Conservation of Fish Species: Safeguarding the Aquatic Diversity

Arpita Singh, Ram Pratap Yadav and Ajay Singh

Department of Zoology, D.D.U. Gorakhpur University, Gorakhpur-273009 (U.P.)

Abstract

With 36,105 species now recognized, fishes are by far the most species-rich category of vertebrates. This is roughly equal to the total number of non-fish vertebrates. Along with a fall in total fish biodiversity, many fish species have seen sharp population declines in recent decades. Numerous human-caused factors, like as overfishing, habitat loss, pollution, aquaculture, loss of river connection, climate change, and the influence of alien species, are endangering fish biodiversity worldwide. One distinct aquatic meal that is good for your physical and mental wellbeing is fish. The consumption of fish is beneficial for human growth and development as well as the prevention and treatment of numerous illnesses associated with contemporary society. Human nutrition benefits from the high-quality protein, fat, carbohydrate, minerals, and vitamins that fish provides.Aquatic species richness has drastically decreased as a result of human activity and development's effects on aquatic landscapes. Some water animals, including crayfish, mussels, snails, and fish, have entirely vanished. Over time, the number of others has been steadily and significantly decreased. The health of the water resource is allegedly indicated by the species of fish. Water plants and animals live in aquatic habitats, which are places where they can find food, shelter, water, and nutrients to help them develop and survive. Aquatic biodiversity declines primarily due to habitat loss. Early settlers cleared the ground, filled and drained marshes, and removed forest along streams, resulting in the loss of many of the native aquatic surroundings. For this reason, a conservation strategy to preserve aquatic life is required in order to support the availability of resources for future generations and preserve the natural balance.

Keywords

Fish species, In-situ, Ex-situ conservation methods, State fish, Cryopreservation, Tissue bank, Mass awareness.

I. INTRODUCTION

Even though freshwater makes up less than 1% of the Earth's surface, freshwater fish make up one-fourth of all vertebrate species (Miqueleiz et al, 2020). Since they are particularly susceptible to human changes brought about by species introduction, overexploitation, fragmentation, the deterioration of continental watercourses, and climate change, they rank among the most endangered vertebrates (Barbarossa et al, 2021). Given that a sizable portion of food genetic resources still come from the wild because of the low level of domestication in the fishing industry, conservation of aquatic biodiversity is crucial. Preserving both the current biodiversity and the evolutionary processes that support it must be the goal of conservation efforts. India is endowed with an abundance of water resources, including 29,000 km of rivers, 0.3 million ha of estuaries, 0.9 million ha of backwaters and lagoons, 3.15 million ha of reservations, 0.2 million ha of floodplain wetlands, 0.72 million ha of upland lakes, and 2.02 million km2 of Exclusive Economic Zone (EEZ) that encircles the seas (8,129 km of coast line, including those of Andaman and Nicobar and Lakshadweep Islands). The nation's surrounding seas, 14 large rivers, 44 medium-sized reservoirs, and countless smaller rivers and other interior water bodies offer one of the world's most abundant fish fauna (Lakra, 2011). The information at hand unequivocally indicates that fish diversity and abundance are decreasing in tandem with rising human populations and destructive practices, like overfishing. Fish extinction results from the same factors that initially cause decline in fish populations. Students study the so-called HIPPO factors—habitat loss, invasive species, pollution, human population growth and consumerism (The Root of All Evil), and overexploitation—in conservation biology classes. Habitat degradation, which includes bottom disturbance, structural element removal, water withdrawal, hydrologic changes (including impoundments), eutrophication, sediment deposition, industrial effluent discharge, etc., is the primary cause of freshwater fish decline and extinction.

Management of ecosystems and habitats, as well as the identification of significant genomes and genes, require knowledge of species, genetic stocks, and ecological roles. Prioritizing, classifying, and identifying species are crucial conservation efforts.

