



(REVIEW ARTICLE)



## Importance of fish biodiversity conservation and management

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### Abstract

One of the key concerns for enabling the sustainable use of natural resources is biodiversity and its conservation. Fish make up the most varied group of vertebrates and they are considered to be a reliable indication of water pollution. Humans are causing an increasing loss of biodiversity in aquatic ecosystems, which is likely to have a detrimental impact on ecosystem functioning, services, and resistance to future environmental change. Overfishing from different water bodies is one of the major issues which could affect the aquatic ecosystems. These fishing pressures may alter the development and behaviour of fish, alter the life cycles and productivity of fish, and reduce availability of fish stocks. All ecosystems undergo change, and both the existence and number of species will fluctuate with or without human intervention and this should be taken into account for safeguarding biodiversity. In some of the most biodiverse areas in the globe, patterns and causes of aquatic biodiversity loss are poorly understood. This is concerning because a growing number of development projects, like hydropower dams, could have significant effects on the fish fauna of the associated river systems. Many of these areas are also among the most threatened aquatic system on Earth and have human populations that are heavily dependent on the ecosystem services they provide.

**Keywords:** Conservation; Environment; Fish Biodiversity; Management; Overfishing.

## 1. Introduction

### 1.1. Importance of fish biodiversity

Fish biodiversity plays a crucial role in maintaining the health and functioning of aquatic ecosystems. Following are the key reasons why fish biodiversity is important:

#### 1.1.1. Ecosystem Stability

Fish species are integral components of aquatic ecosystems, serving various ecological roles. They contribute to the regulation of nutrient cycles, maintain water quality, and help control populations of other organisms. A diverse fish community ensures a balance within the ecosystem and promotes its stability (Dallaire *et al.*, 2023).

#### 1.1.2. Food Security

Fish are a vital source of protein and essential nutrients for a significant portion of the global population. Maintaining fish biodiversity ensures sustainable fisheries and helps meet the nutritional needs of communities that rely on fish as a primary food source.

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### 1.1.3. Economic Value

Fisheries and aquaculture industries generate significant economic benefits worldwide. A diverse range of fish species provides opportunities for commercial fishing, recreational fishing, and aquaculture, supporting livelihoods, employment, and economic growth in coastal and inland communities.

### 1.1.4. Ecotourism and Recreation

Many people engage in recreational activities such as sport fishing and wildlife watching, including snorkeling and diving, which depend on diverse fish populations. Fish biodiversity enhances the attractiveness of natural environments and supports ecotourism, contributing to local economies (Dallaire *et al.*, 2023).

### 1.1.5. Indicator Species

Fish can serve as indicators of the overall health and ecological integrity of aquatic ecosystems. Changes in fish populations can provide insights into environmental conditions, pollution levels, habitat degradation, and climate change impacts. Monitoring fish diversity helps in detecting and addressing environmental issues early on (Tao *et al.*, 2023).

### 1.1.6. Genetic Diversity

Fish species exhibit genetic variation within and among populations, which is essential for their long-term survival and adaptation to changing environmental conditions. Genetic diversity enables resilience and enhances the capacity of fish populations to withstand disturbances such as disease outbreaks or habitat alterations (Dallaire *et al.*, 2023).

### 1.1.7. Conservation of Ecosystem Services

Fish biodiversity contributes to various ecosystem services, including water filtration, erosion control, and carbon sequestration. Protecting fish populations and their habitats helps maintain these services, benefiting both humans and the environment.

### 1.1.8. Cultural and Traditional Importance

Fish have cultural significance for many societies and indigenous communities. They are associated with folklore, traditional practices, and spiritual beliefs. Preserving fish biodiversity helps safeguard cultural heritage and traditions linked to these species (Dallaire *et al.*, 2023).

### 1.1.9. Research and Education

Fish provide valuable subjects for scientific research, helping us understand fundamental ecological processes, evolutionary biology, and the impacts of environmental changes. Diverse fish communities offer rich opportunities for educational purposes, enabling students and researchers to study and appreciate aquatic ecosystems.

## 1.2. Fish Biodiversity Conservation

Fish biodiversity conservation refers to the deliberate efforts and strategies aimed at preserving and protecting the variety of fish species and their habitats. It involves implementing measures to maintain healthy fish populations, protect their natural environments, and sustainably manage fisheries. Here are some key aspects of fish biodiversity conservation:

### 1.2.1. Habitat Protection

Preserving and restoring the habitats essential for fish species is crucial for their conservation. This includes safeguarding wetlands, rivers, lakes, coral reefs, mangroves, and other aquatic ecosystems that serve as breeding grounds, feeding areas, and migration routes for various fish species. Measures such as establishing protected areas, habitat restoration projects, and reducing pollution and habitat degradation are important components of habitat protection (Tao *et al.*, 2023).

### 1.2.2. Sustainable Fisheries Management

Adopting sustainable fishing practices is essential for maintaining fish biodiversity. This involves implementing regulations and policies that ensure fishing activities being carried out at levels that allow fish populations to reproduce and replenish. Strategies may include setting catch limits, implementing fishing gear restrictions, establishing no fishing

zones, and employing techniques such as selective fishing to reduce bycatch and minimize harm to non-target species (Smith *et al.*, 2023).

