic capability for detecting the eleven fish OIE (The World Organization for Animal Health or Office International des Epizooties) listed pathogens using molecular and immunological tools are available today. Success has also been achieved in developing monoclonal antibodies against *Labeo rohita*, which will be extremely useful in serodiognostics for pathogen surveillance in aquaculture of Indian major carps. We have been able to establish referral laboratory for all OIE listed pathogens in India. The National Repository of Fish Cell Lines established at NBFGR with financial support of DBT possessing 50 fish cell lines is a significant step forward for undertaking research on fish virology in coming years.

Conclusion

The conservation needs must be aimed towards preserving existing biodiversity and also the evolutionary processes that foster biodiversity. The conservation of fish diversity and resources of the country requires concerted efforts by integrating capture, culture fisheries and environmental programmes using latest technological innovations. Suitable programmes on the priority areas in consortia mode involving different research organisations, developmental agencies and community and stakeholder participation will certainly generate more results with respect to sustainable utilisation of fish genetic resources and management fisheries.