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European waters — assessment of status and pressures

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European Environment Agency

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The report is based on data delivered by the Member States via the Water Information System for Europe (WISE) up to May 2012 and in some cases information available in digital version of RBMPs. Member States and Stakeholders comments to the draft technical reports on ecological and chemical status and pressures and hydromorphology during the consultation in February and March 2012 have been included as far as possible. Where data are available, it has been dealt with, and is presented, to the best of our knowledge. Nevertheless, inconsistencies and errors cannot be ruled out.

The report contain sentences and paragraphs that is partly copy and paste of text from the multitude of documents produced on the WFD (Commission and national WFD guidance documents, RBMPs and Article 5 reports, etc.). Sources have been acknowledged in these cases.

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Acronyms and abbreviations

AWB	Artificial water body
BHDs	Birds and Habitats Directives
BOD	Biochemical oxygen demand
CAP	Common Agricultural Policy
DDT	Dichlorodiphenyltrichloroethane
DEHP	Di-(2-ethylhexyl) phthalate
EEA	European Environmental Agency
EFTA	European Free Trade Association
Eionet	European Information and Observation Network
EQS	Environmental Quality Standards
ETC/ICM	European Topic Centre on Inland, Coastal and Marine Waters
ETC/BD	European Topic Centre on Nature and Biodiversity
EU	European Union
GEP	Good ecological potential
GES	Good ecological status
HMWB	Heavily modified water body
IAS	Invasive alien species
NGO	Non-governmental organisation
NIS	Non-indigenous species
NREAP	National renewable energy action plan
NWRM	Natural water retention measure
PAHs	Polycyclic aromatic hydrocarbons
RBD	River basin district
RBMP	River Basin Management Plan
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
SCI	Site of Community Importance
SPA	Special Protection Area
SWMI	Significant Water Management Issue
TBT	Tributyltin
UWWT	Urban Waste Water Treatment (Directive)
WB	Water body
WFD	Water Framework Directive
WFD-CIS	Water Framework Directive Common Implementation Strategy
WISE	The Water Information System for Europe

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Executive summary

EEA 2012 'State of Europe's water' assessments

2012 is the European year of water in which the European Commission published its 'Blueprint to safeguard Europe's waters' (referred to hereafter as the Blueprint) comprising reviews of the Water Framework Directive (WFD) (2000/60/EC), water scarcity and drought and adaptation to climate change policies. To accompany and inform the blueprint, throughout 2012 the European Environment Agency (EEA) produced a set of reports on the state of Europe's water. The reports are developed in close cooperation and coordination with the assessment of the European Commission's Directorate-General for the Environment (Environment DG) of the River Basin Management Plans (RBMPs) and other Commission work preparing the Blueprint.

The first reporting of the RBMPs under the WFD was due at the end of 2009. Most Member States (23 of 27) have reported their RBMPs and delivered an enormous amount of data on status, pressures and measures to the Water Information System for Europe (WISE) WFD database. The report *European waters — assessment of status and pressures* is based on an assessment by the EEA of the RBMPs and data reported by Member States. The information in the RBMPs, together with other related sources of information, has been analysed to establish an assessment of the status of and pressures affecting Europe's waters. This work by the EEA reflects the cooperation with the Commission on the assessment of implementation of the WFD as laid out in Article 18 of the WFD according to which:

'The EU Commission shall publish a report on the implementation of this directive at the latest 12 years after the date of entry into force of this directive (two years after the Member States have delivered the RBMPs). The report shall among others include the following:

- a review of progress in the implementation of the directive;
- a review of the status of surface water and groundwater in the Community undertaken in coordination with the European Environment Agency.'

Improved knowledge, but ambiguous results due to data gaps and methodology issues

The quality of the EEA's assessments relies on the quality of the Member States' reports and data delivery. There are examples of very good, high-quality reporting. However, there are also cases where reporting contains gaps or contradictions. Bad or incomplete reporting can lead to wrong and/or incomplete assessments.

Due to delays in the development of national classification systems in many Member States, only a few biological quality elements could be used for assessing ecological status of water bodies for the first RBMPs. Many water bodies have been classified without actual monitoring of biology or chemical pollutants, and by using expert judgement partly based on the information compiled in the pressure and impact analyses.

The knowledge base to classify the ecological and chemical status, pressures and impacts was not optimal for the first RBMPs. However, compared to the situation before the WFD, there has been a significant improvement of the knowledge base and increased transparency by bringing together information on all characteristics, pressures and impacts on water bodies at basin level.

In the EEA's opinion, this report's results present good and robust European overviews of the data reported by the first RBMPs, and of the ecological status and pressures affecting Europe's waters. Caution is advised concerning country and river basin district (RBD) comparisons, as results may be affected by the methodology approach used by the individual Member State. Likewise, it is not advisable to draw detailed conclusions on the chemical status results: in the first RBMPs, there was a lack of chemical monitoring and of comparability of the information on chemical status of water bodies among Member States.

Trend in status of and pressures affecting waters up to the first RBMPs

Europe's waters are affected by several pressures, including water pollution, water scarcity and floods. Major modifications to water bodies also affect morphology and water flow. To maintain and improve the essential functions of our water ecosystems, we need to manage them well.

Clean unpolluted water is essential for our ecosystems. Pollutants in many of Europe's surface waters have had detrimental effects on aquatic ecosystems and resulted in the loss of aquatic flora and fauna and is cause for concern for public health. These pollutants arise from a range of sources including agriculture, industry, households and the transport sector, and they are transported to water via numerous diffuse and point pathways. Agriculture, for example, causes widespread problems of nutrient enrichment in inland and coastal waters across Europe, despite some recent improvements in some regions.

During the last 25 years, significant progress has been made in numerous European waters in reducing the pollution This progress includes improved wastewater treatment, reduced volumes of industrial effluents, reduced use of fertilisers, reduced or banned phosphate content in detergents, as well as reduced atmospheric emissions. Implementation of the Urban Waste Water Treatment (UWWT) Directive (91/271/EEC), together with national legislation, has led to improvements in wastewater treatment across much of the continent. This has resulted in reduced point discharges of nutrients and organic pollution to freshwater bodies. Water quality in Europe has therefore improved significantly in recent decades, and effects of pollutants have decreased.

For decades, sometimes centuries, humans have altered European surface waters (straightening and canalisation, disconnection of flood plains, land reclamations, dams, weirs, bank reinforcements, etc.) to facilitate agriculture and urbanisation, produce energy and protect against flooding. The activities result in damage to the morphology and hydrology of the water bodies, in other words, to their hydromorphology. Such activities result in altered habitats and have severe and significant impacts on the status of the aquatic ecosystems.

There are several hundred thousand barriers and transverse structures in European rivers. In many river basins, the continuity of the rivers is interrupted every second kilometre. Many water courses have their seasonal or daily flow regimes changed for various purposes, including damming for hydropower production and storage of irrigation water. Transitional and coastal habitats have been altered in many ways: by dredging, land reclamation and hard infrastructure for coastal protection and erosion management.

Ecological and chemical status, pressures and impacts

The WFD requires that all the issues mentioned above are addressed in order to ensure that by 2015 all water bodies have good status. For surface waters, there are two separate classifications, ecological and chemical status. Groundwater bodies are classified according to their chemical status and quantitative status. For a water body to be in overall good status, both chemical status and ecological or quantitative status must be at least good.

The European Union (EU) Member States have via the RBMPs reported information from more than 13 000 groundwater bodies and 127 000 surface water bodies: 82 % of them rivers, 15 % lakes, and 3 % coastal and transitional waters. The results are analysed below.

Ecological status

- More than half of the surface water bodies in Europe are reported to be in less than good ecological status or potential, and will need mitigation and/or restoration measures to meet the WFD objective.
- River water bodies and transitional waters are reported to have worse ecological status or potential and more pressures and impacts compared to water bodies in lakes and coastal waters.
- The pressures reported to affect most surface water bodies are pollution from diffuse sources, in particular from agriculture, causing nutrient enrichment, and hydromorphological pressures resulting in altered habitats.
- The worst areas of Europe concerning ecological status and pressures in freshwater are in central

and north-western Europe, while for coastal and transitional waters, the Baltic Sea and Greater North Sea regions are the worst.

A large proportion of water bodies, particularly in the regions with intensive agriculture and high population density have poor ecological status and are affected by pollution pressures. The situation calls for increased attention to achieve good water quality and ecological status. Despite some progress in reducing agricultural inputs of pollutants, diffuse pollution from agriculture is a significant pressure in more than 40 % of Europe's water bodies in rivers and coastal waters, and in one third of the water bodies in lakes and transitional waters. The RBDs and Member States with a high proportion of water bodies affected by diffuse pollution are found in north-western Europe in particular, and correspond to the regions with high fertiliser input and high river nitrate concentration. Discharges from wastewater treatment plants and industries and the overflow of wastewater from sewage systems still cause pollution: 22 % of water bodies still have point sources as a significant pressure.

Hydromorphological pressures and altered habitats are the most commonly occurring pressures in rivers, lakes and transitional water, affecting around 40 % of river and transitional water bodies and 30 % of the lake water bodies. The hydromorphological pressures are mainly attributable to hydropower, navigation, agriculture, flood protection and urban development.

Chemical status

The information provided in the RBMPs on chemical status is not sufficiently clear to establish a baseline for 2009. The chemical quality of water bodies has improved significantly in the last 30 years, but the situation as regards the priority substances introduced by the WFD is not clear. The assessment of chemical status presents a large proportion of water bodies with unknown status. Monitoring is clearly insufficient and inadequate in many Member States, where not all priority substances are monitored and the number of water bodies being monitored is very limited. The results from the first RBMPs showed:

- Poor chemical status for groundwater, by area, is about 25 % across Europe. A total of 16 Member States have more than 10 % of groundwater bodies in poor chemical status; this figure exceeds 50 % in four Member States. Excessive levels of nitrate are the most frequent cause of poor groundwater status across much of Europe.
- Poor chemical status for rivers, lakes, and transitional and coastal waters does not exceed 10 %, aggregated across Europe as a whole. Notably, the chemical status of many of Europe's surface waters remains unknown, ranging between one third of lakes and more than half of transitional waters.
- A total of 10 Member States report poor chemical status in more than 20 % of rivers and lakes with known chemical status, whilst this figure rises to above 40 % in five Member States.
- Polycyclic aromatic hydrocarbons (PAHs) are a widespread cause of poor status in rivers. Heavy metals are also a significant contributor to poor status in rivers and lakes, with levels of mercury in Swedish freshwater biota causing 100 % failure to reach good chemical status. Industrial chemicals such as the plasticiser di-(2-ethylhexyl) phthalate (DEHP) and pesticides also constitute widespread causes of poor chemical status in rivers.
- Six Member States report poor chemical status in transitional waters to be more than 50 % of the water bodies with known chemical status. PAHs, the antifouling biocide tributyltin (TBT) and heavy metals are the most common culprits.
- Six Member States report all their coastal waters as having good chemical status, although in five others, poor chemical status exceeds 90 % of those water bodies with a known chemical status. A variety of pollutant groups contribute to poor status in coastal waters, reflecting a diverse range of sources.

