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Talhat Munir

Department of Zoology,
University of Gujrat.

Dr. Mubashar Hussain

Department of Zoology,
University of Gujrat.

Sana Naseem

Department of Zoology,
University of Gujrat.

Water Pollution-A Menace of Freshwater Biodiversity: A Review

Talhat Munir, Dr. Mubashar Hussain, Sana Naseem

Abstract

From all the described species of biodiversity, 6% belongs to fresh water and has great importance as source of food, building material, preventing flood and erosion. It contributes to economic productivity, and treasury to genetic material. On Earth, freshwater is the most transformed and threatened ecosystem due to many threats. Water pollution is one of them, which include both point and non-point sources by human activities. Water pollution causes many haphazards, so protection of freshwater biodiversity from this is the ultimate challenge.

Keywords: Fresh-water, Biodiversity, Water-Pollution

Introduction

The contamination of water bodies with various types of pollutants (chemical, physical, radioactive and pathogens) from different sources (industrial effluents, agricultural run-off, domestic sewage, construction activities and mining activities) is major threat to freshwater biodiversity [1]. It causes a large number of diseases and deaths worldwide, mostly in Africa and Asia [2]. Physical pollutants (temperature change and large objects) cause visual water pollution e.g. plastic bags released into water bodies by human activities (Hogan, 2014). Pathogens are exude from untreated sewage [3] and radioactive matter released from nuclear power plants [4]. Water pollution also caused by urban runoff and it contains toxins from land areas, impurities from street, dirt, debris, pesticides, and adulterant from vehicles [5].

Sources of water pollutants (point sources and non-point sources) are exude from sewage and agriculture run-off [4, 6, 7, 8]. In Africa, according to 1992 assessment, major causes of pollution are industries effluent, mining, and feces exude from land. Whereas in Asia major causes are eutrophication, heavy metals, pathogens, sediments from deforestation and organic matter. While in Europe, eutrophication, nitrates, pathogens, organic matter, acidification and pesticides are major causes of water pollution [9, 10].

Importance of Freshwater Biodiversity

Use of freshwater increased by 10% from 2000 to 2010 because of increase in population growth and economic development [9, 11]. About 40% freshwater used worldwide in irrigation for crop production [9]. Almost 20 to 40 litres per day water is used for drinking, sanitation, and its increases to 50 liters when bathing and kitchen is concern [10]. Human health, industrialization, economy, all depend on freshwater [12]. From all the described species, 6% belongs to fresh water [13]. Freshwater fish contribute 40% of the total fish [14] and freshwater molluscs form 25% of all the molluscs [15]. Phytoplanktons are basic producers of freshwater ecosystem [16]. Freshwater biodiversity is source of large number of goods and services for mankind [13, 17] including food, building material, preventing flood and erosion [18, 19]. It contributes to economic productivity, and treasury to genetic material [13, 20]. Fish is the main part of food web (Master *et al.*, 1998) and source of protein for billions of peoples [4]. In Africa, 21% protein obtained from fish whereas 28% in Asia [15]. Fresh water crabs being the part of food web play critical role in species richness by serving them as food [21]. Many freshwater species such as algae, worms, fungi, and many other bottom dwelling species play important role in ecosystem by processing the biological, chemical and physical processes [22]. Most of the carbon dioxide is emitted by freshwater system than land, so play important role in carbon cycle [23]. Mussels (filter feeders) clean the water by eliminating noxious particles [4]. Other freshwater organisms play important role in decomposition, contaminants removal, food production and sustaining water quality [23]. They have medicinal, agricultural and industrial

Correspondence

Talhat Munir

Department of Zoology,
University of Gujrat.

importance [4].

Threats to Freshwater Biodiversity

Freshwater threats are diverse and vary worldwide [24]. There are five interacting threats to freshwater biodiversity (Fig.1): habitat degradation, species invasion, flow modification, over exploitation and water pollution [13, 19, 25, 26]. Freshwater ecosystem is the most threatening ecosystem of the world because it includes vulnerable, endangered and critically endangered species from all the taxa [25]. Freshwater ecosystems are vulnerable due to invasive species and change the physical, chemical and ecological conditions of the system [23]. Non-native species

alter the predator-prey relationship and also relationships with other living communities [22] causing destruction of native species such as introduction of non-native Nile perch into lake Victoria cause disappearance of many species of native haplochromine cichlids [23]. Globally, freshwater diversity is reduced due to interacting threats [27]. Among them, 32% amphibians, 12% birds, 23% mammals' species are known as threatened [13].

