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Short topic assessment:

Integrated approaches for wetland conservation and management

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Contents

1 Introduction

As a result of generations of human activity, most of today's wetlands in Europe exist within a mosaic of heavily managed land and highly exploited seascapes (EEA 2010a). Despite global and national recognition of their importance, Europe's wetlands remain under severe pressure.

Wetlands depend completely on the hydrological cycle (both natural and regulated by man) of the surrounding water catchment area. Because they receive and retain water from their surroundings, wetlands often are sinks that accumulate chemicals, sediments and other inputs from these areas.

In recent decades, growing public and political awareness of wetlands decline has led to improved commitments, policies and practices for their conservation and sustainable use throughout much of Europe. As wetlands - and the ecosystem services they provide – are increasingly recognised as a fundamental component of our life support system, attention to their conservation has amplified.

Despite such efforts, the loss of wetlands continues in many parts of Europe. Major threats include habitat destruction and fragmentation, the establishment and spread of invasive alien species, pollution from agricultural runoff, increasing water abstraction and use, overexploitation, and the increasing impact of climate change (EEA 2010a).

In parallel, during the last decades, traditional centralised national government retreated, and shifts in governance have occurred. In the 1990ies, power and authority of the nation states in the EU has been affected by three trends (Breton 2007). The first was from a top down regulation towards a more inclusive cooperative governance system, in which voluntary agreements played an increasing role. The second trend was from compartmentalisation and differentiation towards more policy integration. The third one is towards multi-level governance with responsibilities shifting from the national level both upwards to the EU and downwards to the regional and local levels. Some of these shifts in policy and governance also affected the way wetlands are used and managed, as has been seen in the development and implementation of the Water Framework Directive (WFD).

Pressures and threats on wetlands often operate at a higher scale than the actual wetland area. Changing hydrology and water quality directly affect the abiotic conditions of water dependent habitats and species. Within protected areas, for example site specific management measures are developed but often the state of biodiversity depends on the (abiotic) factors influenced from outside, i.e. the surrounding (farmland) landscape within the watershed.

Indeed, in spite of the general trend of improving water quality across Europe (especially a reduction of compounds such as phosphates), significant amounts of chemical pollutants (active hormonal substances, biocides and pharmaceuticals) transported by water from agricultural lands or urban areas continue to reach the wetland habitats through overland flow and seepage (EEA 2015).

Therefore, integrated approaches to policy, governance, management and conservation of water related habitats need to be taken at the level of river basins[1], with the full information and

[1] A river basin is the land area between the source and the mouth of a river including all of the lands that drain into the river.

participation of relevant stakeholders. Within the changing political, institutional, economic and ecological constellations there is a clear need for increased cross sector cooperation and integration. Such integrated approaches offer the opportunity to address some of the important challenges and threats faced by wetlands.

This short topic assessment provides a short overview of the current state and trends of wetlands and their biodiversity, identifies some barriers to their adequate and efficient management and conservation and explores some of the integrated policy and governance responses at EU to local levels that have been developed to address their continuing decline throughout the EU.

2 Wetlands in Europe

2.1 Definition of wetlands

The essence of wetlands is not easy to capture, and different international bodies often use slightly different definitions. Wetlands include both land and water environments and some wetlands can be seasonally aquatic or terrestrial. In general, wetlands are areas where water is the primary factor controlling the environment and the associated habitats. They typically occur where the water table is at or near the surface of the land, or where the land is covered by shallow water. The MAES process of mapping and assessing ecosystems and their services in the EU defines two types of wetlands (Maes e.a. 2013):

1. Inland wetlands: predominantly water-logged specific plant and animal communities supporting water regulation and peat-related processes. This class includes natural or modified mires, bogs and fens, as well as peat extraction sites.
2. Marine inlets and transitional waters: ecosystems on the land-water interface under the influence of tides with salinity higher than 0.5 ‰. They include coastal wetlands, lagoons, estuaries and other transitional waters, fjords and sea lochs as well as embayments.

Wetlands are complex, dynamic systems with fluctuating and undefined borders, and are difficult to classify. The wetland habitats listed in Annex I of the Habitats Directive (92/43/EC) and included in the Interpretation Manual of European Union Habitats – EU-27 (EC 2007a), are largely identified by their plant composition and in some cases by a range of ecological characteristics. In all, the directive lists some 40 wetland habitat types (EC 2007b).

2.2 Significance of wetlands

Biodiversity

Identification and classification of wetlands species is hampered by the fact that many species share their life cycle between freshwater and marine environments. However, wetlands are primarily very rich ecosystems in terms of biodiversity. Wetlands support high concentrations of birds (especially waterfowl), mammals, reptiles, amphibians, fish, invertebrate species and plants and are essential for some of the life stages of these species groups (Maltby 2009). For example, they provide hatching and spawning grounds for fish, and nesting, feeding, migratory and wintering areas for many species of birds (EEA 2010b). The periodical or seasonal fluctuations in hydrology typical of many wetlands impose harsh conditions on many species that have adapted to these conditions. The many adaptations that animal and plant species have developed to adapt to these extreme conditions have resulted in a high species and genetic diversity of these environments (Mitsch 2007). Because of the pressures on

wetlands in Europe, many of the species that depend on these environments for part of their life cycle are in an unfavourable conservation status.

Ecosystem Services

Although wetlands occupy less than 9 % of the Earth's terrestrial surface, they may contribute up to 40 % of global annual renewable ecosystem services (Zedler en Kercher 2005) such as fish and fibre, water supply, water purification, climate regulation, flood regulation, coastal protection, recreational opportunities (MEA 2005; ten Brink e.a. 2011).

When both the marketed and non-marketed economic benefits of wetlands are considered, the total economic value (TEV) of unconverted wetlands is often greater than that of converted wetlands (MEA 2005). The significance of wetland economic value is demonstrated by various studies, such as the one conducted in the *marais du Cotentin* (France) where wetland TEV was estimated at € 2 400 to € 4 400 per hectare (Bouscasse e.a. 2011).

The value of specific services provided by wetlands at European level has also been evaluated. Based on an extrapolation of detailed studies carried out in the Azores (Portugal) and Catalonia (Spain) (Cruz en Benedicto 2009; Brenner 2007), Ten Brink et al (2011) estimated annual value of natural water filtration provided by forests and freshwater habitats in the entire Natura 2000 network is € 2.2 – € 25 billion. Freshwater wetlands, including wetlands in Natura 2000 areas provide a significant proportion of this value (Table 2.1).

Table 2.1 EU-wide benefit of water filtration from Natura 2000 areas by land cover

Land cover type	Value from (Brenner 2007) in 2004 USD/ha/year	Value adjusted to 2009 EUR PPP/ha/year	Natura 2000 land cover (m ha)	Value of water filtration € bn
Temperate forest	$ 403	€ 363	25,84	€ 9,4
Freshwater wetland	$ 3 815	Average adjusted value of benefits from freshwater habitats: € 2 872	5,44	€ 15,6
Open freshwater	$ 1 011			
Riparian buffer	$ 4 747			
All other land cover types	N/A	N/A	48,72	N/A
Total				**€25.0**

Source: (ten Brink e.a. 2011)

Wetlands are also particularly important in relation to climate change adaptation and mitigation. As far as climate change mitigation is concerned, they represent significant carbon sinks (Table 2.2). They are therefore, a crucial factor in reducing the levels of greenhouse gases in the atmosphere (World Bank 2009; Morris e.a. 2013) and may account for as much as 40 % of global reserve of terrestrial carbon. Maintaining and restoring wetland habitats protects these carbon sinks; clearance and drainage can lead to peat collapse and further carbon emissions.