II. MODES OF CONSERVATION

- *In-Situ* Conservation

The preservation and recovery of viable populations of species in their natural environments and, in the case of domesticated or cultivated species, in the environments where they have developed their distinctive properties" is the definition of in-situ conservation (Convention on Biological Diversity, Article 2). Declaring certain areas as Marine Protected Areas (MPAs) or designating them as National Parks, Wildlife Sanctuaries, or Biosphere Reserves allows for in-situ conservation of marine ecosystems. Marine protected areas safeguard not only populations and species that are rare, endangered, threatened, or reduced, but also their environments. To preserve marine ecosystems and their resources, India has four significant National Marine Parks, three significant Marine

Sanctuaries, and four significant Biosphere Reserves (Lakra, 2011). Programs for in situ conservation of fish germplasm resources must incorporate information on fish and habitat diversity, habitat use, biology, including genetic structure and life history features, human intervention, and other socioeconomic concerns. Through in situ conservation, wild species can continue to co-evolve with various forms, preserve species genetic diversity, and develop evolutionary adaptations. For the first time in the nation, NBFGR implemented a novel strategy for fish conservation in 2006 by designating a State Fish. Key stakeholders were integrated into the conservation strategy, and in order to achieve real-time conservation success, 16 states nationwide partnered with NBFGR to establish conservation and enhancement strategies for their chosen State Fish (Table 1).

Table 1: Table showing State Fishes

S.No.	State	Common name	Scientific name
1	Andhra Pradesh	Snake head murrel	*Channa striatus*
2	Kerala	Karimeen	*Etroplussuratensis*
3	Karnataka	Carnatic carp	*Puntiuscarnaticus*
4	Orissa	Mahanadi mahaseer	*Tor mahanadicus*
5	West Bengal	Hilsa	*Tenulosailisha*
6	Arunachal Pradesh	Golden mahaseer	*Tor putitora*
7	Bihar	Magur	*Clarias batrachus*
8	Haryana	Kalbasu	*Labeo calbasu*
9	Himachal Pradesh	Golden mahaseer	*Torputitora*
10	Jammu & Kashmir	Golden mahaseer	*Tor putitora*
11	Manipur	Pengba	*Osteobramabelangri*
12	Mizoram	Nghavang	*Semiplotusmodestus*
13	Nagaland	Chocolate mahaseer	*Neolissocheilushexagonolepis*
14	Tripura	Pabda	*Ompok bimaculatus*
15	Uttar Pradesh	Chital	*Chitala chitala*
16	Uttarakhand	Golden mahaseer	*Tor putitora*

- *Ex-Situ* Conservation

  Ex situ conservation, which provides a way to save severely endangered species with the hope of future population restoration, is becoming more and more significant in the protection of fish biodiversity in addition to in situ conservation. Ex situ conservation is the process of removing endangered species from their native environment and relocating them elsewhere recognized aquariums, whether in zoos or research facilities. Through ex situ conservation, scientists can obtain important new data about a species' behaviour and reproduction, as well as the information required to create the best captive breeding practices.

- Fish Gametes and Embryos Cryopreservation

  Since NBFGR is the main agency in India performing fish sperm cryopreservation for long-term gene banking, it has developed methods specific to 27 species (Jena et al, 2011). Protocols tailored to each species must be developed for the cryopreservation of fish sperm. Following the development of the captive breeding procedure, these protocols are created by experimentally standardizing a variety of criteria. The lengthy mating season and poor domestication of the majority of aquatic species, particularly marine fishes, make this a bottleneck. However, the amount of time available for performing experiments in each of these situations is limited and based on the species' mating cycle. Given the limitation, it is imperative that sperm cryopreservation candidate species be given priority. The long-term storage of fish eggs and embryos, with the exception of the tiny fertilized abalone eggs, remains a significant issue in fish gamete cryopreservation research. Cloning technology and the development of fish cell lines, embryonic stem (ES) cells, and germ cells from Indian fishes have been highlighted as alternatives to the long-term storage of finfish eggs and embryos. Pluripotent stem cell lines called embryonic stem (ES) cells are derived from early embryos and have the ability to develop into any tissue in the body. Effective procedures for grafting embryonic cells into host embryos can be crucial for the intended genome's germline transmission in creating successful programs for endangered species rehabilitation.

