



# The Environmental and Social Importance of Ecosystems

The first United Nations World Water Development Report (WWDR1) noted that a healthy and unpolluted natural environment is essential to human well-being and sustainable development, stressing that aquatic ecosystems and their dependent species are an integral part of our lives and provide a resource base that helps us to meet a multitude of human and ecosystem needs (UN-WWAP, 2003). These goods and services include water for human consumption, food production, irrigation, energy generation, regulating services (e.g. flood mitigation, water filtration, aquifer recharge and nutrient cycling), and transport and recreational services. Their value is irreplaceable, and they are an important part of the water, energy, health, agriculture and biodiversity (WEHAB) sectors, which are

essential for poverty alleviation and socio-economic development. The ecosystem approach further focuses on coastal and freshwater ecosystems, which are stepping stones for migratory birds and fish species and provide global environmental services that underpin the natural functions of the Earth. But, as WWDR1 shows, these ecosystems are under severe pressures that threaten their ability to meet the multiple and growing demands placed upon them.

## Goods and services

All ecosystems, aquatic and terrestrial, play a role in regulating the way water flows through the landscape, highlighting the need to better understand the relations between them and manage them in an integrated way.

Forests absorb precipitation and regulate streamflow, while wetlands act as sponges, absorbing excess water in times of heavy rain and high tides and releasing water slowly during dry periods. Aquatic ecosystems play a number of vital roles in human society: regulating climatic extremes, providing food resources and, in the case of freshwater, sustaining agricultural production. Many other human lifesupporting goods and services (see Table 5.2) are derived from aquatic ecosystems, including:

- hydrological regulation of floods, availability and supply of water during dry periods
- sediment retention, water purification, and waste disposal
- recharge of groundwater supplies
- drinking water and sanitation for large populations
- irrigation water for crops and drinking water for livestock
- coastline protection
- climate change mitigation through greenhouse gas absorption and impact buffering
- recreation and tourism
- cultural and spiritual values
- a range of goods such as fibres, timber, animal fodder and other food products
- transport routes – sometimes the only accessible routes
- hydroelectric and mechanical power.



The ability of any particular aquatic ecosystem to supply the range of services listed above depends upon a variety of factors, such as the type of ecosystem, the presence of key species, management interventions, the location of human communities and the surrounding climate and topography. Few sites have the capacity to provide all of the above services. Whereas recreation opportunities may depend only on the presence of clean water, for example, the provision of fish for food usually depends upon the presence of a fully functioning food chain to sustain the fish populations. Generally speaking, the more biologically diverse an ecosystem is, the greater the range of services that can be derived from it. There is some evidence from aquatic systems that a rich regional species pool is probably needed to maintain ecosystem stability in the face of a changing environment (UNEP Millennium Ecosystem Assessment, 2006).

Aquatic ecosystems refer not only to coastal waters, rivers and lakes, but also to a complex and interconnected system of permanent and temporary habitats, with a high degree of seasonal variation. Temporary habitats play a key role in the overall value of water ecosystems. For example, coastal estuaries and river floodplains are among the most productive ecosystems on Earth (Junk et al., 1989). Some, such as the Amazon floodplain, stretch over thousands of kilometres, while others may be only a few metres wide. Seasonal variation is vital for the integrity of such ecosystems, as many fish depend on the seasonal inundation of river floodplains for breeding or feeding.



The extent of flooding is in these cases positively correlated with fish catches (Welcomme, 1979). Many tropical freshwater wetlands have a low nutrient status, as in the black and clear floodplains in Amazonia (Furch, 2000). In these systems, high biodiversity is not an indicator of high productivity, but rather of quick and efficient nutrient recycling. These habitats are particularly vulnerable to overexploitation. Estuaries and river floodplains also have an important role in dissipating high tides and river flows and preventing flood damage and coastline erosion. In many countries, river floodplains also serve as nutrient-rich sites for agriculture.

The precise value of many of these services (particularly their monetary value) remain poorly understood. However, direct use values of water buffering (e.g. flood prevention) alone have been estimated at US \$350 billion at 1994 prices, and recreational values at US \$304 billion (Constanza et al., 1997). It was estimated that reef habitats



provide human beings with living resources, such as fish, and services, such as tourism returns and coastal protection, worth about US \$375 billion each year (Constanza et al., 1997). Economic losses from degradation can also be serious. One example is coastal erosion, which results from altered currents and sediment loads caused by changes in coastal and upstream land use. The beaches of Tangiers in Morocco, for instance, largely disappeared in the 1990s after new ports were built. The destination lost 53 percent of its international tourist night-stays and substantial tourism income, estimated at about US \$20 million per year (Blue Plan, 2005). Figure 5.1 roughly summarizes some of the estimates for marine ecosystems.