Table 2.2 Average carbon density (in tonnes of C per hectare) in selected ecosystems

Habitat type	Average carbon density estimated (t/ha)
Temperate forest	150
Boreal forest	410
Temperate grass	240
Deserts/Semi-deserts	40
Tundra	130
Wetlands	690
Cropland	80

Source: (World Bank 2009)

In terms of climate change adaptation, wetlands can play a significant role in reducing the likelihood or scale of extreme events possibly linked to climate change, such as flooding, sometimes at a lower cost than that of manmade risk reduction measures (ten Brink e.a. 2011). For example, it has been estimated that restoration of the original river landscape within the *Kalkense Meersen* Natura 2000 site (Belgium) can bring flood mitigation benefits between € 640 000 – € 1 654 286 per annum (Arcadis Belgium, ECNC, and EFTEC 2011).

2.3 Main factors of wetland degradation

Globally, the primary indirect drivers of degradation and loss of wetlands (population growth and increasing economic development (Asselen e.a. 2013; Davidson 2014)) result in direct pressures including drainage for agriculture - which is the main direct cause of wetland conversion (Asselen e.a. 2013) -, urban and infrastructure development, hydraulic engineering, land conversion, afforestation, water withdrawal, eutrophication and pollution, mining, overharvesting, overexploitation of groundwater resources, and the introduction of invasive alien species (MEA 2005; EC 2007b; Mediterranean Wetlands Observatory 2012). Wetlands are particularly vulnerable to specific use and management objectives maximizing one specific ecosystem service (such as agricultural production) at the detriment of the ecosystem integrity and the multiple services it provides without a clear understanding of the trade-offs and the associated true costs (UK National Ecosystem Assessment 2014). Figure 1 lists the top ten pressures and threats to wetland ecosystems as reported under the last round of Article 17 reporting (2007 – 2012) for the Habitats Directive. Overall, across the EU, changes in hydrological conditions are the most widespread pressure on wetland ecosystems.

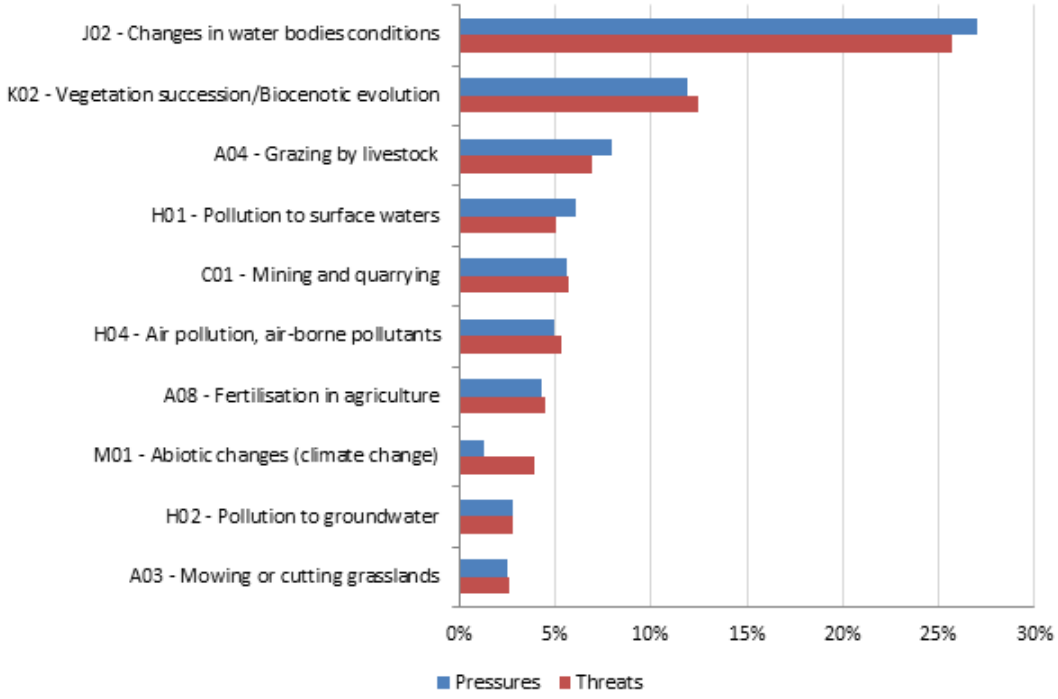

Figure 2.1 Top 10 (% of frequency) reported high ranked pressures and threats for habitats associated with inland wetlands ecosystem (MAES definition)

Notes: The total number of pressures and threats is respectively 604 and 579. No Article 17 report was provided by Greece.

Source: EEA 2015b, Article 17 reports and assessments.

Changes from wetlands to other land cover classes are visualised in Figure 2.2. Although these latest CORINE land cover data are already 10 years old, they are in line with the pressures and threats on EU wetlands as reported under the latest Article 17.

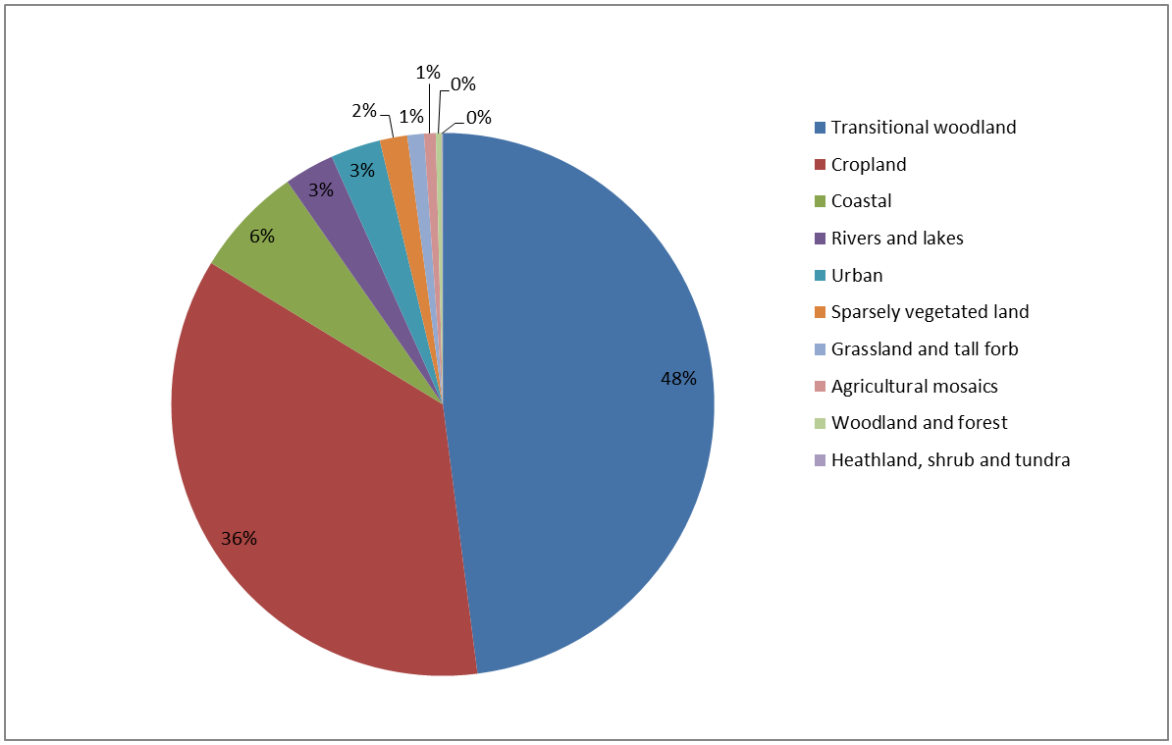

Figure 2.2 Changes in land cover between 2000 and 2006: Conversion of wetlands into other classes

Source: Corine Land Cover 2000 - 2006 changes provided by European Environment Agency (EEA); Corine Land Cover 2006 provided by European Environment Agency (EEA)

Indeed, the main land cover class to which wetlands are converted is transitional woodlands which correlates well with the second most reported pressure and threat which is natural succession / biocenotic evolution. This process is often triggered or enhanced as a result of changes in hydrological conditions, the most frequently reported pressure / threat.