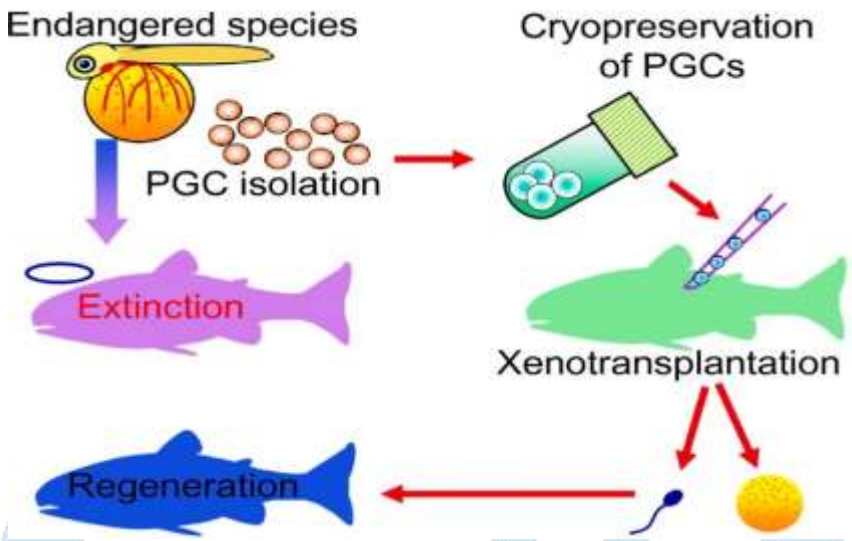

Figure 1: Cryopreserved PGCs are essential for building genetic resources. Cryopreserved germ cells could be transplanted into recipient surrogate hatchlings of closely similar species to restore a threatened or even extinct fish species (Yoshizaki & Lee, 2018).

- Tissue Bank
  Tissue banking is a quick way to preserve biological material for extended periods of time and can be used in the future for genetic information retrieval and genetic manipulation research. Approximately 15,000 tissue accessions of freshwater and marine fish species that were gathered from island and mainland environments are kept in the NBFGR tissue bank (Jena et al, 2011).

- Live gene repository
  With the following goals in mind, NBFGR has set up a live gene bank in Lucknow that houses species of high conservation significance: a) Gathering rare, endangered, and threatened fish species and managing their populations on farms. b) Research on these species' development, maturity, survival, and adaptability under controlled settings; and c) Analysis of the vulnerable species' life history characteristics as a means of both in-situ and ex-situ conservation. To avoid domestication, inbreeding depression, and unintentional selection, the endangered species are reared, raised, and genetically managed in a live gene bank, a genetic resource center. Wild stocks of endangered species, including Notopterus chitala, Channa marulius, Tor putitora, Labeo bata, L. dyocheilus, and L. Calbasu, are maintained by the NBFGR in the mini germplasm repository. Several locations are concurrently establishing these repositories. Guwahati already has one of these built up for different North-East regions.

- Aquatic Diversity Management Areas (ADMAs)
  ADMAs are a systematic approach to watershed management, with the primary goal being the preservation of the region's aquatic biodiversity. ADMAs range from modest biodiversity-focused initiatives to extensive laws safeguarding certain species halting or drastically cutting back on any human activity that leads to the degradation of the local ecosystem is the most effective way to manage ADMAs.

- Translocation
  In order to create a self-sustaining population in the event that the original populations become extinct, translocation is a conservation strategy that involves removing wild fish, fertilizing the eggs in the field, returning the adults to the donor body, and introducing the species into new water bodies as fertilized eggs, yolk-sac larvae, or juveniles.