Even though inland and coastal harvests continue to increase, maintained mainly by aquaculture expansion, most coastal and freshwater systems are stressed by overfishing, habitat loss and degradation, the introduction and presence of invasive species, pollution, and the disruption of river flows by dams and other diversions (FAO, 1999 and Revenga et al., 2000).

This degradation threatens not only the biodiversity of riverine and lacustrine ecosystems, but also the food security and livelihood of millions of people – particularly those of poor rural and coastal communities in the developing world. The following section provides a brief overview of the status of freshwater and coastal ecosystems around the world.

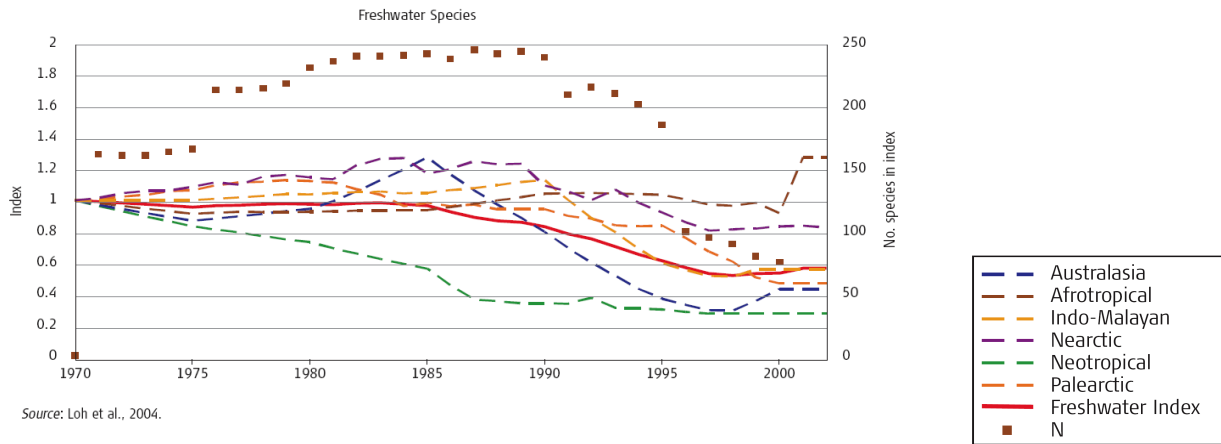
### Status of and Trends in Ecosystems and Biodiversity

Freshwater and coastal ecosystems comprise a range of highly productive habitats, such as lagoons, estuaries, lakes, rivers, floodplains, small streams, ponds, springs, aquifers and wetlands.

The term 'wetland' describes a particular group of aquatic habitats representing a variety of shallow, vegetated systems, such as bogs, marshes, swamps, floodplains, coastal lagoons, estuaries, coral reefs and seagrass beds, where the shallowest sites are often transitional areas and can be seasonally or intermittently flooded (Groombridge and Jenkins, 1998).



Figure 5.2: Living Planet Index, 1970–2000



## Pressures and Impacts

Most aquatic ecosystems are vulnerable to a range of human activities. The likely impact of these activities varies from place to place and according to the type of habitat involved. Table 5.2 summarizes some of the key pressures with respect to different coastal and freshwater ecosystem types, as well as some of the goods and services that these ecosystems supply.