In what follows, the main factors of wetland degradation are briefly described.

Inappropriate water resources management – According to the latest Article 17 reporting this is the most important factor of wetlands degradation (see Figure 2.1 "changes in water bodies conditions). The factors related to inappropriate water management include over-exploitation of water. This is especially severe in the Mediterranean, with agriculture being the main consumer (64 %), followed by industry (22 %) and domestic use (including tourism) 14 % (Mediterranean Wetlands Observatory 2012). Inappropriate management also affects the hydroperiod (with permanent water bodies becoming seasonal and vice-versa) and this has an impact on the plant and animal communities (Poff e.a. 2007). The modification of the hydrographic system through channelization, dam construction, and hydropower installation disturbs the water flow regime, blocking migration routes, and retains sediments (inducing coastal retreat).

Inappropriate land use practices – Globally, inappropriate land use practices, such as unsustainable forestry (e.g. clear cutting) and unsustainable intensive agriculture, especially in the upper watershed, can lead to increased soil erosion and reduced water retention capacity. Upland agriculture through land clearing and subsequent operation can have a major negative impact on water quality and also lead to significant changes in flood and dry season flows. Lowland agriculture can lead to the drainage or conversion of floodplain wetlands resulting in loss of biodiversity and natural functions and benefits. In the EU, land abandonment in combination with inappropriate management of water resources result in biocenotic evolution where wetlands gradually change toward transitional

woodland. In other places, inappropriate grazing intensities with livestock, and inappropriate mowing regimes represent important factors of wetland degradation.

Pollution – Pollution affecting wetlands can consist of solid waste and soluble (chemical) substances. The pressures related to solid waste seem relatively under control as waste management improved, but it is still a problem in southern and south-eastern European countries. Far more important pressures to wetlands are the soluble substances: nitrates and pesticides (agriculture), heavy metals, PAHs and PCBs (industry) and phosphates (domestic wastewater) (EC 2007b). According to the latest Article 17 reporting, in the EU, the most important sources of pollution affecting wetlands are surface water pollution, air borne pollution, pollution from agriculture (fertiliser use) and groundwater pollution.

Land conversion - Large scale conversion to agricultural and urban land use of extensive wetlands occurred in the 20th century but has now come to a halt in Europe. Most of the conversion happens in the margins of remaining wetlands. There is a special risk related to the high level of fragmentation that resulted from wetland conversion and the related loss of ecological connectivity (UK National Ecosystem Assessment 2014). Mining and quarrying is the most frequently reported pressure related to land conversion in the latest Article 17 reporting (see Figure 2.1). Conversely, many artificial wetlands have been created and some of them nowadays play a significant role in the conservation of certain species.

Climate change - Changes in rainfall patterns are already being observed throughout Europe and rainfall is expected to further decline in the coming decades, putting increasing pressure on wetlands (Mediterranean Wetlands Observatory 2012). It is identified as an important threat to wetland conservation by the experts consulted as part of the latest Article 17 reporting (see Figure 2.1). Northward movement of mobile species is observed to follow changes in climate (temperature and precipitation). Less mobile species such as amphibians and fish may not be able to catch up with the speed of change. Sea level rise puts a significant pressure on coastal wetlands through coastal squeeze.

Although not figuring among the top ten most frequently reported threats to wetlands conservation in the latest Article 17 reporting round, three other main factors of wetland degradation can be identified at global level, and are locally important throughout the EU.

Hunting, fishing and harvesting - In addition to all other threats to plant and animal communities, direct harvesting presents an additional pressure. Hunting is a significant factor threatening the conservation of many wetland species, especially in some countries in the Mediterranean. Fishing is less of a threat in freshwater wetlands, but can affect some species in particular (Mediterranean Wetlands Observatory 2012).

Disturbances - Tourism and outdoor activities present a real danger to many wetlands, in particular in coastal areas. Infrastructure development directly threatens some species, but also human disturbance including trampling is a significant factor. This is especially true for nesting sites of birds and turtles for example.

Invasive (alien) species - Invasive species (in particular introduced species of fish) are of particular concern to the conservation of wetlands. Once introduced, predatory fish can wipe out native species in a matter of years. Exotic fish species can also pose a great threat to amphibians.

2.4 Status and trends of wetlands

Drainage of wetlands has been common practice in Europe for centuries. However, the extent of this intervention has increased significantly in the past century, and especially in the last 50 years (EC 2007b), leading to a substantial decrease in the number, size and quality of the natural wetland habitats. This has altered the visual landscape and the environmental functions of these habitats. In particular, land reclamation has resulted in the fragmentation of the once connected network of wetlands (UK National Ecosystem Assessment 2014). In spite of increased awareness and certain moves towards wetland conservation, this trend continues, albeit more slowly (Table 2.).

Table 2.3 Surface area (km^2) of inland wetland ecosystem in 1990, 2000 and 2006

	1990	2000	2006
Inland marshes	9 729	9 702	9 727
Peatbogs	16 635	15 611	15 371
TOTAL	**26 364**	**25 313**	**25 098**

Source: Corine Land Cover
Geographical coverage: EU except Greece, Finland, Sweden and the United Kingdom

- In 2006, the total area of wetland ecosystems was over 25 000 km^2: 39 % inland marshes and 61 % peatbogs.
- In 2006, the total area of wetland ecosystems was around 5 % smaller than in 1990 for the same geographical area.
- In 2006, for the same geographical area as surveyed in 1990, there was no change in inland marshes and peatbogs had decreased by almost 8 %.

Wetlands continue to be lost to agricultural intensification and development. The main trend however, is for conversion of wetlands to forest and semi-natural areas. In some cases, this is through the planting of commercial crops but, in others, it is natural succession due to changes in water regimes, drying out and the colonisation of shrub and tree species (EEA 2010c). Nearly two thirds of inland wetland-related species of European interest and almost 85 % of all inland wetland habitats of European interest are in unfavourable status (Figure 2.3.). There are only some favourable habitat assessments for the Alpine and Macaronesian regions.

