



Wetlands in Europe: Perspectives for restoration of a lost paradise



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ABSTRACT

Although 80% of their original area has been lost in the past millennium, Europe's wetlands still cover large areas in the northern part of the continent. Most original wetland types are still represented: bogs and fens are common in the boreal, atlantic and temperate parts of the continent. Riverine wetlands, although strongly reduced in size and functionality, still occur along Europe's streams and rivers. Freshwater tidal wetlands have become very rare in Europe's temperate zone. European wetlands are valued because of their biodiversity and their ecosystem services; their protection and restoration is supported by the Ramsar Convention, EU directives and national legislation for nature protection in the various states. These actions need to be intensified to stop any further degradation of the resource and its many services. The ecosystem services of wetlands should be taken into account in management decisions on land and water use. Multiple wetland restoration initiatives in river catchments and fen areas are good examples of the way forward.

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1. Wetlands in the European context

The European continent has a relatively long coastline relative to its land area: with 66,000 km, its coastline is even longer than that of Asia, which has a 5 times larger land area than Europe (National Geographic Atlas of the World 7th Ed). The continent also has major mountain ranges bordering extensive areas of lowlands, e.g. the Ural, Alps and Pyrenees. The many rivers flowing from the mountains to the sea give rise to many wetlands: wet depressions, floodplains, brackish marshes and mudflats in the estuaries near their mouths. A major proportion of the European continent also has cool, temperate climates with mild oceanic conditions. In these areas, e.g. Scandinavia, the British Isles, as well as the western part of the continent until the Alps and Pyrenees, peatlands have developed over large surfaces. It is a well-known fact that Europe, until one millennium ago, had relatively extensive wetland complexes, with vast peatlands particularly in the north and floodplains and estuarine wetlands in the lowlands toward the coast.

Another typical feature of the European continent is that human settlements, after a relatively late start about 5000 years ago, have increased to the point that the land cover started to show drastic changes relatively early, about 1000 years ago. Agricultural activities and the large-scale use of wood for construction and fuel, led to progressive deforestation, drainage of peatlands and embankment

of floodplains for flood protection. These ever more intensive activities have resulted in massive losses of pristine wetland habitats and the development toward 'novel' semi-natural ecosystems as remnants of the previous wilderness in an agricultural setting. There are no formal assessments of wetland loss for the European continent, but losses have been roughly estimated to amount to 80% of the total resource (Spiers, 1999). The greater part of these losses has taken place in the past 75 years (EU, 2007). This is a high value compared to estimated losses in North America (50%), while Asia may have lost a similarly high percentage as in Europe.

The first large-scale reclamations of peat bogs and fens for agriculture took place in the western part of The Netherlands in the 11th–12th century (Borger, 1992; Pons, 1992). Extensive peat excavations with rational methods followed from the 17th century onwards. In the 19th and 20th century, the Dutch were called in to drain wetlands in many other European countries, e.g. Great Britain, Germany and Russia. Control structures to fix river courses for the purpose of flood control, agricultural use of floodplains and guaranteed navigation started in the late 19th century; placing dams to generate electricity followed not long afterwards. As a result, most of the large European rivers have lost their ecological functioning in terms of meandering, flooding regime, braided channels, oxbows and freshwater tidal wetlands (Nienhuis et al., 2002; Petts et al., 2006).

Hence, although vast areas of wetlands have completely disappeared from the European continent, many wetlands of great importance can still be found. Part of these wetlands is in a near-pristine state, e.g. the wet tundra and peatland ecosystems in northern Scandinavia and Russia. By far the most wetlands are,

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Table 1
Wetland ecosystem services (de Groot et al., 2002).

- Flood detention and water storage
- Nutrients and contaminant retention: better water quality
- Carbon fixation and storage
- Enhancement of offshore fisheries
- Feeding grounds for river fish
- Cultural heritage and ecotourism
- Biodiversity and gene pool

however, present in landscapes strongly modified by man in terms of water management and land use. In Northern Europe, many former peatlands have been drained and forested, while remnants of the former bogs and fens remain, often near rivers or lakes or in protected nature reserves. Peatlands, riverine wetlands and freshwater tidal wetlands and saltmarshes in temperate Western Europe are often reduced in size compared to their original area, but may still be valuable in terms of biodiversity and ecosystem services. Increasing awareness on the importance of ecosystem functioning and biodiversity conservation has resulted in increased interest in restoration of ecosystems. As wetlands are among the best examples of ecosystems with a whole range of goods and services (de Groot et al., 2002), these systems have a relatively high priority in restoration schemes.

