



Conservation of Indigenous Fish Species in Himalayan Rivers: Challenges and Strategies

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Abstract

The Himalayan rivers harbor a rich diversity of indigenous hill fish species, including the iconic golden mahseer (*Tor putitora*) and snowtrout (*Schizothorax richardsonii*), which play critical ecological, socio-economic, and cultural roles. These species sustain nutrient cycling, regulate aquatic food webs, and act as bioindicators of freshwater health, while simultaneously supporting rural livelihoods, eco-tourism, and traditional conservation practices. However, their survival is increasingly threatened by hydropower development, habitat fragmentation, exotic fish introductions, destructive fishing practices, and the intensifying impacts of climate change. This study synthesizes insights from published scientific literature, institutional reports, and field-based studies to examine the current status of hill stream fisheries, identify key threats, and evaluate conservation strategies. Findings highlight severe habitat loss, population declines, and knowledge gaps across the Eastern Himalayas, underscoring the urgent need for integrated interventions. Promising approaches include community-driven sanctuaries, watershed-based management, restoration of migratory pathways, sustainable aquaculture, and policy frameworks that balance development with biodiversity conservation. Safeguarding Himalayan hill fish requires not only scientific innovation but also active participation of local communities and transboundary cooperation. By adopting a holistic, multidisciplinary approach, it is possible to secure the ecological integrity of these rivers while sustaining the cultural and livelihood values deeply embedded within Himalayan societies.

Keywords: Indigenous fish, Himalayan rivers, freshwater biodiversity, ecological importance, community-based conservation, sustainable fisheries management.

1. Introduction

An extensive range of native coldwater fish, including the endangered golden mahseer (*Tor putitora*) and the endangered common snowtrout (*Schizothorax richardsonii*), can be found in the rivers that wind through the majestic Himalayan mountains. These fish are essential for maintaining ecological balance and supporting local livelihoods (Sehgal, 1990). In addition to their ecological role, they support rural populations by offering food, revenue from small-scale fishing, and even chances for ecotourism, including recreational fishing. These species live in swift, rocky, oxygen-rich streams, having evolved specialized adaptations for survival in these unique habitats (Wikipedia, 2025). However, these native fish populations are under stress. Critical migratory routes have been obstructed by dams and other hydropower developments, severely diminishing the number of mahseer and destroying breeding sites (Sehgal, 1990). River valley modifications, pollution, overfishing, and the introduction of exotic species, such as brown trout (*Salmo trutta*) and common carp (*Cyprinus carpio*), have disrupted ecosystem balance and outcompeted endemic species (FAO, 1988; India Water Portal, 2014).

These risks get worse by climate change; for instance, snowtrout habitat loss is predicted to be 16% by 2050 and up to 26% by 2070, as appropriate water temperatures shift upward and the pressure on high-altitude habitat increases (Economic Times, 2020). Effective conservation planning is further hindered by damaging fishing methods like dynamite fishing and lack of comprehensive biological data on the distribution, breeding biology, and population dynamics of many indigenous species, from large areas of Eastern Himalayas, create major obstacles to effective conservation (Sehgal, 1990).

There is still hope in spite of these rising barriers. Fish populations have been maintained in certain areas due to cultural traditions including community-driven sanctuaries and religious prohibitions protecting sacred stream pools (Sehgal, 1990). Further, integrated watershed management combining fishery development with soil and water conservation can enhance stream flows and revive local fisheries (India Water Portal, 2014).

By considering all factors, protecting Himalayan hill river fish is a complex necessity that protects biodiversity, rural livelihoods, and ecological heritage. A comprehensive strategy is needed to address it, combining transboundary collaboration among Himalayan countries, sustainable policy frameworks, and science-based habitat restoration. Since Himalayan rivers are transboundary in their character, international collaboration between Himalayan countries is necessary to ensure the long-term sustainability and preservation of this shared aquatic heritage.