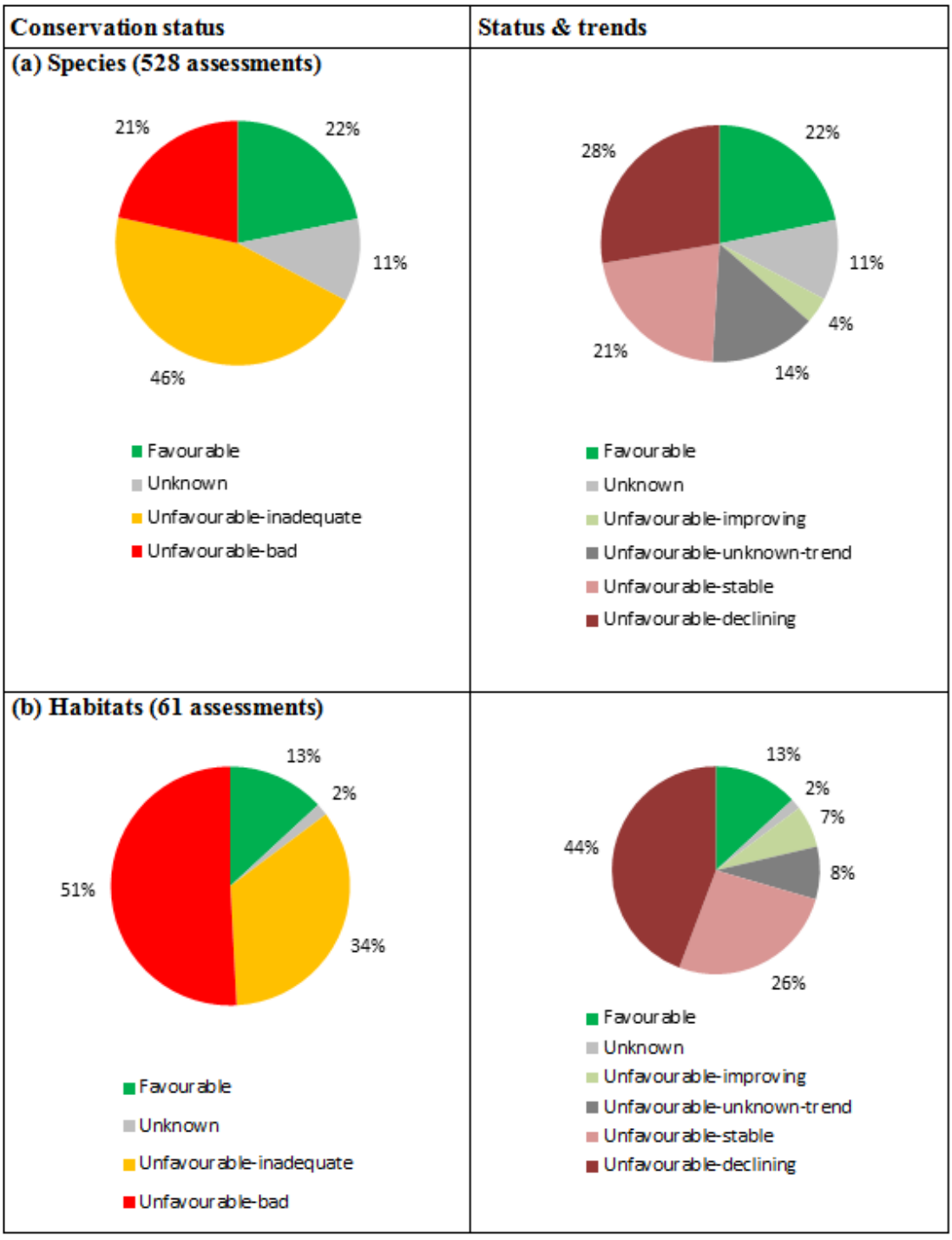

Figure 2.3 Conservation status and trends of non-bird species (a) and habitats (b) (Habitats Directive) associated with inland wetlands ecosystem (MAES definition)

Notes: Non-bird species are species from the Habitats Directive. The total number of assessments is 528 and 61 respectively for non-bird species and habitats. No Article 17 report was provided by Greece.

Source: EEA 2015b, Article 17 reports and assessments.

Wetlands play a significant role in the life cycle of 127 bird species of the Birds Directive. The latest Article 12 reporting (2007 – 2012) shows that the populations of 54% of these wetland dependent

birds are secure. However, the trends for 32% of populations are declining while 51% are either stable or increasing.

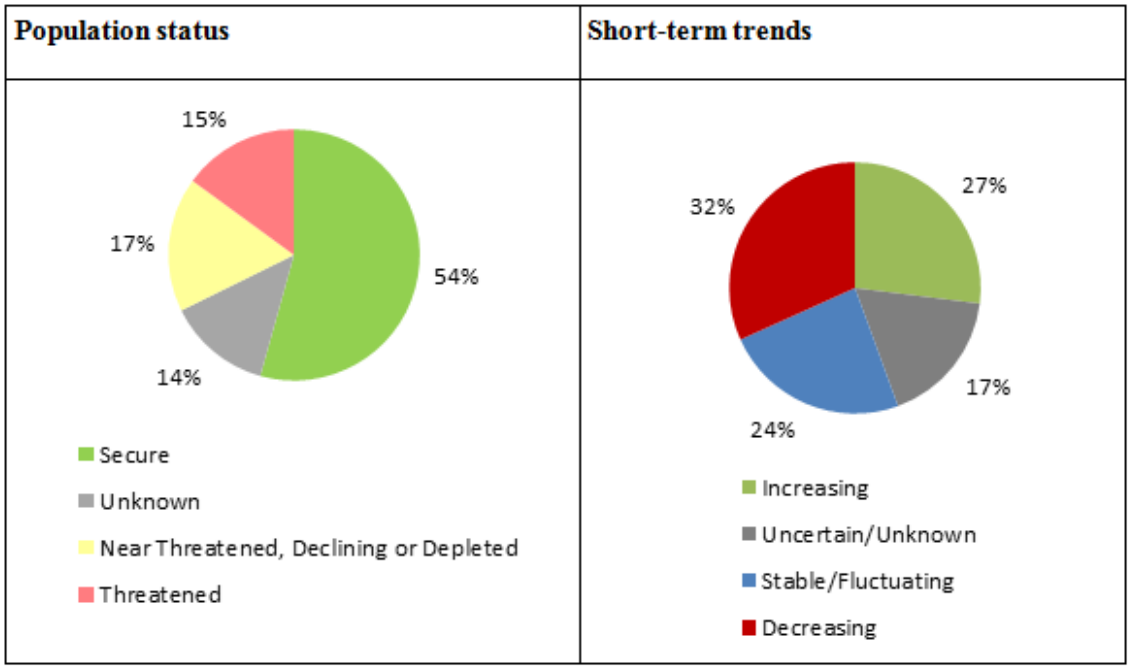

Figure 2.4 Population status and short-term trends of bird species associated with wetlands ecosystem (MAES definition)

Note: The total number of assessments is 127. No Article 12 report was provided by Greece.

Source: EEA 2015b, Article 12 reports and assessments.

2.5 Barriers to wetlands conservation and management

In spite of the increasing awareness of the worrying state and trends of wetland conservation status and the associated reduction of the multiple benefits and services they provide, effective measures for improving wetland conservation status are regularly hampered by a series of barriers typical for water dependent habitats.

One of the key issues identified in dealing with the conservation of wetlands is the division of management responsibilities for one river basin between different administrative authorities, resulting in fragmented approaches to water resources planning and management.

Many wetland-dependent species, especially fish and amphibians, require management in the river basin context to ensure their survival. The current governance structure for protecting habitats and wildlife along administrative boundaries can lead to protection measures for one site or species being nullified by activities elsewhere in the river basin.

Another key issue is the lack of awareness of the cross-sectoral nature of water issues and the need for a new development paradigm towards integrating the technical, economic, environmental, social and legal aspects of water management.

Water resources and wetlands are often the responsibility of separate sectoral agencies, each with their own objectives and modes of operation. As a result there are regular conflicts over water resource use and river basin management. In these considerations wetlands have not always been given the priority they deserve based on the important services they deliver in contributing to the maintenance of healthy and productive river systems (Ramsar Convention Secretariat 1999).

Finally, although wetlands provide major services, their benefits are inadequately identified and valued and therefore poorly reflected in planning and decision making (UK National Ecosystem Assessment 2014).

3 Integrated responses to wetlands decline

3.1 Legislation and strengthened policy integration

3.1.1 Legal framework

In addition to the global multilateral environmental agreements (notably the Ramsar Convention), in Europe, the main legal instruments for wetland conservation are the Birds Directive (EC 2009), the Habitats Directive (EC 1992) and the Convention on the Conservation of European Wildlife and Natural Habitats (Council of Europe 1979). In addition, most European countries have specific national measures for wetland protection integrating the provisions of the relevant MEAs and EU directives.

A series of legal documents regulating water quality and quantity have also become increasingly relevant for wetland conservation. These include the Directive on Urban Wastewater Treatment (EC 1991), the Nitrates Directive (EU 1991), the Groundwater Directive (EC 2006) and the Directive on Industrial Emissions (replacing the Directive on Integrated Pollution Prevention and Control or IPPC) (EC 2010b). With a focus on managing the flows of water, the Flood Risks Management Directive (EC 2007c) is also of direct relevance to wetlands, since wetlands play a vital role in water retention and act as an important buffer zone in the prevention of flooding.

To make the patchwork of water related legislation more coherent, the EU adopted the Water Framework Directive or WFD (EC 2000), creating a global and unified approach to water legislation. It sets up a new legislative approach, establishing objectives for water quality (all water bodies to meet good ecological status[2] by 2015) and protection. It also requires groundwater bodies to achieve good quantitative status.

