Inland Waters Biodiversity - What's the Problem?

We used to think that energy and water would be the critical issues for the next century. Now we think water will be the critical issue (Mostafa Tolba of Egypt, former head of the United Nations Environment Programme)

The biodiversity of freshwater ecosystems is declining faster than for any other biome. More». Vast changes are expected in world freshwater resources and hence in the ecosystem services provided by freshwater systems. Managing these changes is critical to human well-being.

Threats to inland waters biodiversity

The primary indirect drivers of change leading to the loss of inland waters biodiversity have been the growth of human populations, in particular in coastal areas, coupled with growing economic activity. Human pressures on rapidly diminishing areas of inland waters resources are increasingly compromising many of the ecosystem services crucial to the well-being of peoples and their economies.

Habitat change, leading to the degradation and loss of inland water ecosystems and species, has been mainly driven by infrastructure development (such as dams, dikes, and levees) and land conversion. The clearing, transformation or drainage for agricultural development has been the principal cause of inland wetland loss worldwide. Coastal areas have been particularly affected by development-related conversion, leading to large-scale losses of habitats and services. Aquaculture development, resulting in the loss of mangroves, and deforestation for firewood and other land uses have also caused major changes in inland waters habitat.

Over the past four decades, excessive nutrient loading has emerged as one of the most important direct drivers of ecosystem change in inland and coastal wetlands. Most land-based activities from agriculture and human settlements generate pollution, land erosion (causing siltation) and nutrient runoff (causing eutrophication), which all exert their impacts on inland waters. Nutrient loading is projected to become increasingly important drivers in the next 50 years. Rivers carry most land-based impacts into coastal areas and the oceans, thereby threatening other important ecosystems.

The unsustainable use of water is a particularly important driver of biodiversity loss, particularly as there are significant competing demands placed on water and these are set to increase. Agriculture accounts for about 70% of all water extracted from rivers. Increased human use of fresh water has reduced the amount available to maintain the ecological character of many inland water ecosystems. Over-harvesting of inland waters, including fisheries for food, recreation or trade, is also a major threat and leads to the decline of indigenous species population.

While habitat loss is the primary cause of extinction of freshwater species, the introduction of non-native invasive species is the second most important cause of decline. As exotic species are introduced, whether accidentally, for fisheries or for pest control purposes, the productivity ar the nutrient cycling of the invaded inland water ecosystem are both altered. Moreover, the invasive species often compete with the indigenous life resulting in the disruption of the food web. There may also be a loss of genetic integrity through hybridization and the introduction of diseases is enhanced.

Impacts of climate change on inland waters biodiversity

Global climate change is projected to become increasingly important drivers in the next 50 years and is expected to exacerbate the loss and degradation of many wetlands biodiversity and to harm the human populations dependent on their services. However, projections about the extent of such loss and degradation or decline are not yet well established. Climate change is projected to lead to increased precipitation over more than half of Earth's surface, and this will make more water available to society and ecosystems. However, increases in precipitation will not be universal, and climate change will also cause substantial decrease in precipitation in other areas. Despite the benefits that increased precipitation may provide to some freshwater wetlands, the projected changes in climate are likely to have pronounced harmful impacts on many wetland ecosystems.

Specifically:

- Many coastal wetlands will change as a consequence of projected sea level rise, increased storm and tidal surges, changes in storm intensity and frequency, and subsequent changes in river flow regimes and sediment transport.
- There will be adverse consequences for wetland species, especially those that cannot relocate to suitable habitats, as well as migratory species that rely on a variety of wetland types during their life cycle.
- Global climate change impacts will often exacerbate impacts of other drivers of degradation of wetlands. For example, decreased precipitation as a result of climate change will exacerbate problems associated with already growing demands for water. In limited cases, however, global climate change could lessen pressure on some wetlands, particularly in areas where precipitation increases.
- The incidence of vector-borne diseases such as malaria and dengue and of waterborne diseases such as cholera is projected to increase in many regions.

Why do we lose wetlands?

There are a number of widely accepted reasons why many types of wetlands such as lakes, marshes, mangroves, tidal fats, and estuaries continue to be lost, converted, or degraded even though benefits gained from maintaining them often are greater than the benefits associated with their conversion:

- The individuals who benefit most from the conservation of wetlands are often local residents, including many who are likely to have been disenfranchised from decision-making processes.
- Decisions concerning the fate of wetlands, however, are often made through processes that are unsympathetic to local needs or that lack transparency and accountability.
- Decision-makers at many levels are unaware of the connection between wetland condition and the provision of wetland services and the consequent benefits for people. In very few instances are decisions informed by estimates of the total economic value of both the marketed and non-marketed services provided by wetlands.
- Many services delivered by wetlands (such as flood mitigation, climate regulation, groundwater recharge, and prevention of erosion) are not marketed and accrue to society at large at local and global scales. More degradation of these "public goods" takes place than is in society's interests. Individuals often do not have incentives to maintain the services for the benefit of wider society. Further, when an action results in the degradation of a service that harms other individuals, market mechanisms do not exist (nor, in many cases, could they exist) to ensure that these individuals are compensated for the damages they suffer.
- The private benefits of wetland conversion are often exaggerated by subsidies such as those that encourage the drainage of wetlands for agriculture or the large-scale replacement of coastal wetlands by intensive aquaculture or infrastructure, including for urban, industrial, and tourism development.
- In some cases, the benefits of conversion exceed those of maintaining the wetland, such as in prime agricultural areas or on the borders of growing urban areas. As more and more wetlands are lost, however, the relative value of the conservation of the remaining wetlands increases, and these situations become increasingly rare.

Future scenarios

Vast changes are expected in world freshwater resources and hence in the ecosystem services provided by freshwater systems. Central to future scenarios is that fresh water is both essential to human development (in particular for the provision of more food and improved sanitation to a rapidly growing population) and is impacted by increased land-use pressures.

Land use change is expected to continue to be a major driver of changes in the provision of ecosystem services up to 2050. Global climate change is expected to exacerbate the loss and degradation of many wetlands and the loss or decline of their species and to harm the human populations dependent on their services. However, projections about the extent of such loss and degradation or decline are not yet well established. Under the Millennium Ecosystems Assessments scenarios, water availability is projected to decrease in 30% of the world's rivers.