- Resilient fish farming
  Regulation of the overuse of fisheries resources in traditional fishing grounds is necessary. To ensure a sustainable stock, brood fishes and juveniles must be protected. Strict adherence to net and mesh size requirements is necessary to protect the youngsters. It should be severely prohibited to randomly kill fish by poisoning or dynamiting them.

- Managing Exotic Fishes
  The native ichthyofauna could be wiped out by the careless introduction of foreign species. In order to prevent any disastrous ecological and economic effects following the introduction of an exotic species, it is essential to screen the biology, genetics, and potential effects on native species in the natural environment (Rout et al, 2007).

- Watershed organizations in the area

It is difficult to enforce resource management and conservation since rivers and streams, regardless of their state, usually go unchecked because they regularly straddle many political jurisdictions. But in recent years, local watershed organizations' initiatives to protect lakes and remote watershed areas have had a beneficial impact.

- Attempts to mitigate and restore

Aquatic regions that have sustained damage, lost habitat, or experienced habitat degradation can be restored. Restoration efforts may even target dwindling species populations (such as salmon stocks in the Pacific Northwest). Several management strategies, including the establishment of riparian buffer zones and the restoration of natural flow patterns and discharge regimes, are employed in riverine ecosystems. In order to compensate for the losses brought about by dredging efforts, many wetland ecosystems have lately undergone habitat restoration.

- Public awareness

The public's widespread understanding of the numerous ecological, socioeconomic, nutritional, cultural, artistic, recreational, pharmaceutical, and other services provided to humanity is known to be essential to the success of biodiversity conservation. Therefore, each and every citizen has a responsibility to conserve the declining diversity. Awareness-building is one of the most important ways to protect aquatic biodiversity. This can be accomplished through volunteer monitoring, incentive programs, and educational initiatives. To increase public awareness of the importance of wetlands and the necessity for protection, the State of Delaware, for example, runs an Adopt-a-Wetland Program.

III. CONCLUSION

Numerous anthropogenic factors, such as overfishing, habitat loss, pollution, aquaculture, loss of river connection, climate change, and the influence of alien species, are endangering fish biodiversity worldwide. The drastic reduction in fish biodiversity worldwide has brought attention to the urgent need for a number of corrective measures, such as stronger regulations for the sustainable management of our commercially significant aquatic resources and more efficient fisheries management to lessen overfishing. Cryobanking reproductive cells and tissues to preserve genetic resources is probably going to be a more useful technique in the preservation of fish biodiversity. In future in situ and ex situ conservation projects, frozen germplasm will be crucial with the aid of various cutting-edge reproductive technologies. Particularly, significant advancements in conservation genomics and improvements in germplasm cryopreservation and germ cell transplanting procedures have created new opportunities for the preservation of fish species. It is imperative that conservation efforts focus on protecting both the current biodiversity and the evolutionary processes that support it. The nation's fish resources and diversity need to be conserved through coordinated efforts that combine environmental programs, capture, and culture fisheries with the newest technological advancements.

The sustainable use of fish genetic resources and fishery management will undoubtedly yield greater results from appropriate programs on the priority areas in consortium mode involving various research organizations, developmental agencies, and community and stakeholder participation. The fact that the majority of our fish production still comes from the wild makes aquatic biodiversity conservation crucial. Preserving both the current biodiversity and the evolutionary processes that support it must be the goal of conservation.

Population increase and economic expansion will continue to put strain on natural habitats, which will result in a decline in biological variety. Some of the detrimental effects that aquatic biodiversity has on humans are caused by ignorance, a lack of knowledge about the significance of aquatic biodiversity, how it can be impacted, etc. Understanding the scope of the issue, the underlying reasons, and the limited resources available to buck strong negative trends will undoubtedly result in the most effective method of preserving the biological diversity of the aquatic ecosystems of India.

IV. REFERENCES

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