The central feature of the WFD, around which all its other elements are arranged, is the use of river basins as the basic unit for all water planning and management actions (figure 5). This recognises that water respects physical and hydrological boundaries, but not political and administrative limits (WWF, 2001). The WFD is thus a key tool to protect and restore wetland biodiversity in terms of

[2] Achieving good status involves meeting certain standards for the ecology, chemistry, morphology, and quantity of waters. In general terms, good status means that water shows only a slight change from what would normally be expected under undisturbed conditions (i.e. with a low human impact).

creating appropriate chemical and hydromorphological conditions (EC 2007b). Although the WFD defines which biological elements must be taken into account when assessing ecological status, it gives the EU Member States a lot of flexibility in defining the details of their own assessment system (EC, 2009d).

Coastal and transitional waters are also covered by the Marine Strategy Framework Directive (EC 2008) and explicit links are established with the Habitats and Birds directives, the WFD and the Convention on Biological Diversity with regards to the protection of biodiversity, including coastal and transitional waters where coastal wetlands occur.

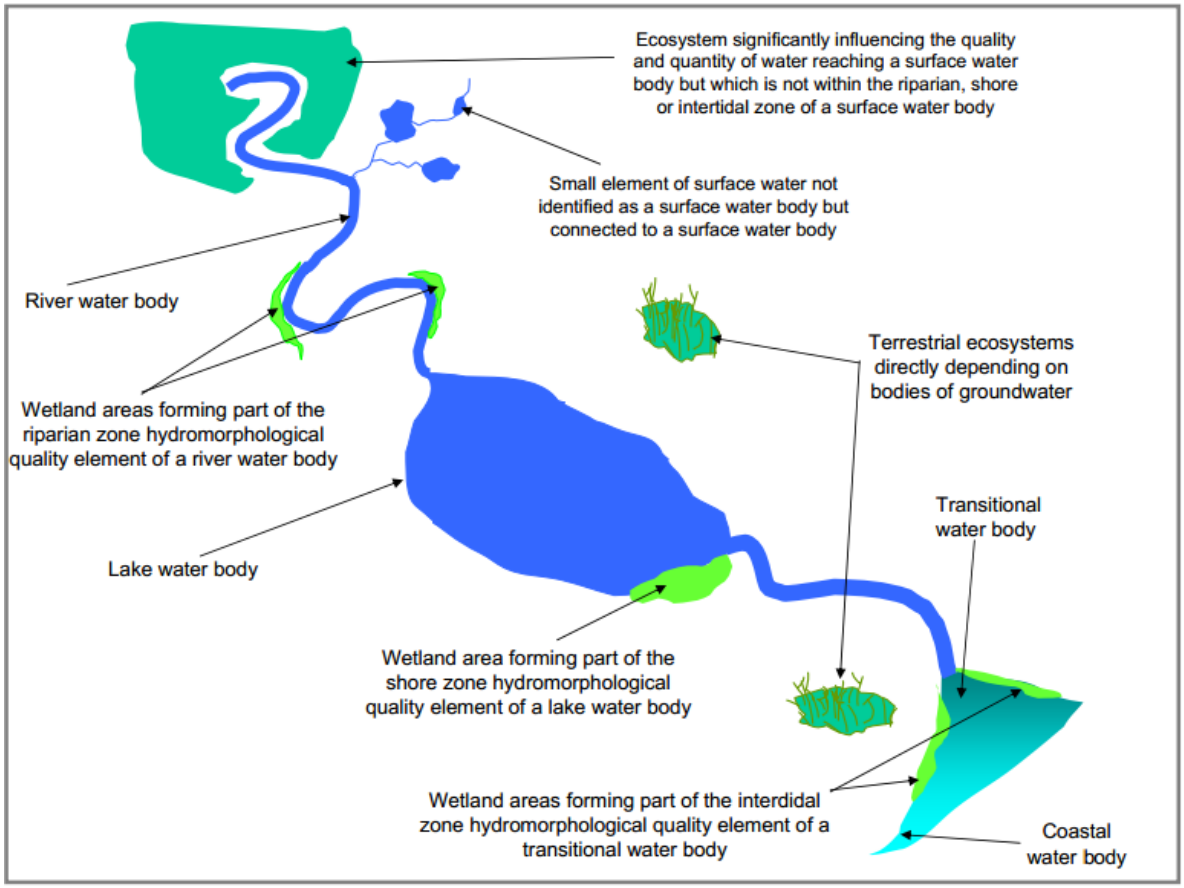

Figure 3.1: Ecosystems within a river basin that may be relevant to the achievement of the Water Framework Directive's objectives (EC 2003)

3.1.2 Policy integration

The EU policies on water and marine environment, nature and biodiversity are closely linked and together they form the backbone of environmental protection of Europe's ecosystems and their services. The key legislation in these areas described in the previous paragraph make cross-references to each other, in particular by ensuring that the protected areas established through the Natura 2000 network are integrated into river basin management and marine strategies. Also the objectives of good ecological status (WFD), environmental status (MSFD) and conservation status (Habitats and Birds Directives) set the basis for relevant measures which are mutually beneficial and will enhance the protection of biodiversity and ecosystem services. Also, certain provisions in these directives (e.g. reporting obligations) need to be applied within similar timeframes (EEA 2012). Furthermore, the EU

Biodiversity Strategy to 2020 (EC 2011b) sets a frame for action that encompasses nature conservation, restoration as well as marine and water protection among other issues. It also calls for an integrated monitoring and reporting framework. This offers an opportunity for streamlining and avoiding the risk of overlaps and unnecessary administrative burden. It is clear from the above that the objectives of protecting, conserving freshwater habitats and the services they provide depends on a wide range of policy responses within the complex legal framework described above. Therefore synergies need to be found between nature conservation policies and sectoral policies if wetland ecosystems are to be maintained or restored.

In order to assist WFD implementation, the EU Member States and the European Commission have developed the WFD 'Common Implementation Strategy' (WFD CIS), which was agreed in May 2001 (WWF 2001).

In view of the above, the EC Nature / Biodiversity and Water / Marine Directors meet at regular intervals to discuss further streamlining of these partly overlapping and potentially mutually reinforcing pieces of EU legislation. These meetings have resulted in the publication of guidance for all appropriate levels on how to best jointly implement the various interrelated directives.

For example, the WFD also ensures that protected areas of the Natura 2000 network are integrated into the river basin strategies. Indeed, Article 6 of the WFD in particular is linked to nature protection, addressing areas designated for the protection of habitats or species where the maintenance or improvement of the status of waters is an important factor in their protection, including relevant Natura 2000 sites designated under the Habitats and Birds Directive.

More recently, the EU Biodiversity Strategy to 2020 proposed a framework to 'halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss'. This strategy is aimed at contributing to the EU's transition towards a resource efficient and green economy. It is an integral part of the Europe 2020 Strategy (EC 2010a), and in particular the resource efficient Europe flagship initiative (EC 2011a).

In addition to aiming for a recovery of species and habitat conservation status through the full implementation of the Natura 2000 network, the Biodiversity Strategy to 2020 actively promotes and sets targets for habitat restoration and encourages the development of a green infrastructure. These processes require important investments and thus rely heavily on the assessment of the services and goods provided by the restored ecosystems and those included in the green infrastructure development. Wetlands, providing a wide range of benefits to society are core building blocks of the restoration agenda and the European green infrastructure.

3.2 Integrated and adaptive management and planning approaches

Actions taken upstream can have profound impacts on wetland resources downstream. Regional approaches such as integrated river basin management (IRBM) and integrated coastal management (ICM) are examples of 'ecosystem approaches'. Ecosystem approaches have been developed as an overall strategy for integrated environmental management promoting conservation and sustainable use in an equitable way. They focus on managing environmental resources and human needs across landscapes and are a response to the tendency to manage ecosystems for a single good or service, by trying to balance trade-offs to both human well-being and ecosystem services (MEA 2005).