Protection of Europe's aquatic ecosystems and their services

The EU policies on water and the marine environment, nature and biodiversity are closely linked, and together they form the backbone of environmental protection of Europe's ecosystems and their services. One of the main objectives of the WFD is the integrated view on and the protection of aquatic ecosystems using a holistic approach. For this reason, the relationship between the results of the first round of RBMP reporting have been compared with the current implementation of the nature legislation (Birds (2009/147/EC) and Habitats

(92/43/EEC)) and the future development under the Biodiversity Strategy 2020.

Both the nature directives and the WFD aim at ensuring healthy aquatic ecosystems while at the same time ensuring a balance between water and nature protection and the sustainable use of natural resources. At the moment, the two processes designating aquatic habitat types under Natura 2000 and the WFD water types are run in parallel, and today there is not enough coordination between the two processes. Common WFD water types will together with the Natura 2000 aquatic habitat types provide a good basis for coordinated assessment of status, pressures and impact, and will result in co-benefits for both processes.

In order to protect small water bodies (small streams and ponds), there is now an urgent need to raise awareness about their ongoing destruction and their many beneficial functions to society. This will increase political recognition of their importance for maintaining a healthy and diverse aquatic environment. Coordinated activities with the protected habitats under the nature directives and WFD activities should help to ensure the protection of these valuable small water bodies.

As many habitats and aquatic species are related to WFD water bodies or water types, the measures proposed under the Birds and Habitats Directives (BHDs) and the WFD may be partly the same. Therefore there is a need for coordination between the responsible authorities for nature conservation and water management; measures may offer joint benefits.

Restoring and preserving aquatic ecosystems has multiple benefits for the WFD and BHDs: this includes activities such as 'making room for the river', river restoration or floodplain rehabilitation, 'coastal zone restoration projects' and integrated coastal zone management. The forthcoming strategy for an EU-wide 'Green Infrastructure' (EC, 2010a) will help reconnect existing nature areas and improve ecological quality overall; both the WFD and BHDs would benefit from green infrastructure projects.

The results and assessment from the three processes within the water (WFD) and marine environment (MFSD), nature and biodiversity are important building blocks for the ecosystems and ecosystem services assessments that will be produced in the coming years.

Challenges for achieving good status

Objectives in the WFD stipulate that good status must be achieved by 2015. Extending the deadline beyond 2015 is permitted under certain conditions.

In 2009, 42 % of all surface water bodies held good or high **ecological status**; in 2015, 52 % of water bodies are expected to reach good status. This is far from meeting the objective and constitutes only a modest improvement in ecological status.

The information provided on the **chemical status of surface waters** was limited and not consistent. More than 40 % of the surface water bodies are reported as having 'unknown chemical status'. The assessment of chemical status for the water bodies with known status is not fully comparable.

For **groundwater**, 80 % of groundwater bodies held good chemical status and 87 % held good quantitative status in 2009. For 2015, an increase in groundwater bodies achieving good status is foreseen; in 2015 some 89 % and 96 % of groundwater bodies are predicted to be in good chemical status and quantitative status, respectively.

To maintain and improve the essential functions of our water ecosystems, we need to manage them well. This can only succeed if we adopt the integrated approach introduced in the WFD and related water legislation. Full implementation of the WFD throughout all sectors is needed to resolve the different pressures and to commit all users in a river basin to focus on the achievement of healthy water bodies with good status. Most of the water challenges faced by aquatic ecosystems can be addressed through better implementation of the extensive legislative framework on water already in place, and by enhancing the integration of water policy objectives into other policy areas such as the Common Agriculture Policy (CAP), the Cohesion and Structural Funds, and the policies on renewable energy and transport.

To achieve good status, Member States will have to address the pressures affecting water bodies. Pollution is one pressure; morphological changes and hydrological changes affecting water flow are others. While Member States are relatively clear about the types of pressures their river basins are encountering, precise information is missing on how these pressures will be addressed and to what extent the selected measures will contribute to the achievement of the environmental objectives in 2015.

Although considerable success has been achieved in reducing the discharge of pollutants into Europe's waters in recent decades, challenges remain for urban and industrial wastewater and pollution from agricultural sources. The focus must be placed on ensuring that existing EU water legislation, including the UWWT, Nitrates (91/676/EEC) and Environmental Quality Standards (2008/105/EC) directives are implemented in all Member States. This will help to improve the quality of water, e.g. by reducing nutrient and chemical pollution before it enters water bodies. Wastewater treatment must continue to play a critical role in the protection of Europe's surface waters, and investment will be required to upgrade wastewater treatment and to maintain infrastructure in many European countries.

Despite improvements in some regions, diffuse pollution from agriculture in particular remains a major cause of the poor water quality currently observed in parts of Europe. Measures exist to tackle agricultural pollution and they need to be implemented according to the WFD, while full compliance with the Nitrates Directive is also required. The forthcoming reform of the CAP provides an opportunity to further strengthen water protection.

New and largely unknown groups of substances keep appearing in the aquatic environment, the effects of which may be even more significant. Examples include antibiotics, medicines and substances that disrupt the hormonal balance. Focus must be placed on reducing the emissions and the effects of these emerging pollutants.

The WFD is the first piece of European environmental legislation that addresses hydromorphological pressures and impacts on water bodies. It requires action in those cases where the hydromorphological pressures affect the ecological status, interfering with the ability to achieve the WFD objectives. If the morphology is degraded or the water flow is markedly changed, a water body with good water quality will not achieve its full potential as a habitat for wildlife.

The restoration of hydromorphological conditions such as river continuity concerns the basin and the full length of the river, from the marine structures through to upstream hydraulic structures, and must involve all public and private stakeholders concerned. In nearly all RBMPs assessed, there are hydromorphological measures proposed in the programme of measures (PoM). Around two thirds of the RBMPs had measures to mitigate the negative impact of mitigation barriers. These include the removal of obstacles and the installation of fish passes. Some measures focused on re-naturation of aquatic habitats, such as improving physical habitats, including by the restoration of bank structures and riverbeds. Measures related to sediment management strategy were also relatively common. Natural water retention measures that restore natural water storage, for example by inundating flood plains and constructing retention basins, were mentioned in less than a fifth of the RBMPs. Measures to improve the water flow regime such as setting minimum flow requirements were found in around half of the RBMPs.

As outlined above, there are ample possibilities for improving water management to achieve the objectives of the WFD, through stringent and well-integrated implementation. However, the next cycle of RBM planning needs to also take into account a wider consideration of water resource management and aspects of climate change.

Preparing for climate change is a major challenge for water management in Europe. In the years to come, climate change will increase water temperature and the likelihood of flooding, droughts and water scarcity. There are many indications that water bodies already under stress from pressures are highly susceptible to climate change impacts, and that climate change may hinder attempts to restore some water bodies to good status. Here the establishment of good ecological and healthy ecosystem conditions are extremely important. Good ecological status will also increase the resilience of the ecosystem, i.e. its capability to absorb additional adverse pressures.

The 'flow regime' and water level fluctuations are one of the major determinants of ecosystem function and services in aquatic ecosystems. In many locations, water demand often exceeds availability, and in many cases exploitation of water resources has led to significant degradation of freshwater biodiversity. Water resource management needs to be an integrated part of the RBMP. In more arid river basins, such as in the Mediterranean, drought management plans are already partly integrated into RBM planning. However, the recent assessment of both the water scarcity and drought policy and the climate change adaptation and vulnerability policies show that there are considerable improvements needed in the future management of water resources in Europe. The European Commission 'Blueprint to safeguard Europe's waters' and EEA's report 'European waters — current status and future challenges (Synthesis)' (EEA, 2012e) kicks-off the discussion of the future management of European water resources.

1 Introduction

1.1 EEA 2012 'State of Europe's water' reports

Europe's waters are affected by several pressures, including water pollution, water scarcity and floods, and by major modifications affecting morphology and water flow. To maintain and improve the essential functions of our water ecosystems, we need to manage them well. Water management in Europe is complex, owing to the diverse geophysical, climatic, socio-economic, and political realities that exist across Member States. It can only succeed if we adopt the integrated approach introduced in the WFD and related water legislation, including the Nitrates Directive and the UWWT Directive. The challenge now is to fully implement this range of legislation.

At the European level, a multitude of state of water assessments have been undertaken (EEA, 2011a). These assessments have primarily focused on the states and pressures of European waters, but recent assessment has showed their scope to be too narrow, requiring a shift in focus towards management and measures.

2012 is the European year of water in which the European Commission published its 'Blueprint to safeguard European waters', comprising reviews of the WFD, water scarcity and drought and adaptation to climate change policies. To accompany and inform the Blueprint, the EEA has produced a set of reports, the 'State of Europe's water', to be published throughout 2012. The reports are developed in close cooperation and coordination with the European Commission's assessment of the WFD RBMPs and other work preparing the 'Blueprint to safeguard Europe's water resources'.

The Commission has published its third WFD implementation report as required by Article 18 of the WFD. This third implementation report is formed by the Communication from the Commission to the European Parliament and to the Council on the Water Framework Directive implementation report (EC, 2012b), plus the Commission Staff Working Document on the European Overview of the implementation (EC, 2012a) and another Commission Staff Working Document with a set of annexes describing the results of the assessment by the Commission of the RBMPs relating to each Member State (EC, 2012c).