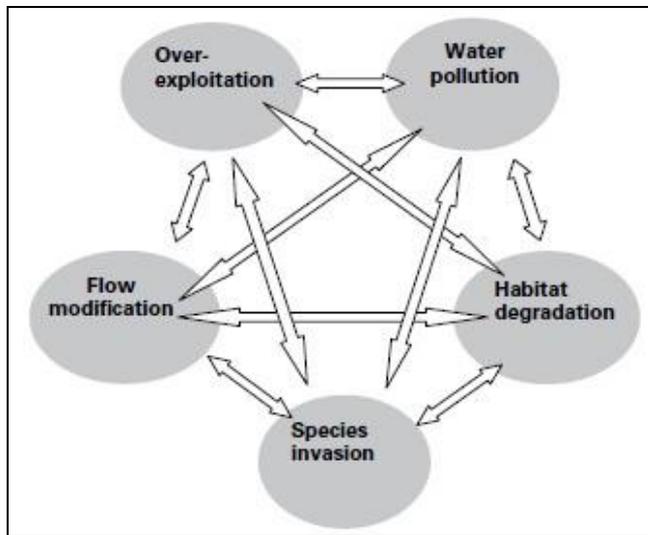


Fig 1: Major Threats to Freshwater Biodiversity [13]

Major threat to freshwater biodiversity is increased climatic temperature. As temperature increases, evaporation increases, chemical properties of water changes, and chances of salination become more due to increase sea level [28].

Water pollution affects the water quality and reduces the water supply [9, 29]. It also reduces the oxygen supply, used by fish and other aquatic organisms [22]. In Africa and other countries, pollution from point and non-point sources is major threat to freshwater biodiversity [13]. In Eastern Africa 40% species (threatened) are the result of water pollution due to over sedimentation [30]. Water pollution caused by the heavy metals contamination is major threat to freshwater biodiversity [31]. Acid rain (sublethal pollution) is major problem to freshwater fish fauna because these pollutant causes fish mortality with slow rate [32]. 20-30% fish population is

Threatened and vulnerable due to pollution, habitat loss, invasive species and overhunting [15, 33, 34]. Pollutant causes parasite infection in freshwater fish by depressing immune system of the fish [35]. Asian rivers are the habitat of three dolphins out of five [22] all these three are endangered species due to habitat loss, pollution and used to kill for gaining oil used in medicines [16, 30, 36, 37].

Conservation Challenges of Freshwater Biodiversity

About one third of all vertebrate species are restricted to freshwater ecosystem [13, 38] whereas most threatened and endangered biota of the world is freshwater biota [39, 40] therefore major conservation challenge of freshwater is to protect its biodiversity [13]. As the freshwater threats diverse and vary region to region [41] therefore there is no single method to resolve them [24]. There are five interacting factors that regulate freshwater ecosystem structure and function, these factors are flow pattern, sedimentation, biota, physical factors (light and temperature) and nutrients availability [18]. Freshwater biodiversity is conserved by using number of approaches such as protecting and conserving water bodies, catchment areas, and other management tools [41]. Point and non-point sources of water pollution are identified and controlled to conserve freshwater biodiversity [18]. Intentionally or non-intentionally constructed wetlands play major role to conserve freshwater biodiversity by controlling water pollution. They are considered as the best option for the treatment of wastewater [42]. Water pollution controlled by using macrophytes loaded in wetlands as wastewater treatment [43]. Recently huge effort has done to evaluate the conservation level of endangered species and identification of their survival threats [44]. There is immediate need of freshwater protected areas to conserve habitat and biodiversity. There should be interaction between scientist and policy makers to sustain the healthy freshwater ecosystem by applying the available information.

Conclusion and Recommendations

There are five interacting threats to freshwater biodiversity: habitat degradation, species invasion, flow modification, over exploitation and water pollution. These factors contribute in the reduction of freshwater species and cause major degradation of freshwater ecosystem. Freshwater ecosystem is regulated by five interacting factors: flow pattern, sedimentation, biota, physical factors (light and temperature) and nutrients availability. There should be communication between scientists and policy makers about the importance of freshwater biodiversity to ensure conservation of biodiversity by the application of all obtained information.

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