Within the context of such ecosystem approaches, a critical requirement for wetland conservation and management is the introduction of land use and water planning and management mechanisms which focus at the river basin (or catchment) scale (UK National Ecosystem Assessment 2014). For this, the development of administrative units in water resource management has to coincide with river basin

boundaries instead of political boundaries (EEA 2014a). In addition it should be a multidisciplinary process and therefore has to be promoted as a collaborative framework among all the relevant agencies operating nationally and those involved within the river basin itself, as well as local communities (Ramsar Convention Secretariat 1999).

In spite of the many challenges these multidisciplinary and integrated approaches show to be able to lead to success. Cross-sectoral and ecosystem-based approaches to wetland management—such as IRBM, ICM or socio-ecological system (SES) approaches – that consider the trade-offs between ecosystem services and socio-economic activities – are more likely to ensure sustainable development than many existing sectoral approaches (MEA 2005; EEA 2010c).

Such integrated approaches use the potential for common synergies and benefits with regard to the environmental objectives and require the coordination of public participation procedures in their preparation. Including wetland management in this integrated implementation process is crucial, as wetlands are vital for water retention and as important buffers in the prevention of flooding.

Examples of good practice are collected and shared online, such as for example the Catchment Wise programme (Box 1) and the joint wetland Vision for England, a partnership project in which statutory agencies and voluntary wildlife groups are developing integrated catchment scale approaches in a number of key wetland areas across England (www.wetlandvision.org.uk).

Box 1 Sustainable Catchment Management Programme – ScaMP project and Catchment Wise programme promote cooperation for catchment level management

United Utilities owns 56 385 hectares of land in the North West of the UK, which it holds to protect the quality of water entering its reservoirs. Much of this land is home to nationally significant habitats for animals and plants, with around 30 % designated as a Site of Special Scientific Interest (SSSI). The Sustainable Catchment Management Programme (SCaMP), which has been developed in association with the Royal Society for the Protection of Birds (RSPB), aims to apply an integrated approach to catchment management across all of the water catchment land. This initiative helps to: protect and improve water quality, reduce the rate of increase in raw water colour which will reduce future revenue costs, reduce or delay the need for future capital investment for additional water treatment, deliver government targets for SSSIs, ensure a sustainable future for the company's agricultural tenants, enhance and protect the natural environment, permit moorland habitat to become more resilient to long term climate change, allow healthy upland peat moors to absorb significant volumes of carbon from the atmosphere.

United Utilities, together with the RSPB and the Department of Environment, Food and Rural Affairs (Defra) have transposed the positive experience acquired through the ScaMP project to a wider Catchment management programme (Catchment Wise), through which catchment level management projects are supported.

http://corporate.unitedutilities.com/catchmentwise.aspx

3.3 Appropriate governance models and stakeholder participation

3.3.1 At the international level

For cross-boundary wetlands, or wetlands that depend on cross-boundary river systems and aquifers, sovereignty is an important issue, making it more challenging to establish a basin-scale organization supported by appropriate governance arrangements. Alternatives such as intergovernmental agreements that mandate development of management arrangements at the basin scale may need to be explored. An important tool for public involvement is the development of a process for transboundary environmental impact assessment (MEA 2005).

In the case of cross-boundary river basins or water catchments, international cooperation is essential, if the above approaches to integrated management of wetlands are to be achieved. Indeed, riverine countries need to have a common vision for the efficient management and effective protection of shared water resources. One option to consider in achieving such outcomes is the establishment of international river commissions, created by several riverine countries to facilitate consultation and broad coordination (Ramsar Convention Secretariat 1999).

This is especially true for riverine and delta wetlands. The management and conservation of wetlands in estuaries and deltas of Europe's largest rivers depend to a great extent on land use planning in the entire upstream areas that often includes several countries. In Europe, international river commissions have been established for the Danube, the River Rhine (see Box 2), the River Sava and the River Mosel. Bilateral cooperation between countries also exists as for example in the case of the River Scheldt (between The Netherlands and Belgium).

In these international river commissions, countries sharing a drainage basin are encouraged to establish frequent specific contacts in order to exchange information on the water resource and its management. Options for this include (Ramsar Convention Secretariat 1999):

- establishing networks for monitoring and exchanging data on the water quality and quantity in the basin,
- a joint analysis of information on the quantity and type of water used for various purposes in each country;
- exchange of information on protection measures for groundwater, upper catchments and wetlands;
- sharing of information on structural and non-structural mechanisms for regulating flow for navigation and flood prevention.

International cooperation relevant for the management and conservation of wetlands also happens for coastal wetlands, such as the Common Wadden Sea Secretariat which coordinates the trilateral cooperation between Denmark, Germany and The Netherlands on the protection of the Wadden Sea.

Box 2 Restoration of the Biesbosch wetland: key role for coordinated international river basin management

The Biesbosch (the Netherlands) was a freshwater intertidal wetland until the closure of the largest river mouths of the Dutch Delta in 1969 and 1972. As a result, the tide was reduced from 2 meters to

barely 20 cm and the original rare and specialised habitats adapted to the hydrological dynamics were replaced through succession. The heavily polluted waters of the Rhine in the 1970ies and nitrogen deposition from surrounding farmland added further pressures on the ecosystem.

Cooperation between the Rhine River States, cooperating in the International Commission for the Protection of the Rhine, has resulted in a dramatic improvement of water quality over the past decades. In addition, many physical barriers for migrating fish have been removed. There are also plans to partly open the sluices at the river mouth in the coming years, and the hope is that this will bring back some of the natural dynamics associated with the tides.

The Biesbosch is protected as Natura 2000 site and as a National Park. It is also one of the major elements in a flood hazard reduction strategy: Room for the River. Wetland restoration goes hand in hand with the creation of large buffer zones that can be flooded during peak discharges, thus reducing the flood risk in the industrialised and heavily populated areas in the West of Holland.

3.3.2 At the national and subnational levels

Also at the national and subnational levels, the management of wetlands is very challenging because of their direct hydrological links with the surrounding landscape. River basins or river catchments and coastal and marine systems influenced by catchment discharges, are important geographical units for considering the management of wetlands and water resources.

This strong dependence of hydrological flows operates at various scales from the small brook catchment to the level of a river basin. Traditional forms of governance with centrally operating ministries are not very efficient in dealing with the ecosystem requirements of wetlands management. The recent changes towards more decentralisation and public private partnerships has given rise to novel forms of water governance in which the management priorities of wetlands can be better included. Not all of these governance types are new. Indeed, in The Netherlands, the water boards are the first governing institutions to have been created in the Middle Ages.

The institutional structures in place for land and water use should permit the integrated management of river basins as single units. Fundamental changes in the administrative structure of water resource management can be achieved through a step by step process. The first step is to establish a process of cooperation and collaboration between the agencies responsible for water resources management, environmental protection, agriculture, etc. Subsequently, representatives of these agencies assist in the establishment of a coordinating authority that assumes responsibility for managing water resources and the wetlands of the river basin. The Thau Basin Joint Management Authority (Box 3) provides a model where this approach has been successfully applied.

Box 3 Joint management authority of the Thau lagoon, France: an innovative governance model

The Joint management authority of the Thau lagoon allows spatial planning and water management policies to be jointly coordinated at the level of a watershed. It provides a coherent framework and tools for the spatial planning scheme (SCOT), the water management scheme (SAGE) and the Natura 2000 management plan by coordinating timetables and spatial perimeters.

This joint approach is particularly useful to integrate the protection of the watershed within the spatial plan, and to control the impacts of the land use plan on the lagoon.

The joint management authority also manages the integrated land management agreement for the Thau area which is original in several ways. The strategic committee provides a forum for consultation of all partners to participate in the land management around the watershed and lagoon. This committee ensures the representation of all stakeholders in the decision making process.