The EEA 2012 'State of Europe's water' assessments consist of an overarching synthesis and integrated report (EEA, 2012e) and three thematic assessments:

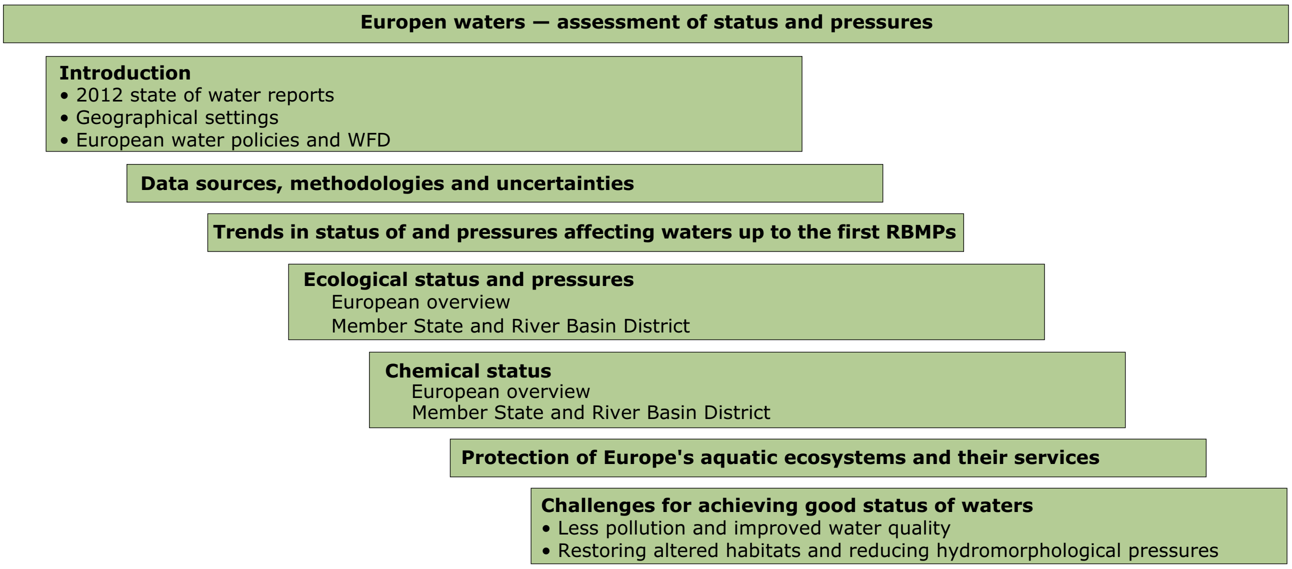
- *Towards efficient use of water resources in Europe* (EEA, 2012a);
- *Water resources in Europe in the context of vulnerability* (EEA, 2012d);
- *European waters — assessment of status and pressures* (the current report).

In addition, a number of EEA technical background reports and documents are being published by the European Topic Centre on Inland, Coastal and Marine waters (ETC/ICM) and by the ETC on Climate Change impacts, vulnerability and Adaptation (ETC/CCA). These reports will contain more detailed information and results on the assessment of information from RBMPs on status and pressures and assessment of water scarcity, droughts and floods. These reports are:

- 'Ecological and chemical status and pressures' (EEA ETC/ICM, 2012a);
- 'Hydromorphology' — (EEA ETC/ICM, 2012b);
- 'Water scarcity and drought' (EEA ETC/ICM, 2012c),
- 'Floods', (EEA ETC/CCA, 2012),

The report *European waters — assessment of status and pressures* is based on an assessment by the EEA of the RBMPs adopted and reported from 2009 to 2012 by Member States. The information in the RBMPs, together with other related sources of information, has been analysed to establish an assessment of the status of and pressures affecting Europe's waters.

Figure 1.1 Report structure



The report provides a baseline for assessing trends in status and pressures in the following RBM planning cycles.

The structure of the report is presented in Figure 1.1.

- Executive summary: presents the key results and conclusions.
- Chapter 1: presents information on the EEA 2012 state of water reports and the geographical settings, including an overview of European river basin and sea regions. The chapter also contains a description of European water policies with particular focus on the different elements of the WFD.
- Chapter 2 summarises data sources and methodology used for data handling, and explains the various assumptions made in relation to the analysis.
- Chapter 3 provides a baseline for assessing trends in pollution and water quality as well as hydromorphology pressures up to the first RBMPs; it illustrates how we can learn from past actions and measures.
- Chapter 4 presents an overview of the results on ecological status, pressures and impacts for each surface water category: rivers, lakes, transitional waters, and coastal waters. Results on ecological status and pressures for EU Member States are also presented.
- Chapter 5 presents European, Member State and RBD overviews of the results on chemical status.
- Chapter 6 discusses the protection of Europe's aquatic ecosystems and their services. It considers the joint benefits of coordinated nature conservation and water management.
- Chapter 7 reviews the expected progress in achieving the WFD objectives, the possible challenges, and the measures for reducing pressures from pollution and hydromorphology.

1.1.1 Geographical settings

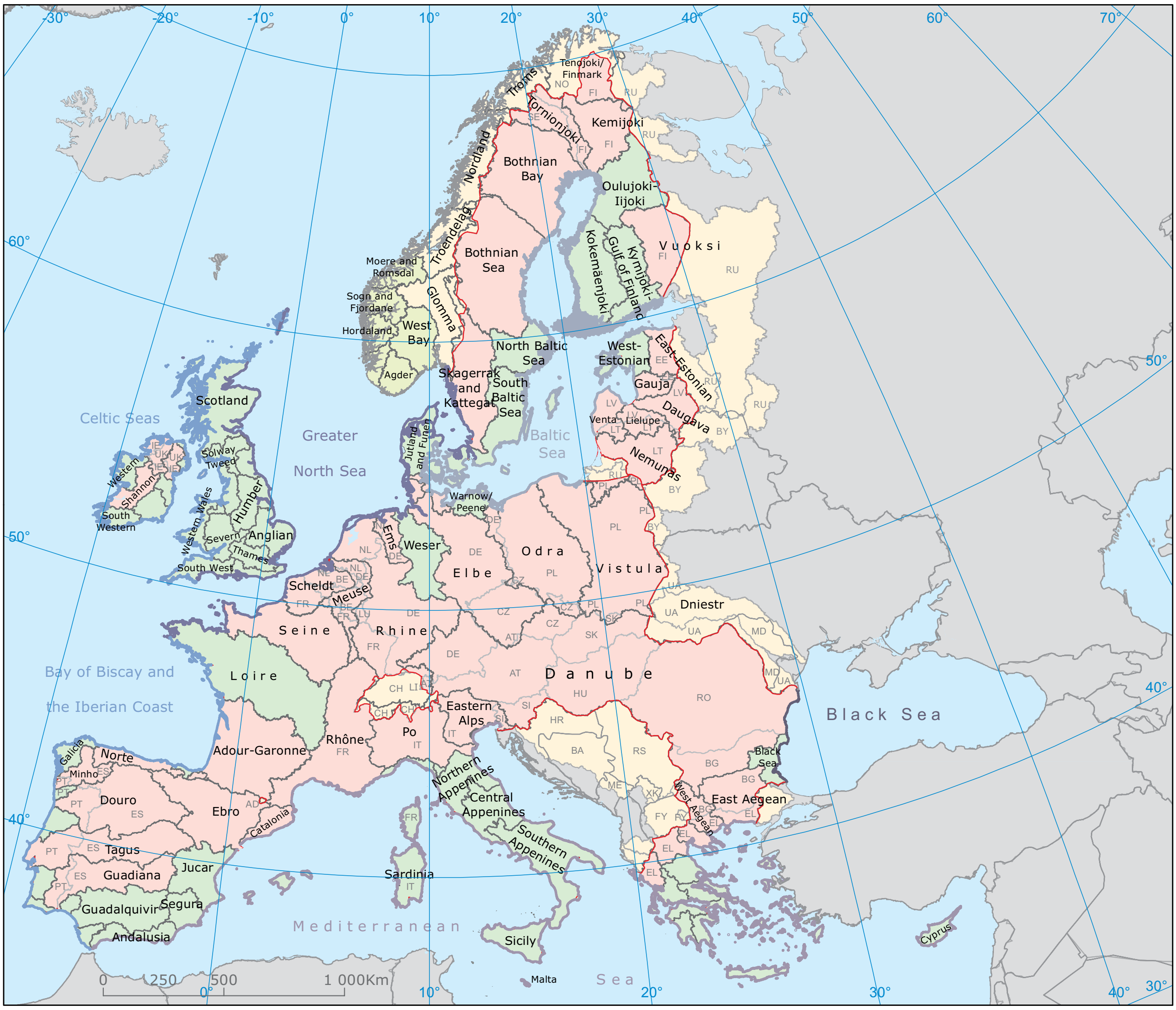
Europe has an extensive network of rivers and streams making up several million kilometres of flowing waters. More than a million lakes cover the European continent. The EU has a long coastline ([1]) and several hundreds of transitional waters in the form of fjords, estuaries, lagoons and deltas. Each body of water has individual characteristics.

([1]) Coastal waters represent the interface between land and ocean, and in the context of the WFD, coastal waters include water that has not been designated as transitional water, extending 1 nautical mile from a baseline defined by the land points where territorial waters are measured.

River basin districts

The implementation of the WFD has resulted in the designation of 111 RBDs across the EU (Map 1.1). There are 40 international RBDs consisting of national parts of RBDs in Member States. The international RBDs cover more than 60 % of the territory of the EU. An important feature of the WFD is a planning mechanism, referred to as the international River Basin Management Plans. The

Map 1.1 Map of RBDs and sea regions used in the report



International and national river basin districts and sea regions	
International river basin district	Regional sea coastline
National river basin district	Black Sea
International river basin district outside EU-27	Mediterranean Sea
National river basin district outside EU-27	Celtic Sea, Bay of Biscay and the Iberian Coast
International river basin district boundary	Greather North Sea
Country boundary	Baltic Sea
EU-27 boundary	Outside EU-27

Source: Administrative boundaries: European Commission — Eurostat/GISCO and WISE River basin districts (RBDs) processed by the ETC/ICM.

aim of these plans is for Member States to cooperate to ensure that environmental objectives targets are met.

Europe's seas include the Baltic, north-east Atlantic, Black, and Mediterranean Seas. The north-east Atlantic includes the North Sea, but also the Arctic and Barents Seas, the Irish Sea, the Celtic Sea, the Bay of Biscay and the Iberian Coast.

1.2 European water policies

The main aim of EU water policy is to ensure that throughout the EU, a sufficient quantity of good-quality water is available for people's needs and for the environment. Since the 1970s, through a variety of measures, the EU has worked to create an effective and coherent water policy.

The first directives, adopted in the mid-1970s, established a series of quality standards aimed at protecting human health and the living environment. The standards covered surface water used for drinking water, bathing water, fish waters, shellfish waters, groundwater and water for human consumption. In the same 'generation' of legislation, a directive that set standards for the discharge of dangerous substances into the aquatic environment was for many years the main instrument to control emissions from industry (see also EC, 2008a).