2. Ecological and Socio-Economic Importance of Indigenous Hill Fish

2.1 Ecological Importance

Indigenous hill fish play a crucial role in maintaining the ecological balance of Himalayan River ecosystems. Species such as mahseers (*Tor* spp.) and snowtrouts (*Schizothorax* spp.) act as keystone species, contributing to nutrient

cycling, sediment redistribution, and energy flow in aquatic food webs (Johal & Tandon, 2017). From carnivorous catfishes like *Sperata seenghala* to algivores like *Garra* spp., their varied feeding habits contribute to the resilience of ecosystems and the regulation of aquatic community structure (Sehgal, 1999). Due to their extreme sensitivity to pollution and hydrological changes, many species also function as bioindicators of water quality (NBFGR, 2010).

2.2 Socio-Economic and Cultural Importance

Hill fish are deeply interlinked with the livelihoods and cultural traditions of Himalayan communities. In Himachal Pradesh and Uttarakhand, native species like the golden mahseer (*Tor putitora*) are highly valued for recreational fishing as well as supporting ecotourism (Nautiyal, 2014). Snowtrouts and local carps form a critical source of animal protein for rural households, particularly in Kashmir, Himachal, and the northeastern Himalayas (Sharma et al., 2020). In some regions of Northeast India, community fish sanctuaries protect entire river segments as part of customary conservation measures, while mahseers are regarded as "river protectors" in Garhwal (Bhaumik & Sharma, 2012). Economically, indigenous fisheries sustain local livelihoods through subsistence fishing, small-scale commercial markets, and emerging aquaculture initiatives (Vass et al., 2009). By providing both ecological services and socio-economic benefits, these species form an indispensable component of Himalayan freshwater biodiversity.

3. Methodology

This study is based on some personal observations and already published scientific literature. This review identifies major challenges to their conservation and evaluates existing as well as potential strategies for their sustainable management. Information was synthesized from peer-reviewed journals, institutional publications and conservation frameworks to provide an integrated perspective on both threats and solutions.

4. Diversity of Indigenous Hill Fish species in the Himalayas

The Himalayan rivers are globally recognized as hotspots of freshwater biodiversity, supporting a remarkable assemblage of coldwater and hill stream fishes. These rivers, fed by glaciers and snowmelt, provide diverse ecological niches ranging from torrential mountain streams to calmer foothill waters, allowing a wide variety of fish species to thrive (Sehgal, 1999). Estimates suggest that the Indian Himalayan region alone harbors more than 200 freshwater fish species, of which a significant proportion are indigenous hill fishes adapted to high-altitude ecosystems (Vishwanath et al., 2010).

Among these, mahseers (*Tor* spp.) and snowtrouts (*Schizothorax* spp.) are considered flagship species due to their ecological, recreational, and conservation significance (Nautiyal, 2014). Other important groups include loaches (*Nemacheilus*, *Botia*, *Noemacheilus* spp.), catfishes (*Glyptothorax*, *Sperata*, *Bagarius* spp.), and various carps and minnows

(*Barilius*, *Garra*, *Labeo* spp.). These fishes exhibit remarkable adaptations such as streamlined bodies, adhesive organs, and specialized feeding habits, enabling survival in swift currents and rocky substrates (Das and Nandi, 2020).