It brings together the contractors carrying out the activities described in the agreement, the partners involved in the financing of actions but also all the municipalities affected by the actions, which therefore have a say in the decision making regarding the project activities directly affecting their territory.

The relevance of each project is discussed at the committee meetings, in terms of its various issues. Structuring projects for the area can be proposed, involving multiple actions and multiple stakeholders, with the support of financial partners who will bring their insights into the modes of financing available for the territory.

It is a unique way of governance model that allows for a better integration of policies that for a long time remained too sectoral and demonstrates that projects can improve the lives and economic activity in the Thau basin area.

This method of governance enables to:

- reach agreement over commitments in a contract between the partners; joint programmes of action for the country; and synergy of financial and operational resources;
- have dialogue and communication between the local steering committee and the state services;
- establish a shared framework for actions and the assessment of their success.

http://www.smbt.fr/content/une-gouvernance-innovante

3.3.3 Involvement of stakeholders, community participation and public awareness

A priority when making decisions that directly or indirectly influence wetlands is to ensure that the decisions are informed by consideration of the full range of benefits and values provided by different wetland ecosystem services. At all levels of decision making wetlands are key elements of a hydrological system in which many users compete for the limited resources and services it provides (EEA 2014a). In order to address these competing demands, stakeholder participation at all stages of planning and development processes, combined with the use of scenarios, is essential for decision-making concerning wetlands, particularly when considering the environmental water requirements of wetlands (MEA 2005).

As in the wider environmental field, governance of river basins and catchment areas, where the most important decisions regarding wetland management are taken has increasingly included active public participation approaches (EEA 2014a). Although the principles of public participation are laid out in the UNECE 1998 Aarhus Convention on Access to Information, Public Participation and Decision Making and Access to Justice in Environmental Matters (UNECE 1998), this public participation is also explicitly defined in article 14 of the EU WFD. The Strategic Environmental Assessment Directive also includes requirements for public participation.

The appropriate measures for river basin management and its positive effects on wetland conservation and wise use require a delicate balance of the interests of various groups of stakeholders. In addition, an active involvement of citizens, interested parties and NGOs is required to ensure legal implementation and buy in by key influential actors. The success of such process requires

transparency, clarity and ownership of the process, also where information is concerned and establishing trust by appointing technical experts and independent facilitators.

The goal of public participation in planning and decision making at river basin level is to involve members of the public as well as organised stakeholders. Indeed many of the measures to improve water quality and resources management need to be supported, implemented or even initiated by actors other than the environmental and water authorities, in areas such as agriculture, energy and transport. In addition, participation in wetland management needs to take into account the multilevel nature of water governance and the need to link the natural boundaries of river basins with the administrative ones (UK National Ecosystem Assessment 2014).

An important element within the concept of integrated management is that planning and management institutions work with and for the entire community of water users in the basin, including wetland wildlife and users, as well as relevant stakeholders outside the river basin. In order to identify the needs and concerns of all water users, public participation in the planning and management of water resources is an important goal.

Until relatively recently there was little consultation on river basin and water resource planning in many countries. A management shift has taken place with a greater role being provided for civil society, with recent experience showing that effective collaboration between agencies and local people increases the chance of success in achieving effective river basin plans. Early consultations with the public can also help identify previously unknown uses and values of resources in the basin and help determine the relative importance of different values. Box 4 presents an example of such approach.

Box 4 A Consortium for Integrated Management and Governance in the Costa Del Garraf - Spain

A successful approach for sustainable and integrated coastal management, through the establishment of a local Consortium which includes municipalities, county councils, and the Regional Departments of the Government of Catalonia, to elaborate action plans and specific projects. This initiative is the implementation at the local level of all the European, national and regional ICM regulations, promoting the coordination and cooperation with institutional actors, scientists and social associations.

The Consortium was created in 2006 with the aim to sustainably manage a coastal, marine and land area in the county of Garraf. The basic objectives to be carried out are related to the protection and conservation of Garraf's coastal area, the adaptation to, and mitigation of, climate change, the integration of environmental and biodiversity conservation with an economic and recreational use of the coast, and finally, institutional and citizen coordination.

3.4 Knowledge, data and information and good practice

Policy implementation and decision making, as well as (participative) planning and management require a sound ecological and wider understanding of wetlands. There is also a need for reliable data and information about the functioning, state and trends of the wetland ecosystems that need to be managed, protected and sustainably used. Yet, understanding the ecological processes that regulate the services of wetlands remains a scientific challenge (UK National Ecosystem Assessment 2014). There still is considerable uncertainty about how ecosystem services are related to ecosystem

structure, functioning, habitat type, size, spatial extent and fragmentation. More research and monitoring are therefore needed to increase understanding of the wetland functioning, their conservation, management and sustainable use of the services they provide.

The sharing of information and knowledge is very important for the good functioning of the participatory planning and decision making process (EEA 2014a). Much of the information relevant for a sound participation is held by public authorities who may be reluctant to share it as it may be (mis)understood and used by non-specialists. It is therefore important to develop provisions that enable the technical information to be prepared or translated for use by different stakeholder groups. Mechanisms to include the knowledge held by stakeholders into the process are also needed. This is sometimes done on a one-to-one basis. But in general this knowledge and information is gathered through methods as public surveys.

In addition to scientific knowledge and data to better understand the functioning of wetland ecosystems and predict their likely responses to external pressures or changes in management, the success of integrated approaches also requires access to examples of good practice (EEA 2014a). Some principles of good practice that apply to the wetland management include: starting public participation early in the process; being clear about what the process involves; starting by a stakeholder mapping or analysis to know what range of different interests are present; adapting the way information is presented to the various types of audience; and using independent facilitation to reach consensus.

Many examples of catchment level projects and initiatives are presented online. The LIFE projects database (European Commission 2014a) is a rich source of EU funded environment projects including many directed towards sustainable water (basin) management. Another important source of good practice is the European Climate Adaptation Platform (EEA 2014b), where integrated wetland management approaches in the area of climate mitigation (wetlands as carbon sinks) and adaptation (wetlands and flood risk reduction strategies) can be found. More specifically relevant for coastal integrated management approaches is the EC OurCoast website (European Commission 2014b) which supports an ICM projects database.

4 References

Arcadis Belgium, ECNC, en EFTEC. 2011. *Recognizing Natura 2000 benefits and demonstrating the economic benefits of conservation measures - development of a tool for valuing conservation measures*. http://ec.europa.eu/environment/nature/natura2000/financing/docs/Recognizing_Natura2000_benefits.pdf.

Asselen, Sanneke van, Peter H. Verburg, Jan E. Vermaat, en Jan H. Janse. 2013. "Drivers of Wetland Conversion: a Global Meta-Analysis". *PLoS ONE* 8 (11): e81292. doi:10.1371/journal.pone.0081292.

Bouscasse, Hélène, Pierre Defrance, Claire Duprez, Pierre Strosser, Yann Beley, en Sylvie Morardet. 2011. *Evaluation économique des services rendus par les zones humides – Enseignements méthodologiques de monétarisation*. n° 49. Études & documents - Économie et Évaluation. Paris, France: Commissariat général au développement durable.

Brenner, J.G. 2007. "Valuation of Ecosystem Services in the Catalan Coastal Zone". PhD Thesis, Barcelona: Universitat Politecnica de Catalunya, Department of Hydraulic, Maritime, and Environmental Engineering. http://disccrs.org/dissertation_abstract?abs_id=1060.

Breton, Albert, red. 2007. *Environmental governance and decentralisation*. New horizons in environmental economics. Cheltenham, UK ; Northampton, MA: Edward Elgar. https://books.google.nl/books?id=zi4trDFXvzoC&pg=PA183&lpg=PA183&dq=decentralisation+nature+conservation+governance+eu&source=bl&ots=K5LQxg_N-K&sig=v7UhGpVKJnOKgZd9rNsJv4nxPbM&hl=en&sa=X&ei=qcBJVau_IILeaumsgZAI&ved=0CCYQ6AEwAA#v=onepage&q=decentralisation%20nature%20conservation%20governance%20eu&f=false.