However, the quality standard approach proved insufficient for protecting Europe's polluted waters. When eutrophication became a major problem in the North and Baltic seas and parts of the Mediterranean in the late 1980s, the EU started to focus on the sources of pollutants. This led to the UWWT Directive, which requires Member States to invest in infrastructure for collecting and treating sewage in urban areas, while the Nitrates Directive requires farmers to control the amounts of nitrogen fertilisers applied to fields. And the Integrated Pollution Prevention and Control (IPPC) Directive (2008/1/EC), adopted a few years later, aims to minimise pollutants discharged from large industrial installations.

The WFD, which came into force on 22 December 2000, establishes a new framework for the management, protection and improvement of the quality of water resources across the EU. The WFD calls for the creation of River Basin Districts (RBDs). In case of international districts that cover the territory of more than one EU Member State, the WFD requires coordination of work in these districts.

EU Member States should aim to achieve good status in all bodies of surface water and groundwater by 2015 unless there are grounds for derogation. Only in this case may achievement of good status be extended to 2021 or by 2027 at the latest. 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. There is also a general 'no deterioration' provision to prevent deterioration in status.

The WFD establishes a legal framework to protect and restore clean water in sufficient quantity across Europe. It introduces a number of generally agreed principles and concepts in a binding regulatory instrument. In particular, it provides for the following:

- A sustainable approach to managing an essential resource: not only does the WFD consider water to be a valuable ecosystem, it also recognises the economy and human health dependent on it.
- Holistic ecosystem protection: the WFD ensures that the fresh and coastal water environment is to be protected in its entirety.
- Ambitious objectives, flexible means: the achievement of 'good status' by 2015 is ambitious and will ensure the fulfilment of human needs, ecosystem functioning and biodiversity protection. At the same time, the WFD provides flexibility for achieving this in the most cost-effective way and introduces a possibility for priority setting in the planning.
- The right geographical scale: the WFD states that the natural administrative unit for water management is the river basin.
- The 'polluter pays' principle: the WFD's introduction of water pricing policies with the element of cost recovery and the cost-effectiveness provisions are milestones in the application of economic instruments for the benefit of the environment.
- Participatory processes: the WFD ensures the active participation of all businesses, farmers and other stakeholders, environmental non-governmental organisations (NGOs), and local communities in river basin management activities.

- Better regulation and streamlining: the WFD and its related directives (the Groundwater Daughter Directive (2006/118/EC) and the Floods Directive (COM(2007)15)) repeal 12 directives from the 1970s and 1980s which created a well-intended but fragmented and burdensome regulatory system. The WFD creates synergies, increases protection and streamlines efforts.

Implementation of the WFD is to be achieved through the river basin management planning process, which requires the preparation, implementation and review of a RBMP every six years for each RBD identified. This calls for an approach to river basin planning and management that takes all relevant factors into account and considers them together. There are five main elements of the process:

- governance and public participation;
- characterisation of the RBD and the pressures and impacts on the water environment;
- environmental monitoring based on river basin characterisation;
- setting of environmental objectives;
- design and implementation of a programme of measures (PoM) to achieve environmental objectives. An important aspect of the measures is full implementation of the UWWT Directive and Nitrates Directive on reducing pollutants that lower pollution and will improve water quality and aid the achievement of good status under the WFD.

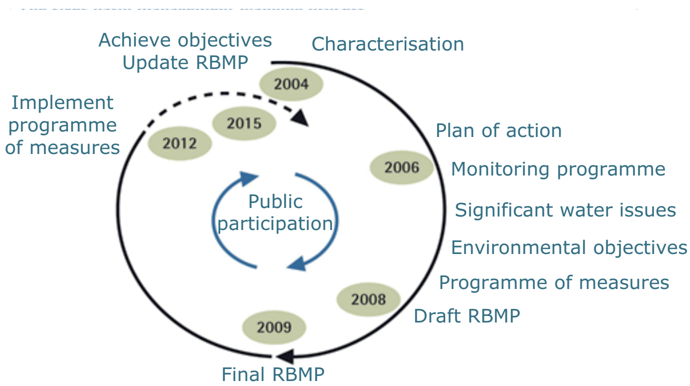
RBMPs are plans for protecting and improving the water environment; they have been developed in consultation with organisations and individuals. River basin planning is a gradual cyclical process that involves public participation throughout. RBMPs follow a series of steps shown in Figure 1.2. The river basin planning process started more than 10 years ago with the implementation of the WFD in national legislation and establishment of the administrative structures. The next steps in 2004 were analyses of the pressures and impacts affecting the water environment in the RBD. The findings were published in 2005 in the characterisation report required by Article 5 of the WFD.

In 2006, monitoring programmes within the RBDs had to be established. The WFD monitoring network enables the identification and resolution of problems, thereby improving the water environment. The reports and consultation on Significant Water Management Issues (SWMIs) in 2007 and 2008 were important steps leading towards the production of the first RBMPs.

The RBMPs describe the measures that must be taken to improve the ecological quality of water bodies and help reach the objectives of the WFD. The WFD requires, via the RBMPs, a programme of measures to be established for each RBD. The measures implemented as part of the programme should enable water bodies to achieve the environmental objectives of the WFD. The PoM must be established by December 2009 and be made operational by December 2012.

The Commission's Water information notes (EC, 2008c) available online, give an introduction

Figure 1.2 The WFD river basin planning process



Source: Based on EC, 2003.

and overview of key aspects of the implementation of the WFD.

Over the last few years, European countries that are not EU Member States have developed similar river basin activities to those introduced by the WFD in the EU Member States:

In **Turkey**, Basin Protection Action Plans have been prepared by the General Directorate of Water Management with the same vision as WFD RBMPs (Cicek, 2012). The 25 Basin Protection Action Plans aim at: protection of the water resources, best use of water resources, prevention of pollution, and improvement of the quality of polluted water resources. A new EU-supported project, 'River Basin Management Plans for five basins', with a EUR 6.6 million budget, is due to kick off in 2013.

In 2007, the **Icelandic** parliament voted for adaptation of the WFD with the objective to fulfill its requirements before 2017. Iceland has identified one RBD, four sub-basins, and several coastal waters (Guðmundsdóttir, 2010).

As a non-EU member, **Switzerland** is not bound to implement the WFD. However, the Swiss legal system sets comparable targets regarding water protection and management (EEA, 2010a). In contrast to the WFD, which is based on planning periods with specified targets, the Swiss legislation formulates binding requirements, including a set of national limits which must be met at all times. As a member of the international commissions of the Rhine River Basin and of the Lakes of Constance, Geneva, Lugano and the Lago Maggiore, Switzerland collaborates with its neighboring states to achieve water protection goals and to implement endorsed programmes, and thus indirectly adopts certain principles of the WFD.

Norway is connected to the EU as a European Free Trade Association (EFTA) country, through the Agreement on the European Economic Area (EEA). The WFD was formally taken into the EEA agreement in 2009, granting the EFTA countries extended deadlines for implementation. The WFD was transposed into the Norwegian Regulation on a Framework for Water Management in 2007 (Vannportalen, Norway, 2012). Norway performed a voluntary implementation of the WFD in selected sub-districts across the country from 2007 until 2009, thus gaining the experience of river basin management planning. RBMPs for the selected sub-districts were adopted by the county councils in 2009, and approved by the national government in June of 2010. RBMPs covering the entire country will be prepared from 2010 until 2015, synchronised with the time schedule of the second cycle of RBM planning in the EU.

The Sava River is the third longest tributary of the Danube and the largest Danube tributary by discharge. It runs through four countries (Slovenia, Croatia, Bosnia and Herzegovina, and Serbia), and part of its catchment is also in Montenegro and Albania.The International Sava River Commission (ISRBC) is working together with countries on the development of the Sava RBMP, in line with the EU WFD (Sava Commission, 2012). A consultation of the draft Sava RBMP has run from December 2011 to April 2012.

2 Data sources, methodology and uncertainties

This report is compiled from information on the status of European ground and surface water bodies as reported from EU Member States in the first round of RBMPs under the WFD. This work by the EEA reflects cooperation with the European Commission on the assessment of implementation of the WFD as laid out in Article 18 of the WFD, according to which:

'The Commission shall publish a report on the implementation of this directive at the latest 12 years after the date of entry into force of this directive (two years after the Member States have delivered the RBMPs). The report shall among others include the following:

- a review of progress in the implementation of the directive;
- a review of the status of surface water and groundwater in the Community undertaken in coordination with the European Environment Agency.'

The RBMPs are comprehensive documents consisting of hundreds to thousands of pages of information, which cover many aspects of water management. They are published in the national languages. The assessment of the plans is therefore an extremely challenging and complex task that involves handling extensive information in more than 20 languages.

The information from the RBMPs is accompanied by information on the status of European waters, which the EEA has collected since the mid-1990s within its European Information and Observation Network (Eionet). This information on water quality trends helps to provide a baseline for future evaluation of the achievements of the WFD and underlying directives.

2.1 Data sources

2.1.1 Data reported via WFD RBMPs to the WISE-WFD database

According to the WFD, from 22 December 2009, the RBMPs should be available for all RBDs across the EU. There are, however, serious delays in some parts of the EU, and in some countries consultations are still ongoing. In May 2012, 23 EU Member States had their RBMPs adopted. Four countries (Portugal, Spain, Greece, and the Walloon and Brussels parts of Belgium) had not yet finalised the consultation of the RBMPs, and therefore had not adopted RBMPs.

In addition to the RBMPs, Member States have reported a comprehensive set of data related to the results of the RBMPs (such as ecological status for each individual water body or significant pressures affecting a water body) to the Water Information System for Europe (WISE). The EEA has a central role in the management of WISE due to the Agency's role as the EU data centre for water. The reporting of RBMP data is described in the WFD-CIS Guidance No 21 (EC, 2009c).

In May 2012, data from 161 RBDs was uploaded by Member States and incorporated into the WISE-WFD database. The WISE-WFD database also included data from Member States (Portugal, Spain, and Greece) that have not yet adopted RBMPs. There is still missing reporting from some Member States and RBDs, and reporting is incomplete on some issues. The EEA and its ETC/ICM have analysed the detailed information and data reported in the WISE-WFD database up to May 2012. The analysis focuses on data and information on status, pressures and impacts on European waters.

Data from the WISE-WFD database are available at country and RBD level at the EEA water data centre homepage: http://www.eea.europa.eu//themes/

water/dc (WISE). For the diagrams, maps and tables included in this report, the source information below the diagrams provide links to the underlying data in the WISE-WFD database.

2.1.2 EEA WISE-SoE data collection

In addition to the data reported from RBMPs to the WISE-WFD database, the EEA holds water quality data, reported voluntarily by EEA member countries each year. These data reflect a representative sub-sample of national monitoring results. In the context of the implementation of the WFD, the annual data flow for water quality has been transferred into the WISE 'State of the Environment' (SoE) voluntary data flow (WISE-SoE). It thereby remains one of the Eionet Priority Data Flows, but gains full integration into the reporting under WISE and complementarity with data collected under the WFD.

