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Aquatic biodiversity with Reference to Fish: A review

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Abstract

Biodiversity is the total genetic pool, all organisms available in all ecosystem, plants, animals and microbes which play an integral part in Man's survival, sustenance and wellbeing on this earth. Aquatic biodiversity encompasses freshwater ecosystems, including lakes, ponds, reservoirs, rivers, streams, groundwater, and wetlands. It also consists of marine ecosystems, including oceans, estuaries, salt marshes, sea grass beds, coral reefs, kelp beds, and mangrove forest. Species losses and range shifts because of climate change, harvesting, and other human activities are altering aquatic biodiversity locally and globally.

Keywords: Biodiversity, aquatic biodiversity, climate change

Introduction

Rich biodiversity and healthy ecosystems are fundamental to life on our planet. Biodiversity or biological diversity refers to the existence of a wide variety of plant and animal species in their natural environments or the diversity of plant and animal life in a particular habitat (Verma, 2021a) [35]. Rich biodiversity ensure the ecological balance (Ashok, 2017) [2], which is necessary for sustainable development (Ashok, 2019; Verma, 2021b) [4, 36] and survival of all living organisms including humans (Ashok, 2018) [3]. Biodiversity or biological resources provide food, clothing, housing, medicine and spiritual nourishment to human beings (Verma, 2020). Apart from the rich flora, having 7% of the 89,500 animal species are found in the world (Prakash, 2017) [18, 25]. The fish diversity is subjected to the changes in land and water resulting into substantial losses of fishes and remaining species may be at a risk (Prakash, 2021a; Chakraborty *et al.*, 2021a) [21, 7].

Freshwater ecosystems account for 0.01% of the earth's surface water but 10% of species. Over 140,000 described species including 55% of all fishes rely on freshwater habitats for their survival. Aquatic biodiversity can be defined as the variety of life and the ecosystems that make up the freshwater, tidal, and marine regions of the world and their interactions. Aquatic biodiversity encompasses freshwater ecosystems, including lakes, ponds, reservoirs, rivers, streams, groundwater, and wetlands (Arya, 2021; Chakraborty *et al.*, 2021b) [1, 8]. It also consists of marine ecosystems, including oceans, estuaries, salt marshes, sea grass beds, coral reefs, kelp beds, and mangrove forests (Hendrik and Martens, 2005) [9]. Aquatic biodiversity includes all unique species, their habitats and interaction between them. It consists of phytoplankton, zooplankton, aquatic plants, insects, fish, birds, mammals, and others (Verma and Prakash, 2020; Kumbhar and Mhaske, 2020) [23, 27, 28, 15].

Aquatic biodiversity is the rich and wonderful variety of plants and animals from crayfish to catfish, from mussels to mayflies, from tadpoles to trout that live in watery habitats. Many species of animals and plants live in water; some, like fish, spend all their lives underwater, whereas others, like toads and salamanders, may use surface waters only during the spring breeding season or as juveniles. Some aquatic creatures live their entire lives in the deep ocean, while others, like water striders, spend their lives skipping along the surface of water.

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change (Prakash and Srivastava, 2019). The loss to biodiversity is mainly from habitat destruction, over-harvesting, pollution and inappropriate introduction of exotic plants and animals (Prakash, 2016; Kumar and Verma, 2017; Prakash and Verma, 2020) [17, 14, 23, 27, 28].

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Freshwater habitats are threatened by many factors, including pollution from industry, increased acidification, and agricultural runoff containing residues of fertilizers or pesticides. In addition, the building of dams destroys many river ecosystems. Development can harm aquatic habitats or remove them altogether, as when marshy areas are filled. The highest loss of freshwater biodiversity has been reported from the Indian subcontinent, specifically the Gangetic plains. Nevertheless, recently, it has been observed to decline rapidly due to environmental degradation like urbanization, damming, abstraction of waters for irrigation and power generation, and pollution. These environmental impacts have induced severe stress on freshwater fish diversity (Verma, 2016a; Sarkar *et al.*, 2008) [31, 30]. Conservation of biodiversity is a useful tool for managing clean up water and environment.

Inland Fish Diversity: Freshwater species are important to local ecosystems, provide sources of food and income to humans and are key to flood and erosion control. However, freshwater species are going to become extinct more rapidly than terrestrial or marine species. Almost one-third of freshwater biodiversity face extinction, largely due to habitat loss, introduction of alien species, pollution, and over-harvesting. This problem is expected to worsen as the human population grows.