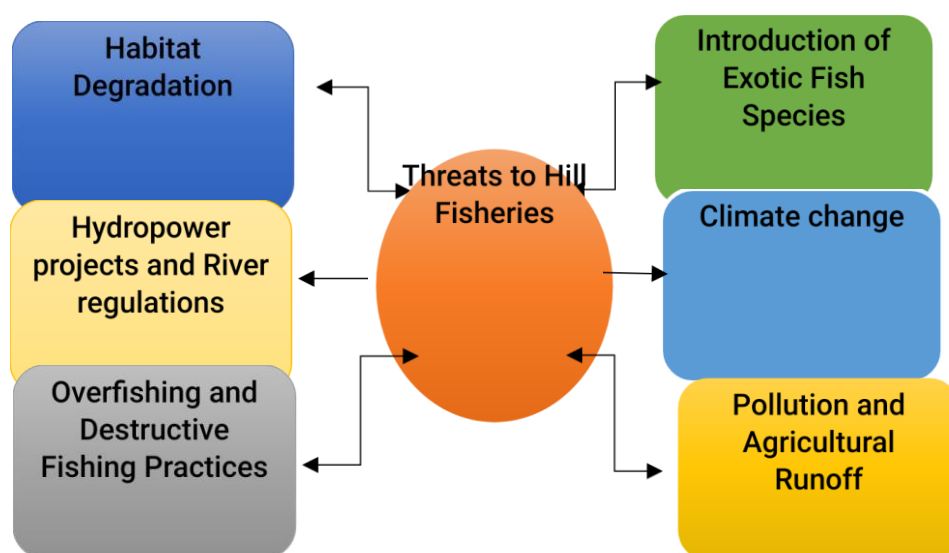
The table below provides a representative list of major indigenous fish species found in the Himalayan rivers, highlighting their ecological roles and conservation status.

Table 1: Representative Indigenous Fish Species of the Himalayan Rivers

Scientific name	Common name	IUCN status	Habitat	Ecological Importance	References
<i>Tor putitora</i>	Golden mahseer	Endangered (EN)	Foothill rivers of Indus, Ganga, Brahmaputra basins	Iconic migratory fish; cultural/religious significance; indicator of river health	Nautiyal, 2014; IUCN, 2024
<i>Schizothorax richardsonii</i>	Common snow trout	Vulnerable (VU)	Coldwater Himalayan streams (India, Nepal, Bhutan)	Staple food fish for hill communities; vital in nutrient cycling	Sehgal, 1990; IUCN, 2024
<i>Neolissochilus hexagonolepis</i>	Chocolate mahseer	Near Threatened (NT)	Northeastern and Eastern Himalayan rivers	Subsistence fishery; ecotourism potential	Dahanukar et al., 2011; IUCN, 2024
<i>Neolissochilus hexastichus</i>	Copper mahseer	Endangered (EN)	Central and Eastern Himalayan streams	Popular food fish; threatened by habitat loss	Vishwanath et al., 2010; IUCN, 2024
<i>Schizothorax progastus</i>	Himalayan Snowtrout	Near Threatened (NT)	Mid-altitude Himalayan Rivers	Supports local fisheries; adapted to fast-flowing waters	Sehgal, 1990; FAO, 1990
<i>Glyptothorax</i> spp.	Assemese Catfish	Data Deficient (DD)	Hill streams and tributaries	Benthic species maintaining	Vishwanath et al., 2010

				ecosystem balance	
<i>Neomacheilus spp.</i>	Stone Loach	Least Concern (LC)	Rocky Himalayan Hill streams	Small indigenous fish; bioindicator species	Sehgal, 1990
<i>Garra gotyla</i>	Garra	Least Concern (LC)	Upper Ganga and Eastern Himalayan streams	Controls algal growth; part of local diets	FAO, 1990; Vishwanath et al., 2010
<i>Barilius spp.</i>	Hill Trout	Least Concern (LC)	Fast-flowing Himalayan rivers	Ornamental value; artisanal fisheries	Dahanukar et al., 2011
<i>Sperata seenghala</i>	Giant River Catfish	Least Concern (LC)	Large rivers of northern India, Nepal, Himalayan foothills	Important inland fishery species; protein source; ecosystem health indicator	FAO, 1990; Sehgal, 1990

5. Threats to Indigenous Hill Fisheries in the Himalayan Rivers



Flowchart showing Threats to Hill Fishes

Hill fisheries face multiple threats arising from both natural and anthropogenic factors. Habitat degradation due to deforestation, sedimentation, and river modification has severely impacted spawning and feeding grounds (Singh and Lakra, 2011). Hydropower development and river regulation further fragment habitats and block migratory routes of species such as *Tor putitora* (Bhatt et al., 2012). Overfishing and destructive practices like poisoning and dynamiting lead to juvenile mortality and stock decline (Sharma, 2008). In addition, the introduction of exotic fish species poses a risk of competition and genetic dilution of native stocks (Singh and Lakra, 2011). Pollution from agricultural runoff and industrial effluents reduces water quality, while climate change alters hydrological regimes and temperature, affecting fish physiology and distribution (Nautiyal, 2014). These combined stressors threaten the sustainability of indigenous fish diversity in Himalayan rivers.