Data are transferred on an annual basis from the countries to the EEA, and are stored in the Agency's 'Waterbase'. By May 2012, EEA Waterbase contained a vast amount of water quality information covering more than 10 000 river stations in 37 countries, 3 500 lake stations in 35 countries, 5 000 coastal stations in 28 countries, and around 1 500 groundwater bodies.

The data reported in the WISE-WFD and the WISE-SoE databases makes it possible to evaluate trends in water quality and to assess the water quality data in conjunction with the WISE-WFD RBMP data on ecological and chemical status and pressure information for the individual water bodies, where the Member State identification code matches for the two datasets.

2.2 Methodology

2.2.1 WFD water bodies

In the context of the WFD, the 'water environment' includes rivers, lakes, estuaries, groundwater and coastal waters out to one nautical mile (12 nautical miles for chemical status). These waters are divided into units called water bodies.

EU Member States have reported 13 300 groundwater bodies and more than 127 000 surface water bodies. 82 % of these are rivers, 15 % are lakes and 3 % are coastal and transitional waters (Table 2.1). All Member States have reported groundwater bodies, and all EU Member States except Malta have reported river water bodies. 24 Member States have reported lake water bodies, and 16 and 22 Member States have reported transitional and coastal water bodies, respectively.

Information has been reported for more than 1.1 million km of European rivers. These rivers have been divided into 104 000 water bodies, with an average length of 11 km. Member States have reported more than 19 000 lake water bodies covering an area of 88 000 km². Nearly 4 000 coastal and transitional water bodies have been reported, covering approximately 370 000 km².

Table 2.1 Number of Member States, RBDs, water bodies, and length or area, per water category

Category	Member States	RBDs	Number of water bodies	Total length or area	Average length/area
Rivers	26	157	104 311	1.17 million km	11.3 km
Lakes	24	144	19 053	88 000 km²	4.6 km²
Transitional	16	87	1 010	19 600 km²	19 km²
Coastal waters	22	114	3 033	358 000 km²	118 km²
Groundwater	27	148	13 261	3.8 million km²	309 km² (*)

Note: (*) Based on 127 RBDs with reported areas of groundwater bodies.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_SIZE_AVERAGE and http://discomap.eea.europa.eu/report/wfd/GWB_DENSITY_ECOSYS_TRB.

2.2.2 *Ecological status classification*

The WFD defines 'good ecological status' in terms of a healthy ecosystem based upon classification of the biological quality elements (phytoplankton, phytobenthos, benthic fauna, macrophytes and fish) and supporting hydromorphological, physico-chemical quality elements and non-priority pollutants. Water bodies are classified by assessment systems developed for the different water categories (river, lake, transitional and coastal waters) and the different natural type characteristics within each water category.

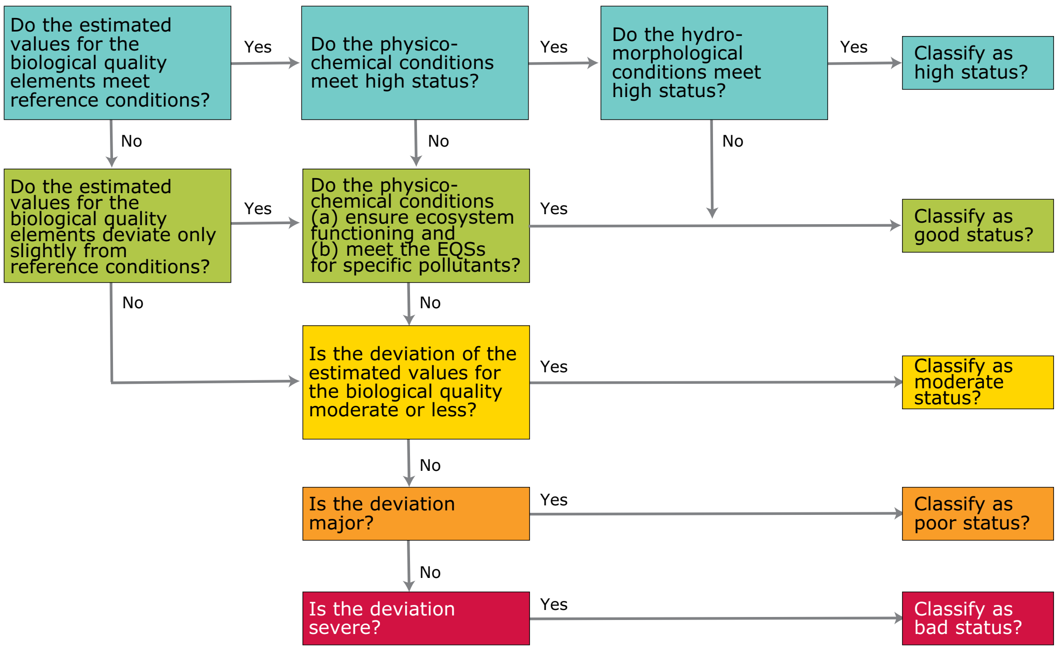
The process of ecological classification is described in Figure 2.1. Ecological status/potential is recorded on the scale of high, good, moderate, poor or bad. 'High' denotes largely undisturbed conditions, and the other classes represent increasing deviation from this natural condition. The ecological status classification for the water body is determined using the worst scoring quality element (also known as the 'one out, all out' principle).

The WFD requires that standardised methods are used for the monitoring of quality elements, and that the good status class boundaries for each biological quality element are intercalibrated across Member States sharing similar types of water bodies. The aim of the intercalibration has been to ensure that the good status class boundaries given by each country's biological methods are consistent and WFD-compliant. Further information on the classification and intercalibration process can be found in the ETC/ICM technical reports (EEA ETC/ICM, 2012a) and the Commission's homepage on 'Ecological status and intercalibration' (EC, 2012g).

In the case of water bodies that have undergone hydromorphological alteration, the WFD allows Member States to designate some of their surface waters as heavily modified water bodies (HMWBs) and artificial water bodies (AWBs). In these cases, Member States will need to meet a 'good ecological potential' criterion for ecosystems of HMWBs and AWBs, rather than fulfil good ecological status as is the case for natural type water bodies. The objective of good ecological potential is similar to that of good status, but it takes into account the constraints imposed by social and/or economic uses.

Ecological potential for HMWBs or AWBs is based on one of two things: either on the same biological, chemical and hydromorphological quality elements as for ecological status after adjusting for the impacts of the hydromorphological pressures

Figure 2.1 Classification of ecological status



Source: EC, 2005.

underlying the designation of the water body as being HMWB or AWB; or at the level of measures taken to mitigate the impacts of all other pressures on those water bodies.

Member States have to report the ecological status or potential status of each surface water body in the RBD. Where no status has been assigned to a water body, it is reported 'unknown' (unclassified). In general, this report only presents results from water bodies with a known (classified) ecological status.

Most Member States have classified the ecological status or potential of all their water bodies, although some countries have a substantial proportion of water bodies that are identified, but not classified. At the EU level, 86 % of a total of 123 000 river and lake water bodies are classified, while 77 % of a total of 4 000 transitional and coastal water bodies are classified. For rivers and lakes, Poland (79 %), Finland (54 %), Italy (48 %), Hungary (39 %) and Greece (38 %) have a substantial proportion of unclassified water bodies. For transitional and coastal waters, Italy (90 %), Poland (60 %), Slovenia (50 %), Denmark (49 %) and Ireland (39 %) have a substantial proportion of unclassified water bodies.

In the analyses in this report, **no distinction has been made between ecological status and potential**. The criteria for classification of natural water bodies (ecological status) and HMWBs or AWBs (ecological potential) vary, but the ecological conditions they reflect are assumed to be comparable, having the same deviation from reference conditions or from maximum ecological potential. The main aim of this report is to provide a holistic picture for Europe, not to focus on the differences between the natural water bodies and the HMWBs and AWBs. Moreover, presenting the natural water bodies and the HMWBs and AWBs in separate diagrams would increase the number of diagrams in the report.

2.2.3 Classification of chemical status

Chemical status is assessed by compliance with environmental standards for chemicals that are listed in the WFD (Annex X) and the Environmental Quality Standards (EQS) Directive (2008/105/EC). These priority substances include metals, pesticides and various industrial chemicals. The Groundwater Directive establishes a regime to assess groundwater chemical status, providing EU-wide quality standards for nitrate and pesticides, and requires standards to be set at national level for a range of pollutants. Chemical statuses are either recorded as good, or, if they fail to achieve good status, they are recorded as being in poor status.

WFD reporting guidance proposed that Member States group the reporting of priority substances into four categories: heavy metals, pesticides, industrial pollutants and 'other pollutants'. The latter category included a mix of individual chemical types including PAHs and TBT compounds. Inconsistency in reporting was apparent between Member States, however, with some reporting a mix of pollutant groups and individual pollutants, and others reporting either individual pollutants or groups only. Moreover, different matrices (i.e. water column, sediment and biota) were sometimes used to assess the risk of particular chemicals across different Member States, meaning that the results are not always directly comparable.

2.2.4 Significant pressures and impacts

To achieve good ecological status, Member States will have to address the pressures affecting water bodies. Pollution is one such pressure, as are morphological changes like dams built on rivers or channelisation of streams, or hydrological changes affecting water flow. The WFD requires that Member States collect and maintain information on the type and magnitude of significant pressures and impacts affecting water bodies.

The common understanding of a 'significant pressure' is that it is any pressure that on its own, or in combination with other pressures, may lead to a failure to achieve one of the WFD objectives of good status. In the WFD, 'impacts' means the effects of these pressures on water bodies such as nutrient enrichment, organic enrichment, acidification, salinisation, temperature increase, altered habitats, contamination with chemicals, and water scarcity.

A water body may have no significant pressure or impact because it holds good (or high) status. However, no reported pressures or impacts may also mean that pressures and impacts have not been reported or identified. In most cases, unclassified water bodies do not have information on pressure and impacts. All analyses on pressures and impacts carried out in the following chapters are based on water bodies holding classified ecological status only.

2.3 Improved knowledge, but ambiguous results due to data gaps and methodology issues

The quality of the EEA's assessments relies on the quality of the Member States' reports and data delivery. It is recognised that reporting constitutes a significant effort for Member States. However, the electronic reporting to WISE is making reporting easier and more streamlined. There are examples of very good, high-quality reporting. However, there are also cases where reporting contains gaps or contradictions. Bad or incomplete reporting can lead to wrong and/or incomplete assessments.