The inland water resources are rich in aquatic biodiversity and the inland fishery sector plays an important place in socio-economic development of the country. India is the second largest producer of fish in the world and the historical scenario of Indian fisheries reveals a paradigm shift from marine dominated fisheries to inland fisheries. The aquatic resources of the inland resources are getting degraded due to pollution, water abstraction, flow modification, eutrophication, spread of invasive alien species, climate change, urbanization, etc. There is an urgent need to address the loss of India's aquatic biodiversity towards enhancing India's food, nutritional and livelihood security (Prakash and Verma, 2019; Jacob *et al.*, 2020) [24, 11]. The freshwater systems possess two distinct categories of faunal resources depending on the temperature regimes *viz.*, cold-water and warm water. The major cold-water resources are upper stretches of the rivers Indus, Ganga, Brahmaputra and their tributaries as well as several coldwater lakes and reservoirs. Some of the commercially important Indian cold-water species are *Tor tor*, *T. putitora*, *T. mosal*, *T. progeneius*, *T. khudree*, *T. mussullah*, *T. malabaricus*, *Naziritor chelynoides*, *Neolissochielus wynaadensis*, *N. hexagonolepis*, *Schizothorachthys progastus*, *S. esocinus*. Some of the commercially important warm water fish species of India include major and minor carps, *viz.*, *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *L. calbasu*, *L. bata*, *L. fimbriatus*, *L. dussumieri*, *Cirrhinus cirrhosa*, *C. reba*, *Puntius dubius*, *P. carnaticus* etc.; catfishes *viz.*, *Clarias batrachus*, *Heteropneustes fossilis*, *Sperata aor*, *S. seenghala*, *Wallago attu*, *Pangasius pangasius*, *Silonia silondia*, *Bagarius bagarius*, *Rita rita*, *Eutropiichthys vacha* etc.; murrels and other important species *viz.*, *Channa striatus*, *C. marulius*, *C. punctatus*, *C. diplogramma*, *Anabas testudineus*, *Chitala chitala* and *Notopterus notopterus* (Jena and Gopalakrishnan, 2012; Verma, 2016b; Prakash and Verma, 2017; Prakash, 2020a & 2020b; Prakash and Singh, 2020; Prakash and Yadav, 2020; Sanjay and Prakash, 2020) [12, 32, 18, 19, 20, 23, 28, 29].

Deep sea Fish diversity: The deep sea is a major reservoir of marine biodiversity. It is believed that the deep seabed supports more species than all other marine environment. Marine biodiversity and ecosystem are threatened by pollution, shipping, military activities and climate change, but today fishing presents the greatest threat. The greatest threat to biodiversity in the deep sea is bottom trawling. This type of high seas fishing is more damaging to seamounts and the cold-water corals they sustain. These habitats are home for several commercial bottom dwelling fish species (Prakash, 2021b) [22].

Coastal fish diversity: Coastal fisheries are critical resources for hundreds of millions of people. Many scientists now point to the dramatic over exploitation of fisheries and the subsequent decline in fish stocks as the major factor in marine ecosystem change over the past two centuries (Jackson *et al.*, 2001) [10]. Recent evidence has revealed that oceanographic and climatic variability has played a dominant role in fish stocks (Klyashorin, 1998; Babcock *et al.*, 2001; Attrill and Power, 2002) [13, 5, 6].

Impact of Climate change on Aquatic Biodiversity:

Climate change caused by anthropogenic activities is going to cause a major impact on water, forest, biodiversity, agricultural productivity, human health and sustainable development (Prakash, 2014; Verma, 2018 & 2021b) [16, 33, 22]. A large number of scientific studies and IPCC's (Inter Governmental Panel on Climate Change) fourth assessment reports are now available. According to these documents global climate change is unequivocally proved as a 'reality'. Indian wetlands face severe ecological problems due to human activities and face increasing pollution, loss of species to total extinction.

Global warming, sea level changes, mining activities and natural hazards like floods, tsunami and earthquake are the major threats to coastal ecosystems. Current rapid urbanization; industrialization and economic development have led to increasing pollution, land and water degradation and loss of biodiversity. Biodiversity in India is already under threat and is projected to decline in future due to multiple pressures such as increased land use intensity.

Conclusion

Biodiversity is not only the richness of species; it is also their genetic variety and the multiple habitats and ecosystems in which these plants and animals live. Aquatic Biodiversity, the variety of life in freshwater, tidal and marine ecosystems assume high significance to mankind by acting as sources of food, energy, atmospheric oxygen, buffers against new diseases, pests, and predators, and protection against food shortages and global climate change. It is found that freshwater protected areas commonly result in increased fish abundances for those threatened fishes which are extremely important for biodiversity conservation and management.

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