### 1.2.3. Invasive Species Control

Invasive species can have a detrimental impact on native fish populations. Efforts to control and manage invasive species are crucial for maintaining the integrity of aquatic ecosystems. This may involve monitoring and early detection of invasive species, implementing measures to prevent their introduction or spread, and developing eradication or feasible programs (Dallaire *et al.*, 2023).

### 1.2.4. Conservation Breeding and Stocking Programs

In some cases, conservation breeding and stocking programs can help restore or augment fish populations that are critically endangered or have suffered significant declines. These programs involve captive breeding of fish species in controlled environments and releasing them into suitable habitats to enhance their numbers and genetic diversity (Gillette *et al.*, 2023).

## 1.3. Community Engagement and Education

Engaging local communities, stakeholders, and resource users is vital for successful fish biodiversity conservation. Promoting awareness, education, and capacity-building initiatives helps foster a sense of stewardship and encourages sustainable practices among local communities. Involving indigenous peoples and incorporating traditional knowledge can also contribute to effective conservation strategies (Gillette *et al.*, 2023).

### 1.3.1. Research and Monitoring

Continuous research and monitoring efforts are essential for understanding fish populations, their habitats, and the factors affecting their survival. This includes studying their behavior, population dynamics, migratory patterns, and responses to environmental changes. Monitoring programs help track the status and trends of fish populations, enabling informed decision-making for conservation actions (Smith *et al.*, 2023).

### 1.3.2. International Cooperation

Fish biodiversity conservation often requires international collaboration and cooperation, especially for migratory species that traverse multiple jurisdictions. Countries and organizations can work together to develop conservation agreements, share scientific knowledge and best practices, and establish transboundary conservation initiatives to protect shared fish populations.

## 1.4. Fish Biodiversity Management

Fish biodiversity management involves the active and adaptive management of fish populations and their habitats to ensure the conservation and sustainable use of fish biodiversity. It encompasses a range of strategies and actions aimed at maintaining healthy fish communities, protecting their habitats, and balancing ecological, social, and economic considerations. Here are the key aspects of fish biodiversity management:

### 1.4.1. Population Assessment and Monitoring

Regular assessment and monitoring of fish populations are crucial for understanding their status, trends, and ecological requirements. This involves collecting data on population size, structure, distribution, and reproductive biology through techniques such as surveys, tagging, and genetic analysis. Monitoring programs help identify changes in fish populations, assess the effectiveness of management interventions, and inform adaptive management approaches (Smith *et al.*, 2023).

### 1.4.2. Setting Harvest Limits and Regulations

Sustainable fisheries management requires the establishment of appropriate harvest limits and regulations. These limits are based on scientific assessments of fish populations, taking into account factors such as growth rates, reproduction, mortality, and ecosystem dynamics. Harvest regulations may include setting catch limits, gear restrictions, size limits, and seasonal closures to prevent overfishing and allow for the replenishment of fish populations (Prakasam & Saravanan 2023).

#### 1.4.3. Habitat Conservation and Restoration

Protecting and restoring fish habitats are critical components of fish biodiversity management. This includes identifying and safeguarding important habitats, such as spawning grounds, nursery areas, and migration routes. Implementing measures to reduce habitat degradation, pollution, and the impacts of human activities helps maintain the ecological integrity of aquatic ecosystems and supports healthy fish populations (Prakasam & Saravanan 2023).

#### 1.4.4. Ecosystem-Based Approach

Fish biodiversity management often adopts an ecosystem-based approach, considering the interdependencies and interactions between fish species, their habitats, and the broader ecosystem. It recognizes that the health of fish populations is linked to the overall functioning of the ecosystem and emphasizes the need to maintain ecosystem resilience and integrity (Gillette *et al.*, 2023).

#### 1.4.5. Conservation Breeding and Stocking Programs

Conservation breeding and stocking programs may be employed as a management tool for species that are at risk of extinction or have undergone significant declines. These programs involve captive breeding, rearing, and releasing fish into suitable habitats to enhance populations and genetic diversity. However, careful consideration of genetic, ecological, and ethical factors is necessary to ensure the effectiveness and sustainability of such programs (Varnes & Olsen 2023).

#### 1.4.6. Stakeholder Engagement and Collaboration

Engaging stakeholders, including fishers, local communities, scientists, policymakers, and conservation organizations, is essential for effective fish biodiversity management. Collaborative approaches that involve local knowledge, traditional practices, and the active participation of stakeholders help build a sense of ownership and promote sustainable practices (Varnes & Olsen 2023).

#### 1.4.7. Adaptive Management

Fish biodiversity management requires an adaptive approach, where management strategies are continuously reviewed and adjusted based on new information and changing circumstances. Adaptive management involves learning from past experiences, monitoring the outcomes of management actions, and making timely adjustments to improve effectiveness and address emerging challenges (Varnes & Olsen 2023).

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## 2. Conclusion

Conservation and sustainable management of fish biodiversity are essential for the well-being of both aquatic ecosystems and human societies, supporting ecological integrity, economic development, and the cultural heritage tied to these remarkable aquatic creatures. By implementing these strategies and integrating them into fisheries management plans, policies, and regulations, fish biodiversity can be effectively managed, ensuring the conservation of fish populations, the integrity of aquatic ecosystems, and the sustainable use of fish resources for present and future generations.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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