Due to delays in the development of national classification systems in many Member States, only a few biological quality elements could be used for assessing the ecological status of water bodies for the first RBMPs. An additional drawback in the systems used for status assessment of water bodies is that not all monitoring schemes and assessment methodologies were in place for the first RBMPs. Many water bodies have been classified without actual monitoring of biology or chemical pollutants and by using expert judgement partly based on the information compiled in the pressure and impact analyses.

In the EEA's opinion, the results in this report present good and robust European overviews of the data reported by the first RBMPs and the ecological status and pressures affecting Europe's waters. Caution is advised for country and RBD comparisons, as the results may be affected by the methodology approach used by the individual Member State. The European Commission's Staff Working Document on WFD implementation (EC, 2012a), and the EEA ETC/ICM background document analyse some of the differences and gaps in methodologies (EEA ETC/ICM, 2012a).

Caution is also advised when drawing detailed conclusions on the chemical status results. In the first RBMPs, there was a lack of chemical monitoring and of comparability of information on the chemical status of water bodies among Member States.

The knowledge base to classify the ecological and chemical status was not optimal for the first RBMPs, due to missing methods, status class boundaries or EQS and monitoring. However, compared to the situation before the WFD, there has been a significant improvement of the knowledge base and increased transparency by bringing together information on all characteristics, pressures and impacts on water bodies at basin level.

3 Trends in status of and pressures affecting waters up to the first RBMPs

Europe's waters are affected by several pressures including water pollution, water scarcity and floods, as well as by major modifications affecting morphology and water flow. The continuing presence of a range of pollutants in a number of Europe's waters threatens aquatic ecosystems and raises concerns for public health. These pollutants arise from a range of sources including agriculture, industry, households and the transport sector. They are transported to water via numerous diffuse and point pathways. Agriculture, for example, causes widespread problems of nutrient enrichment in inland and coastal waters across Europe, despite recent improvements in some regions. In addition to those pressures impacting upon water quality, structures such as dams for hydropower, navigation or supplying water for irrigation have resulted in significant hydromorphological modifications — physical changes — to many of Europe's waters, with potential adverse ecological consequences.

This chapter describes in brief the status and main pressures affecting Europe's waters up to the first WFD RBMPs. The focus is placed on presenting trends in water quality from the start of the 1990s to 2010 when the first RBMPs were reported. As the WFD addresses hydromorphological modifications, a description of morphological and hydrological pressures and impacts is provided. The chapter provides a baseline for assessing trends in pollution and water quality as well as hydromorphology pressures up to the first RBMPs, and it illustrates what we can learn from past actions and measures.

3.1 Trends in water quality and pollution

Clean unpolluted water is essential for our ecosystems. Aquatic plants and animals react to changes in their environment caused by changes in water quality. Pollution takes many forms. Faecal contamination from sewage makes water aesthetically unpleasant and unsafe for recreational activities such as swimming. Many organic pollutants, including sewage effluent as well as farm and food-processing wastes, consume oxygen, suffocating fish and other aquatic life. Excess nutrients can create eutrophication, a process characterised by increased plant growth, problematic algal blooms, depletion of oxygen, loss of life in bottom water, and an undesirable disturbance to the balance of organisms present in the water. Moreover, pollution through hazardous substances and chemicals can threaten aquatic ecosystems and human health.

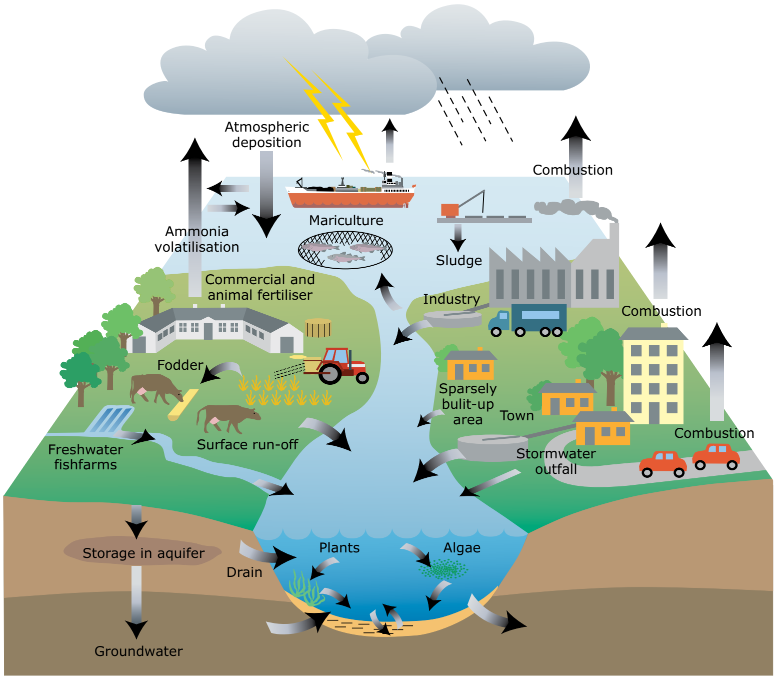
Many human activities result in water pollutants, with the main sources being discharge from urban wastewater treatment, and industrial effluents and losses from farming (Figure 3.1). During the last century, increased population growth and increased wastewater production and discharge from urban areas and industry (point sources) resulted in a marked increase in water pollution. Due to improved purification of wastewater and changed industrial production and processes, pollution discharges are today partly decoupled from population growth and economic growth.

Agriculture is a key source of diffuse pollution, but urban land, forestry, atmospheric deposition and rural dwellings can also be important sources. Agricultural production is becoming increasingly intensive, with high input of fertilisers and pesticides, in turn resulting in significant loads of pollutants to the water environment through diffuse pollution.

Sources for hazardous substances are pesticides and veterinary medicines from farmland, discharge of heavy metals and some industrial chemicals, and wastewater from consumer products such as body care products, pharmaceuticals and cleaning agents.

In parts of Europe, mining – including abandoned mines – exerts a localised but significant pressure upon the chemical and ecological quality of water, particularly with respect to the discharge of heavy metals. Landfill sites and contaminated land from historical industrial and military activities can be a source of pollution to the aquatic environment. Intensive aquaculture can be a significant local source of discharges of nutrients and causes

Figure 3.1 Overview of different pollution sources



Source: Ærtebjerg et al., 2003.

eutrophication. Feed spills and excrement are usually not collected but are released directly into the water.

Once released into freshwater, pollutants can be transported downstream and ultimately discharged to coastal waters, together with direct discharges from cities, industrial discharges and atmospheric deposition polluting coastal waters. Shipping, harbour and port activities, offshore oil exploration and aquaculture all emit a variety of pollutants.

3.2 Improved wastewater treatment

Over the past few decades, the treatment of wastewater has increased, and pollutant discharges have consequently decreased throughout Europe. The economic recession of the 1990s in central and eastern European countries also contributed to this drop, as there was a decline in heavily polluting manufacturing industries. Clear downward trends in water quality determinants related to urban and industrial wastewater are evident in most of Europe's surface waters, although these trends have levelled off in recent years.

Organic matter, measured as biochemical oxygen demand (BOD) and total ammonium, are key indicators of pollution by oxygen-consuming substances. Severe organic pollution may lead to rapid deoxygenation of river water, a high concentration of ammonia, and the disappearance of fish and aquatic invertebrates. Mainly due to the implementation of secondary biological wastewater treatment under the UWWTD Directive (91/271/EEC), concentrations of BOD and total ammonium decreased in European rivers in the period from 1992 to 2010 (Figure 3.2(a)).

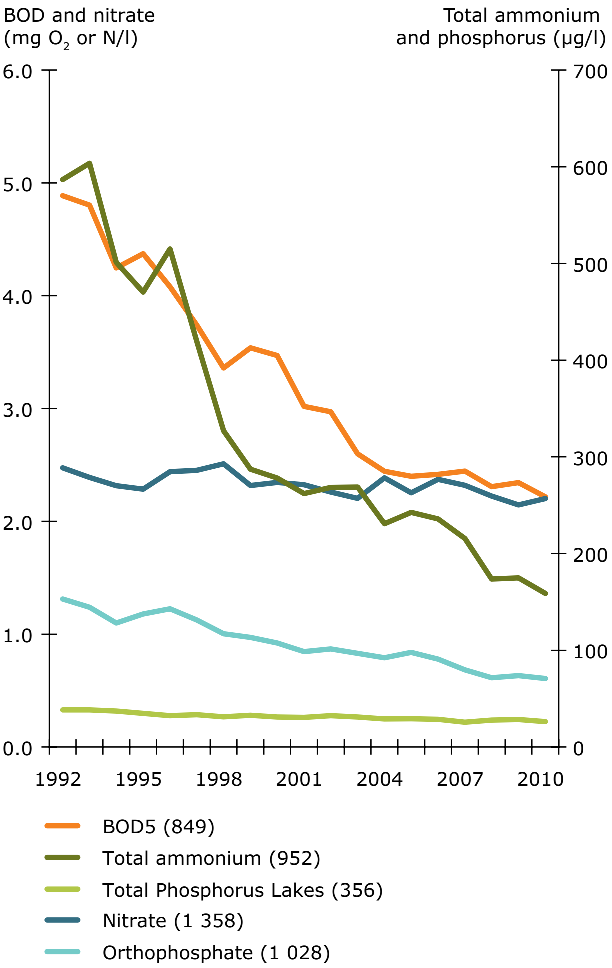
Many years of investment in the sewage system and better wastewater treatment have led to Europe's bathing waters being much cleaner today than they were 30 years ago, when large quantities of untreated or partially treated urban and industrial wastewater were discharged into water. The quality of EU bathing waters has improved significantly since 1990 — in 2011, more than 90 % of bathing areas had good water quality (see Figure 3.2(c)) (EEA, 2012b).

Average phosphate concentrations in European rivers have decreased markedly over the last two decades, falling by more than half between 1992 and 2010 (a 54 % decrease, see Figure 3.2(a)). Also, average lake phosphorus concentrations decreased over the same period (by 31 %, see Figure 3.2(a)). The major part of this decrease in phosphorus concentrations occurred in the beginning of the period, but is still ongoing. The decrease in phosphorus concentrations reflects both improvement in wastewater treatment and reduction in phosphorus in detergents. In Switzerland for instance, the heavy phosphorus pollution of lakes in the 1970s has been successfully addressed by the improvement in wastewater treatment from 1980, and the ban on phosphates in detergents in 1985 (FOEN, 2011a).