6. Management and Conservation Strategies

The conservation of indigenous hill fish species in Himalayan rivers necessitates an integrated and scientifically informed approach. With increasing pressures from anthropogenic activities, habitat alteration, overfishing, pollution, invasive species, and climate variability, the survival of these native fish populations is under significant threat. Therefore, it becomes imperative to adopt comprehensive conservation strategies that not only address immediate challenges but also ensure the long-term ecological sustainability of Himalayan River ecosystems. The following strategies outline key measures for effective conservation and management.

a) Habitat restoration and protection

Habitat degradation caused by hydropower development, siltation, and river modification is among the biggest threats to hill stream fishes. Restoration of degraded spawning and feeding grounds, maintaining ecological flow regimes, and declaring sensitive stretches as fish sanctuaries are essential steps for sustaining native populations (Singh and Lakra, 2011; Katiha et al., 2002).

b) Regulation of destructive fishing practices

The employment of harmful techniques like poisoning, dynamite blasting, and fine-mesh nets leads to mass mortality and depletion of fish stocks. Enforcing bans on such practices, along with promoting sustainable and selective fishing gear, is necessary to conserve juvenile and brood fish populations (Sharma, 2008).

c) Captive breeding and stock enhancement

Ex-situ measures like hatchery-based breeding of threatened species, including *Tor putitora* (golden mahseer) and *Schizothorax spp.*, are crucial for their recovery. Stock enhancement and restocking programs have been found



effective in re-establishing populations in degraded habitats and ensuring their long-term survival (Jhingran, 1991; Nautiyal, 2014).

d) Integration of Traditional ecological knowledge

Indigenous fishing communities hold valuable insights regarding fish breeding seasons, migratory routes, and habitat preferences. Incorporating such traditional ecological knowledge with modern scientific practices enhances the effectiveness and social acceptance of conservation strategies (Sarkar and Bain, 2007).

e) Community based fisheries management

The involvement of riparian communities is critical for successful conservation. Awareness programs, participatory river management, and the development of alternative livelihoods can reduce fishing pressure and foster community stewardship of aquatic resources (Sinha and Khan, 2001).

f) Policy support and Watershed management

Strong policy measures are required to tackle river pollution, unregulated hydropower expansion, and watershed degradation. Integrated watershed and river basin management approaches help maintain ecological balance, thereby safeguarding the native fish diversity of Himalayan rivers (Bhatt et al., 2012).

Conclusion

The indigenous hill fish species of Himalayan rivers represent a vital component of freshwater biodiversity and play an essential role in maintaining ecosystem balance as well as supporting local livelihoods. However, their survival is under increasing threat due to habitat degradation, hydropower development, destructive fishing, pollution, exotic species introduction, and climate change (Singh and Lakra, 2011; Bhatt et al., 2012). To address these challenges, conservation must adopt a multi-pronged approach that combines habitat restoration, strict regulation of unsustainable fishing practices, ex-situ breeding and restocking, and community-based management systems (Jhingran, 1991; Nautiyal, 2014). Policy support in the form of watershed management, eco-friendly hydropower development, and stricter pollution control measures is equally crucial for safeguarding aquatic resources (Sinha and Khan, 2001). Protecting hill fisheries is not merely an ecological obligation but also a socio-economic necessity for sustaining mountain communities and preserving the long-term integrity of Himalayan rivers. A collaborative framework involving scientists, policymakers, and local stakeholders offers the most promising pathway to help ensure these special fish resources continuous existence for upcoming generations (Sarkar and Bain, 2007).



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