2. Wetland ecosystem services and their relevance in the European context

The most important ecosystem services that have been recognized for wetlands are listed in Table 1. Although all these services are relevant in the European context, some of them have lost importance in Europe over the past centuries, whereas others have increased. Carbon sequestration is an ecosystem function performed mostly by peatlands. In particular the vast surfaces of bogs and patterned mires in Northern and Central Europe were once a large, globally important carbon sink (Armentano and Menges, 1986; Armentano and Verhoeven, 1990; Maltby and Immirzi, 1993). As a result of large-scale peat excavations and drainage of bogs and fens for forestry and agriculture, the area of wetlands performing this function in Europe has greatly decreased. The same is true for floodplain wetlands performing services of flood detention and water storage. In some of the most important river basins, e.g. the Rhine and the Danube, the area of active floodplains in connection with the river channel has become so small that river water levels at times of high discharge become very high, providing a risk of devastating flooding to human settlements and agricultural land. At the same time, the river water has no chance to fill depressions and pools in the landscape, so that drought periods have become more damaging. Moreover, the role of floodplains as a foraging resource for fish and waterfowl has been strongly reduced as well.

A wetland service that has increased in importance in Europe is the nutrient and contaminant retention function. Most of Europe has a long tradition of agriculture, with a strongly increased intensity of farming during the past 100 years. Intensive livestock raising and high-intensity crop farming have resulted in high nutrient loading of the landscape, affecting streams, lakes and wetlands (Kronvang et al., 1995, 2005). Examples of regions where leaching of nitrates and, to a lesser degree, also phosphates have eutrophicated the surface water to a major degree are Southern Sweden, Denmark, The Netherlands and the Po catchment in Italy. In these areas, water quality in inland lakes as well as coastal waters has severely deteriorated (Arheimer and Wittgren, 1994; Hoffmann and Baattrup-Pedersen, 2007; Vermaat and Hellmann, 2010; Windolf et al., 2011). Wetland ecosystems in catchments

have been shown to have a positive effect on water quality by nutrient retention (Sabater et al., 2003; Verhoeven et al., 2006). Interest in the protection of riparian buffer zones to enhance water quality has increased and in Southern Sweden large-scale restoration of wetlands in agricultural catchments has been planned and realized (Arheimer and Wittgren, 1994, 2002; Tonderski et al., 2005). Although the EU has called for buffer zones along natural streams that should remain free of intensive agricultural activities, there is no international incentive for restoring or creating riparian wetlands in Europe.

Wetlands in Europe are extremely important habitats for biodiversity conservation. Not only are wetlands inhabited by their characteristic plant, animal and microbial species, they also play an important role in the life cycle of migrating birds. Biodiversity conservation in Europe benefits from EU policies such as the Birds and Habitat directives since 1979 and 1992, respectively. The areas that have become protected under these directives are gradually forming the Natura 2000 network of protected nature areas in Europe. Wetlands that are part of this network have specific conservation targets and a well-protected status. Further, all European countries have endorsed the Ramsar Convention and have identified wetlands of international importance as so-called 'Ramsar sites', which brings obligations for nature protection and limitations of human use. Another major EU policy is the Water Framework Directive (WFD), which has given a methodology to set water quality standards in the various member states and, once implemented, will be the legal framework for compliance to these standards. Wetlands have also been considered in the WFD, resulting in incentives for wetland restoration (EU, 2003).

3. Perspectives for wetland protection and restoration in Europe

Wetland protection in Europe may seem guaranteed with the appropriate legislation at three different levels, i.e. Ramsar, the EU directives and the national legislations in the various European countries. In theory, destruction or damage to major pristine wetlands should have stopped entirely by now. However, there are still threats for precious wetlands; in some cases, concessions for drainage or excavation of peatlands have been given in the past. Destruction of wetlands, even if they are protected, is not uncommon if major economic interests are at stake, e.g. for constructions of roads, airports, shopping centers, etc. While often mitigation is required and wetland areas have to be created or restored for compensation of the losses, the balance may still be negative because of the high quality of the habitats lost. In other cases, the damage to nature is done while the mitigating measures are delayed, minimized or even canceled. A good example of the last case is the rewetting of the Hedwig Polder in The Netherlands, as a compensation for dredging in the Western Scheldt estuary to facilitate navigation. After The Netherlands and Belgium had agreed on this compensation in the Scheldt treaty between the two countries in 2005, regional pressure groups were able to delay the implementation for years, until the Dutch government decided in 2011 to cancel the rewetting altogether. After strong protests from the governments of Belgium and the European Commission, the decision has now been turned around and the polder will finally be rewetted. It remains necessary to critically watch the planning of infrastructural projects and land use schemes to prevent damage to valuable wetlands. Arguments of biodiversity conservation and the importance of wetland ecosystem services can go hand in hand to give wetland protection the momentum it deserves.

The perspectives for wetland restoration in Europe are very good, at least in some parts of the continent. Large wetland

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