**Table 5.2: Major threats to coastal and freshwater ecosystems and services**

Ecosystem	Goods and services	Threats
Rivers	Many environmental, economic (e.g. fish, water supplies, transport disposal, biological cleaning, climate regulation, etc.), religious and spiritual values	Redamation, drainage, regulation of flow including dam construction, hydroelectric power, pollution, deforestation, soil erosion and degradation, climate change and alien invasive species
Estuaries	High biodiversity, fish, waterfowl, sedimentation, buffer zones, biological cleaning, recreation	Reclamation, drainage, irrigation, hydroelectric power, regulation of water flow, dams and dykes, pollution, agricultural intensification, deforestation, soil erosion/degradation, overexploitation of fish and other food species, climate change, waterborne disease control, and alien invasive species
Coral reefs	High species diversity, coastal protection, biological cleaning, tourism	Climate change, suspended solids from coastal construction, upstream agriculture and logging, tourism; nutrients from untreated sewage and agricultural runoff; pollution from industrial discharges, urban, agricultural and landfills runoff, mining
Mangroves	High species diversity, coastal protection, water purification, CO <sub>2</sub> absorption, breeding and nursing grounds for commercial fish species, source of firewood and timber, coastal protection, tourism	Cutting for firewood and building materials, timber industry, road construction, reclamation for aquaculture, agricultural, urban and industrial areas, tourism developments, and sea-level rise
Sea-grass beds	High species diversity, nursing grounds for commercial fish species, coastal protection, water purification, CO <sub>2</sub> absorption, sediment stabilization	Dredging for harbours, ports and shipping lanes, fishing by benthic trawling, aquaculture, coastal pollution, and clearance for beaches and other tourism developments and facilities
Inland deltas	Water supplies, sediment and nutrient retention, recreation	Drainage, irrigation, regulation of water flow, pollution, agricultural intensification, deforestation, soil erosion/degradation, overexploitation of fish and other food species, climate change
Floodplains	High productivity, high fish and fibre productivity, flood buffers, fire protection, carbon storage, recreation, groundwater recharge	Redamation, drainage, irrigation, hydroelectric power, regulation of water flow, dams and dykes, pollution, agricultural intensification, deforestation, soil erosion/degradation, overexploitation of fish and other food species, climate change, waterborne disease control, and alien invasive species
Lakes	Water supplies, fibre, fish, waterfowl, recreation, groundwater recharge, religious and spiritual values	Pollution, agricultural intensification, eutrophication, deforestation, soil erosion/degradation, overexploitation of fish and other food species, climate change, waterborne disease control, and alien invasive species
Freshwater marshes	Flood buffers, carbon storage, reed, willow, food and fibre, purification	Drainage, regulation of water flow, dams and dykes, pollution, agricultural intensification, soil erosion/degradation, overexploitation of fish and other food species, and waterborne disease control
Raised bogs	Carbon storage, fossil fuels, purification	Reclamation, drainage, regulation of water flow, pollution, agricultural intensification, eutrophication and climate change
Fen mires	Carbon storage, pastoralism, willow, reed, groundwater recharge	Redamation, drainage, regulation of water flow, pollution, agricultural intensification, and climate change
Alpine meadows	Species diversity, husbandry, pastoralism, recreation, groundwater recharge	Drainage, agriculture and climate change
Tundra wetlands	Carbon storage, climate regulation, water flow, subsistence hunting and herding, groundwater recharge	Pollution, climate change, overexploitation of fish and other food species
Forest swamps/shrubs	Timber and fibre, biological cleaning, sanitation, flood buffers, groundwater recharge, purification	Deforestation, soil erosion, degradation and pollution
Groundwater aquifers	Water reservoirs, water storage, storage of nutrients	Irrigation, pollution, agricultural intensification, eutrophication, deforestation, soil erosion/degradation, overexploitation of food species and waterborne disease control
Freshwater springs and oases	Water and food supplies, stop-over sites for migratory species, recreation, religious and spiritual values	Irrigation, agricultural intensification, pollution, overexploitation of fish and other food species, and alien invasive species
Wet grasslands	Carbon storage, food supply, flood buffers (mostly on floodplains), groundwater recharge	Regulation of water flow, drainage, agricultural intensification, eutrophication, overexploitation of food species, and climate change
Ponds, gravel pits, drainage channels	Water supplies, recreation	Pollution, eutrophication and overexploitation of fish and other food species

Source: UNEP and UNEP-WCMC, 2004.

## Floods

Catastrophic floods cause human tragedy, endanger lives and bring heavy economic losses.

In addition to economic and social damage, floods can have severe environmental consequences, for example when installations holding large quantities of toxic chemicals are inundated. The coming decades are likely to see a higher flood risk in Europe and greater economic damage.

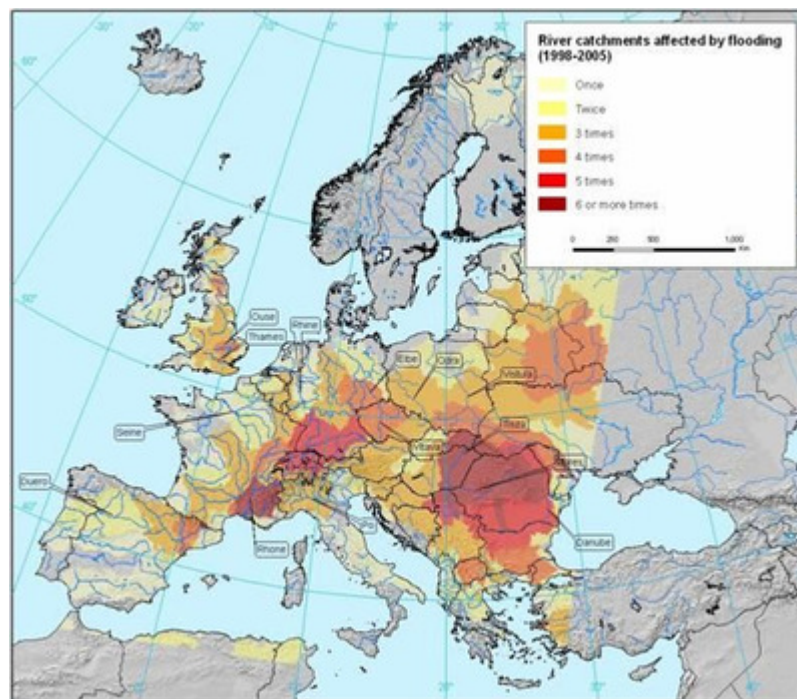
During the last five years Europe has suffered over 100 major damaging floods, including the catastrophic floods along the Danube and Elbe rivers in summer 2002, in northern