Council of Europe. 1979. "Convention on the Conservation of European Wildlife and Natural Habitats". Council of Europe. http://conventions.coe.int/Treaty/Commun/QueVoulezVous.asp?NT=104&CM=8&DF=&CL=ENG.

Cruz, A de la, en J. Benedicto. 2009. *Assessing Socio-economic Benefits of Natura 2000 – a Case Study on the ecosystem service provided by SPA PICO DA VARA / RIBEIRA DO GUILHERME*. Output of the project Financing Natura 2000: Cost estimate and benefits of Natura 2000 (Contract No.: 070307/2007/484403/MAR/B2). http://ec.europa.eu/environment/nature/natura2000/financing/docs/azores_case_study.pdf.

Davidson, Nick C. 2014. "How much wetland has the world lost? Long-term and recent trends in global wetland area". *Marine and Freshwater Research* 65 (10): 934–41.

EC. 1991. "Council Directive 91/271/EEC concerning urban waste water treatment of 21 May 1991". Official Journal of the European Union. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31991L0271.

———. 1992. "Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora". Official Journal of the European Union. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20070101.

———. 2000. "Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 Establishing a Framework for Community Action in the Field of Water Policy". Official Journal of the European Union. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060.

———. 2006. “Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration”.
———. 2007a. “Interpretation Manual of European Union Habitats”. Office for Official Publications of the European Communities. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf.
———. 2007b. *LIFE and Europe’s Wetlands - Restoring a Vital Ecosystem*. European Communities. http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/nat.htm#wetlands.
———. 2007c. “Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks”. Official Journal of the European Union. (OJ L288, 6.11.2007, p.27).
———. 2008. “Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)”. Official Journal of the European Union. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF.
———. 2009. “Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version)”. Official Journal of the European Union. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0147.
———. 2010a. “Communication from the Commission: Europe 2020 - A strategy for smart, sustainable and inclusive growth”. European Commission.
———. 2010b. “Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) Text with EEA relevance”. Official Journal of the European Union. http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32010L0075.
———. 2011a. “Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy.” European Commission.
———. 2011b. “Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions: Our life insurance, our natural capital: an EU biodiversity strategy to 2020.”
EEA. 2010a. *Assessing biodiversity in Europe — the 2010 report*. EEA Report 5/2010. Copenhagen, Denmark: European Environment Agency. http://www.eea.europa.eu/publications/assessing-biodiversity-in-europe-84.
———. 2010b. *Ecosystem accounting and the cost of biodiversity losses The case of coastal Mediterranean wetlands*. No 3/2010. EEA Technical report. Copenhagen, Denmark: European Environment Agency. http://www.eea.europa.eu/publications/ecosystem-accounting-and-the-cost.
———. 2010c. *EU 2010 Biodiversity Baseline*. Copenhagen: European Environment Agency. http://www.eea.europa.eu/publications/eu-2010-biodiversity-baseline/.
———. 2012. *Water resources in Europe in the context of vulnerability*. EEA Report No 11/2012. Copenhagen, Denmark: European Environment Agency.
———. 2014a. “European Climate Adaptation Platform”. http://climate-adapt.eea.europa.eu/web/guest.
———. 2014b. *Public participation: contributing to better water management - Experiences from eight case studies across Europe*. EEA Report No 3/2014. European

Environment Agency. http://www.eea.europa.eu/publications/public-participation-contributing-to-better.

———. 2015a. *Freshwater Quality - European Briefing*. State of Europe's Environment Report 2015. Copenhagen, Denmark. http://www.eea.europa.eu/soer-2015/europe/freshwater.

———. 2015b. *State of Nature in the EU*. EEA Technical Report N°2/2015. Copenhagen, Denmark. http://www.eea.europa.eu/publications/state-of-nature-in-the-eu

EU. 1991. *Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources*. *OJ L 375, 31.12.1991, p. 1–8.*

European Commission. 2014a. "Environment - LIFE by Theme". http://ec.europa.eu/environment/life/project/Projects/.

———. 2014b. "Environment - OURCOAST". http://ec.europa.eu/ourcoast/index.cfm?menuID=3.

Maes, J., Teller, A., Erhard, M., Liquete, C., Braat, L., Berry, P., Egoh, P., e.a. 2013. *Mapping and Assessment of Ecosystems and Their Services: An Analytical Framework for Ecosystem Assessments under Action 5 of the EU Biodiversity Strategy to 2020: Discussion Paper - Final, April 2013*. Luxembourg: Publications Office Of the European Union. http://dx.publications.europa.eu/10.2779/12398.

Maltby, E. 2009. *Functional Assessment of Wetlands: Towards Evaluation of Ecosystem Services*. Elsevier.

MEA. 2005. *Ecosystems and human well-being: wetlands and water synthesis: a report of the Millennium Ecosystem Assessment*. Washington, DC: World Resources Institute.

Mediterranean Wetlands Observatory. 2012. *Biodiversity – Status and trends of species in Mediterranean wetlands*. Issue number 1. Thematic collection. Tour du Valat, France. http://medwet.org/2012/04/mediterranean-wetlands-outlook-2012/.

Mitsch, William J. 2007. *Wetlands*. 4th ed. Hoboken, N.J: Wiley.

Morris, Edward P., Susana Flecha, Jordi Figuerola, Eduardo Costas, Gabriel Navarro, Javier Ruiz, Pablo Rodriguez, en Emma Huertas. 2013. "Contribution of Doñana Wetlands to Carbon Sequestration". *PLoS ONE* 8 (8): e71456. doi:10.1371/journal.pone.0071456.

Poff, N. LeRoy, Julian D. Olden, David M. Merritt, en David M. Pepin. 2007. "Homogenization of Regional River Dynamics by Dams and Global Biodiversity Implications". *Proceedings of the National Academy of Sciences* 104 (14): 5732–37. doi:10.1073/pnas.0609812104.

Ramsar Convention Secretariat. 1999. *Guidelines for integrating wetland conservation and wise use into river basin management - Adopted by Resolution VII.18 (1999) of the Ramsar Convention*. http://www.ramsar.org/pdf/guide/guide-basins.pdf.

Ten Brink, P., T. Badura, S. Bassi, E. Daly, I. Dickie, H. Ding, S. Gantioler, e.a. 2011. *Estimating the Overall Economic Value of the Benefits Provided by the Natura 2000 Network*. Final Report to the European Commission, DG Environment on Contract ENV.B.2/SER/2008/0038. Brussels: IEEP / GHK / Ecologic. http://ec.europa.eu/environment/nature/natura2000/financing/docs/Economic_Benefits_of_Natura_2000_report.pdf.

UK National Ecosystem Assessment. 2014. *The UK National Ecosystem Assessment*. UK: UNEP-WCMC, LWEC. http://uknea.unep-wcmc.org/Default.aspx.

UNECE. 1998. "Aarhus Convention on Access to Information, Public Participation and Decision Making and Access to Justice in Environmental Matters". http://www.unece.org/env/pp/welcome.html.

World Bank. 2009. *Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change*. Washingotn DC.

WWF. 2001. *Elements of Good Practice in Integrated River Basin Management. A Practical Resource for Implementing the Water Framework Directive*. Brussels: World Wide Fund for Nature. http://www.wwf.eu/?7215/Elements-of-Good-Practice-in-Integrated-River-Basin-Management-A-Practical-Resource-for-Implementing-the-Water-Framework-Directive.

Zedler, Joy B., en Suzanne Kercher. 2005. "WETLAND RESOURCES: Status, Trends, Ecosystem Services, and Restorability". *Annual Review of Environment and Resources* 30 (1): 39–74. doi:10.1146/annurev.energy.30.050504.144248.