In transitional, coastal and marine waters, data availability is still a problem that prevents an overall assessment of phosphate concentrations and trends in European seas, especially for the Mediterranean and Black Sea regions where no data for trend estimation is available. Nevertheless, between 1985 and 2010, 10 % of all the stations in the European seas reported to the EEA showed a decrease in orthophosphate concentrations (Figure 3.2(b)). This decrease was most evident in coastal and open water

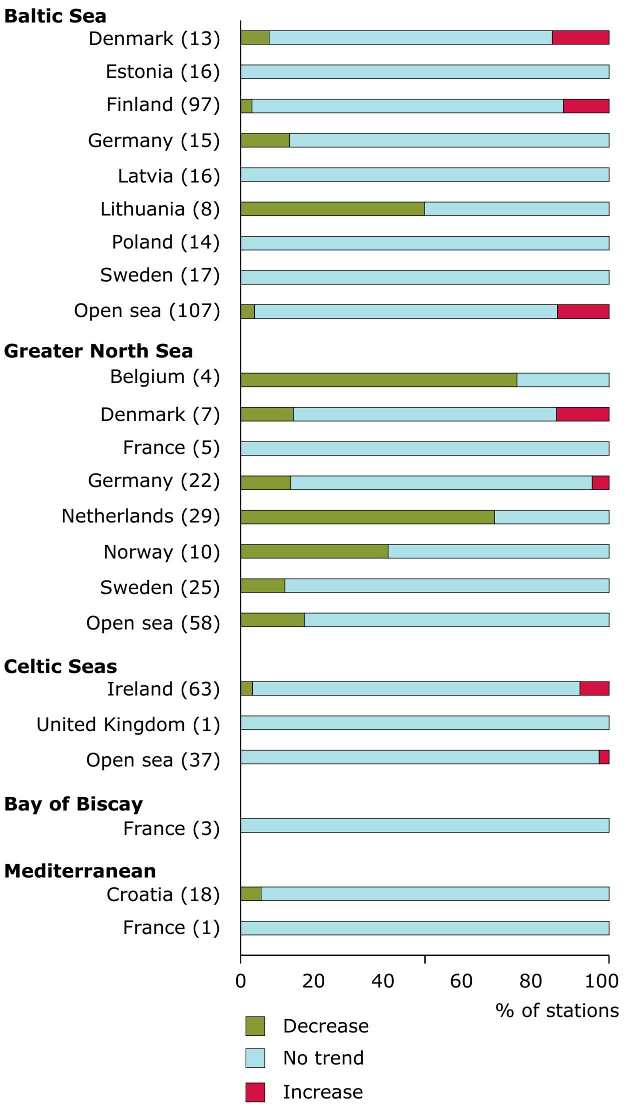
Figure 3.2 Changes in water quality variables during the last two decades

(a) BOD5, total ammonium, nitrate, orthophosphate concentrations in rivers and total phosphorus concentration in lakes between 1992 and 2010



Source: EEA, 2012g and 2012h.

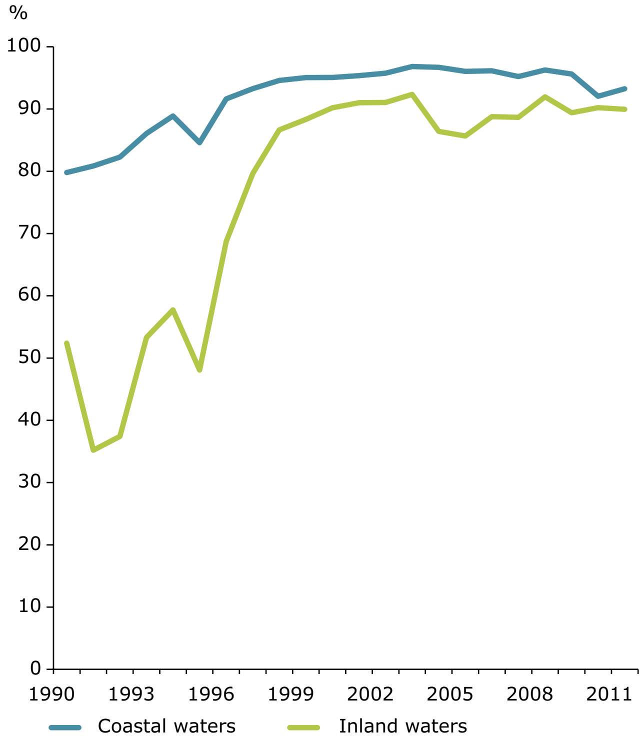
(b) Change in winter orthophosphate concentrations in coastal and open waters of the north-east Atlantic, Baltic, Mediterranean and North seas



Source: EEA, 2012i.

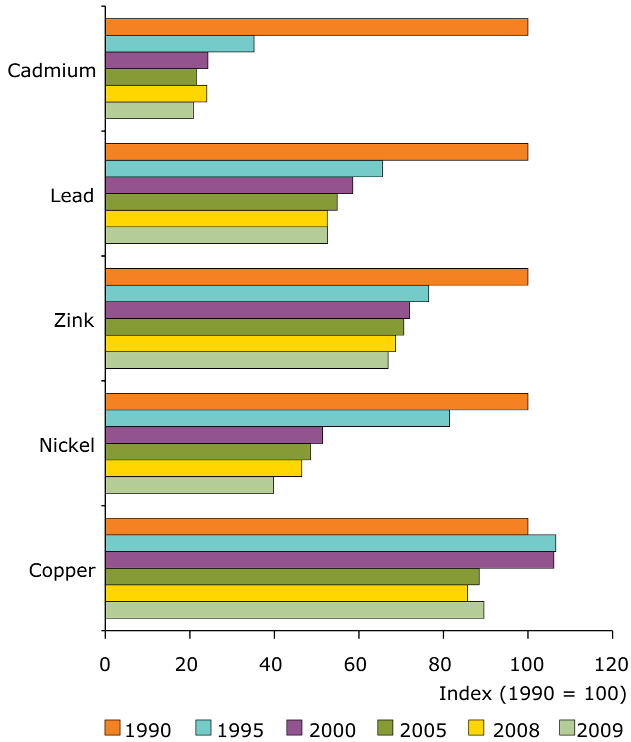
Figure 3.2 Changes in water quality variables during the last two decades (cont.)

(c) Percentage bathing waters complying with mandatory quality requirements, EU results based on more than 21 000 beaches



Source: EEA, 2012j.

(d) Emission of heavy metals from Dutch wastewater treatment plants



Source: CBS, PBL, Wageningen UR, 2011.

stations in the Greater North Sea, and in coastal stations in the Baltic Sea. Increasing orthophosphate trends, observed for 6 % of the reported stations, were mainly detected in Irish, Danish and Finnish coastal waters (Gulf of Finland and Gulf of Bothnia) and in open waters of the Baltic proper.

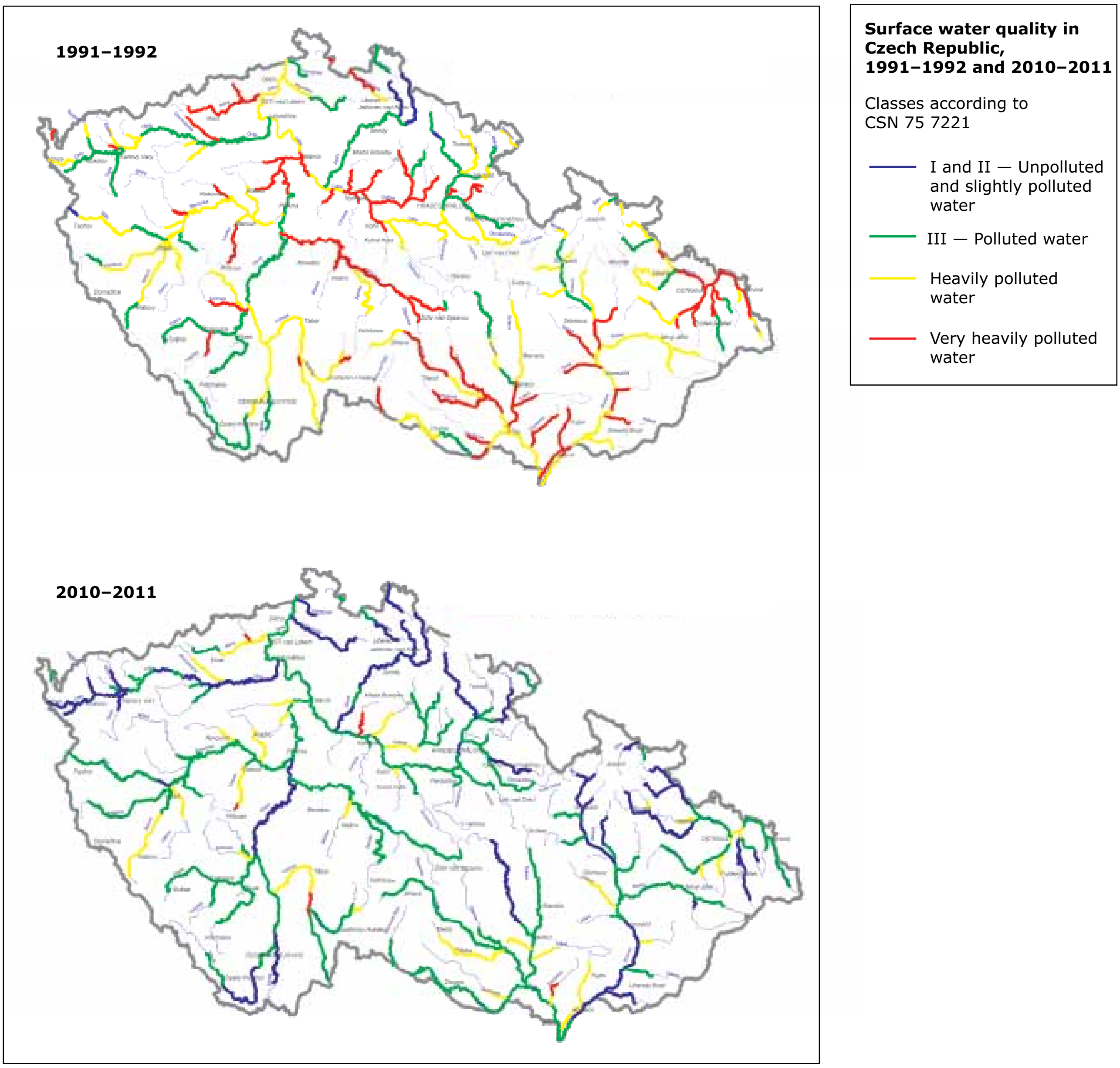
The emission of some hazardous chemicals from wastewater treatment has also been reduced, as evidenced, for example, by a decline in the discharge of heavy metals from wastewater treatment plants in the Netherlands (see Figure 3.2(d)) and to the River Seine (Meybeck et al., 2007).