Caucasus in July and August 2002, in the Alps in summer 2005 and along the Danube in spring 2006. Since 2000, floods in Europe have caused at least 700 deaths, the displacement of about half a million people and at least EUR 25 billion in insured economic losses.

Some areas have been more affected than others. Between 1998 and 2005 north-western Romania, south-eastern France, central and southern Germany, northern Italy, and eastern England experienced the highest concentration of repeated flooding.

#### Recurrence of flood events in Europe between 1998 and 2005



**Source:** EEA based on Global Active Archive of Large Flood Events, Dartmouth Flood Observatory.

### Climate impacts on water resources

The main climate change consequences related to water resources are increases in temperature, shifts in [precipitation](#) patterns and snow cover, and a likely increase in the frequency of flooding and droughts.

Depending on the region, climate change will have widely differing effects on Europe's water. Higher temperatures will generally intensify the global [hydrological cycle](#). Annual [precipitation](#) trends in Europe indicate that northern Europe has become 10%-40 % wetter over the last century, whereas southern Europe has become up to 20 % drier. Over the last century annual river discharge has increased in some regions, such as eastern Europe, while it has fallen in others, such as southern Europe.



Climate change may also markedly change the seasonal variation in river-flow. Higher temperatures will push the snow limit upwards in northern Europe and in mountainous regions. This, in conjunction with less [precipitation](#) falling as snow, will result in a higher winter run-off in northern European and mountain-fed rivers, such as the Rhine, the Rhône, the Po, and the Danube. Moreover, earlier spring melts will lead to a shift in peak flow levels. As a result of the declining snow reservoir and decreasing glaciers, there will be less water to compensate for the low flow rates in summer.

Climate change tends to increase the frequency and intensity of rainfall; there may be an increase in the occurrence of flooding due to heavy rainfall events. Groundwater recharge may also be affected with a reduction in the availability of groundwater for drinking water in some regions.

Changes in average water availability in most European river basins are estimated to be relatively small for the next 30 years. However, in the long-term most climate change scenarios predict that northern and eastern Europe will see an increase in annual average river flow and water availability. In contrast, average run-off in southern European rivers is projected to decrease. In particular, some river basins in the Mediterranean region, which already face [water stress](#), may see marked decreases of water availability.

### **Socio-economic impacts**

Changes in Europe's water resource will have consequences for several economic sectors. Low water and droughts have severe consequences on most sectors, particularly agriculture, forestry, energy, and drinking water provision. Activities that depend on high water abstraction and use, such as irrigated agriculture, hydropower generation and use of cooling water, will be affected by changed flow regimes and reduced annual water availability. Moreover, wetlands and aquatic ecosystems will be threatened. This will affect the sectors that depend on the goods and services they provide.

### **Climate change and European water policies**

The integration of climate change into European policies such as the Water Framework Directive (Directive 2000/60/EC) has not taken place yet. The directive itself



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does not include specific provisions to address climate change impacts. However, upon request from EU Member States, an extensive assessment of the potential impacts of climate change on water resources was carried out in 2005 ([Eisenreich, 2005](#)). In February 2007, a symposium organised by the EU German Presidency discussed [climate change and the European water dimension](#). In October 2005, the European Commission launched the second phase of the European Climate Change Programme focusing on impacts and adaptation. To support this process the EEA has compiled a summary of best practices in Member States in adapting to climate change in the water sector ([EEA, 2007](#)). This will be followed by a Green Paper from the Commission in 2007.

Climate change is also part of the Directive on Flood Risk Management; it is one of the key issues to consider when Member States undertake an initial assessment of the flood risks and draw up the risk management plans. Similarly, climate change has to be taken into account in relation to water management planning regarding droughts and water scarcity.

Learn more on: <http://www.eea.europa.eu/themes/water/water-resources>