The major improvement in water quality over the last decades is also partly reflected in biological indicators related to water quality and pollution effects. In the Czech Republic, for example, significant improvements in river water quality have occurred since the early 1990s, based on a classification scheme incorporating indicators for BOD, nutrients and macro-invertebrate communities (see Map 3.1).

Recovery of aquatic fauna in rivers

In some rivers, the aquatic fauna and oxygen balance in water have been recorded since at least the beginning of the last century. Around 100 years ago, the Rhine was inhabited by some 165 species of macrozoobenthos, while in 1930, the Elbe was inhabited by around 120 species (Figure 3.3). As pollution increased and oxygen levels fell, the

Map 3.1 Comparison of water quality in rivers in the Czech Republic, 1991–1992 and 2010–2011

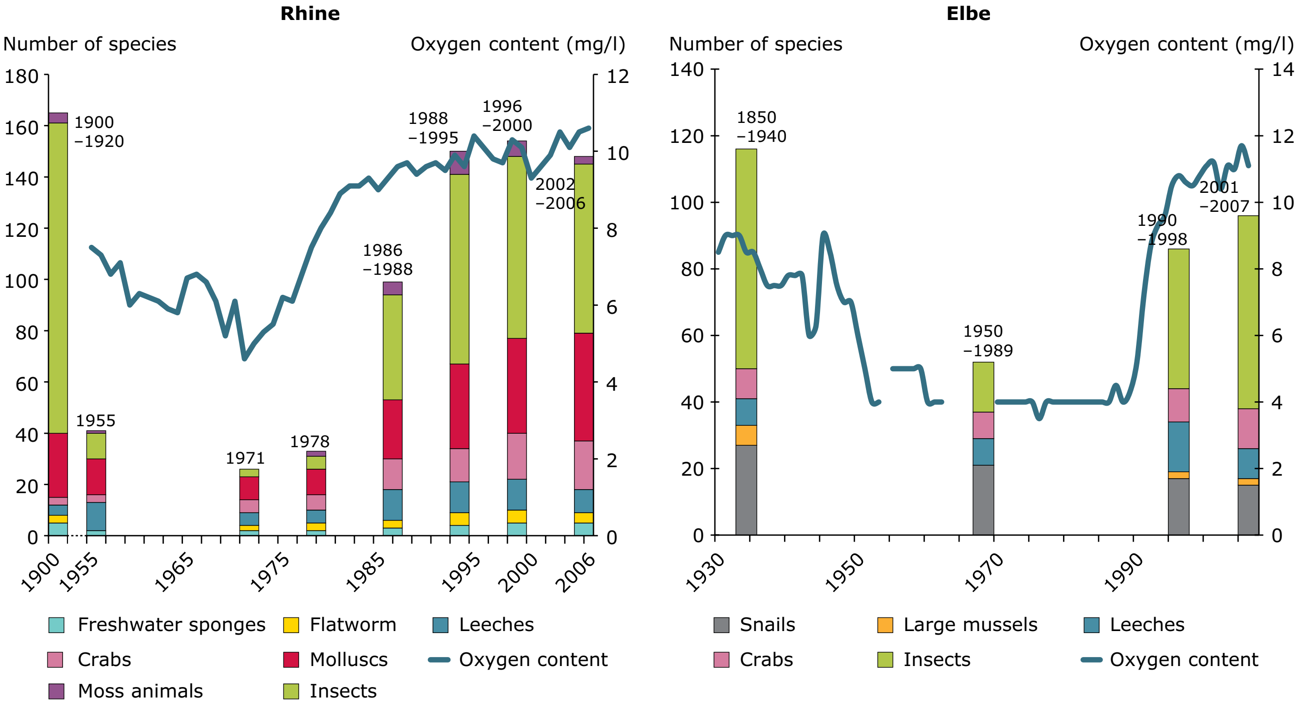


Source: ISSaR, 2011.

numbers of species declined dramatically. By 1971, few species remained in the two rivers.

Improved oxygen conditions associated with improved wastewater treatment in the Rhine led to a turnaround from the mid-1970s onwards, while in the Elbe the situation did not improve until after German reunification in the early 1990s. Some of the characteristic river species that had been considered extinct or heavily decimated have now returned, but a large number of typical species remain absent, partly due to the fact that their habitats no longer exist because of structural impoverishment. Additionally, large numbers of alien species have now replaced the typical indigenous species (see also Box 7.4 (Invasion of large European rivers)).

Figure 3.3 Historical development of the biotic community and average oxygen levels of the River Rhine near Emmerich and the Elbe near Magdeburg



Source: BMU/UBA, 2010; adapted from Schöll, 2009a; 2009b.

3.3 Eutrophication and diffuse pollution

Modern-day agricultural practices often entail the intense use of fertilisers and manure, leading to high nutrient surpluses that are transferred to water bodies. Agriculture is the largest contributor of nitrogen pollution. The average nitrate concentration in European rivers decreased by approximately 11 % between 1992 and 2010 (from 2.5 mg/l N to 2.2 mg/l N; see Figure 3.2(a)). This reflects the effect of measures to reduce agricultural inputs of nitrate at a European level (e.g. the EU Nitrates Directive (91/676/EEC)) and at national level, as well as improvements in wastewater treatment. Despite this progress, agricultural inputs of nitrate are still significant and need increased attention to achieve clean water.

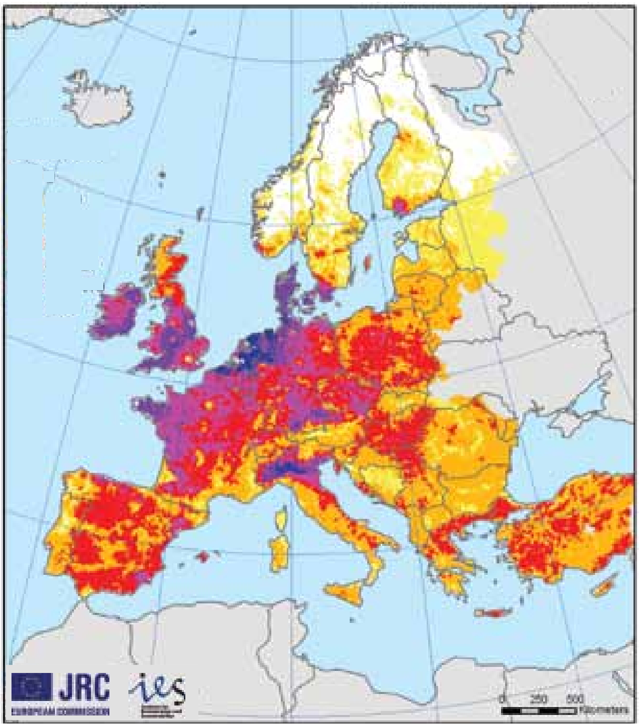
In Europe, mineral fertilisers account for almost half of all nitrogen input into agricultural soils, while manure is the other major input. Today, the highest total nitrogen application rates occur generally, although not exclusively, in western Europe (see Map 3.2(a) (Grizzetti et al., 2007; Bouraoui et al., 2011). There is generally a high correlation between nitrogen application and level of nitrate in rivers (see Map 3.2(b)).

Coastal water eutrophication: Nutrient concentrations in transitional, coastal and marine waters are caused by inputs mainly from land and atmospheric sources. Algal growth in seawater is generally limited by available nitrogen. Therefore nitrogen concentration is usually used as an index of nutrient enrichment in coastal and marine waters. Algae (i.e. phytoplankton), measured by chlorophyll-a concentrations, are most abundant in the summer and their abundance is linked to, among other things, the availability of nutrients in the water. Nutrient enrichment/eutrophication may therefore cause excessive growth of plankton algae (i.e. increase in phytoplankton biomass), which increases the concentration of chlorophyll-a. This in turn may result in an increase in frequency and duration of phytoplankton blooms, which can pose hazards to human health.

The latest assessment of EEA indicators of nutrients (EEA, 2012i) and chlorophyll-a (EEA, 2012k) in transitional, coastal and marine waters (Map 3.3), showed in 2010 there was clear evidence of nutrient enrichment in a number of areas where data was reported. Those areas were: within the coastal zones, bays and estuarine areas of some parts of southern coasts of the Greater North Sea, particularly those

Map 3.2 Total nitrogen application to agricultural soil and river nitrate concentration

(a) Total nitrogen application, manure and mineral fertiliser for year 2005

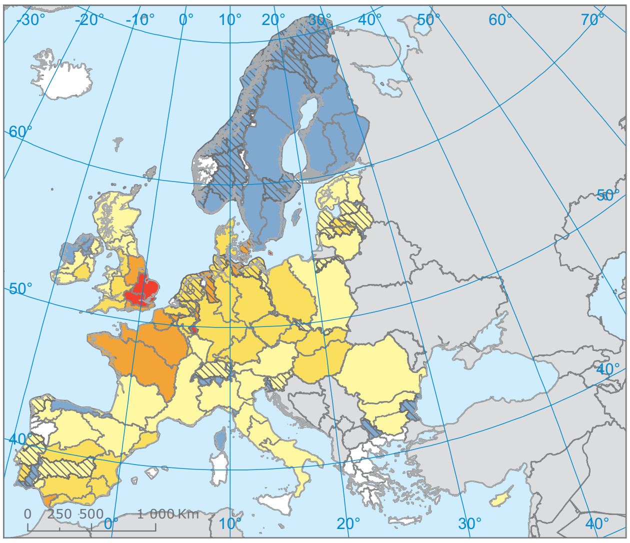


Total nitrogen fertilizer for year 2005 (kg/ha)

- 0
- 1–10
- 11–40
- 41–80
- 81–120
- 121–170
- > 170
- Outside data coverage

Source: Bouraoui et al., 2011.

(b) Annual average river nitrate concentration (mg/l NO_3-N) in 2010, averaged by RBD



Mean annual nitrates in rivers aggregated by national river basin districts 2010 or the latest reported year (mg/l N)

- < 0.8
- ≥ 0.8 < 2
- ≥ 2 < 3.6
- ≥ 3.6 < 5.6
- ≥ 5.6 < 11.3
- No data
- RBD with 10 or fewer stations

Note: This map shows the mean annual concentrations of nitrate (NO_3) as mg/l NO_3-N, measured at Eionet-Water River monitoring stations during 2010 or the last year of reporting. All data are annual means.

Source: EEA, 2012m.

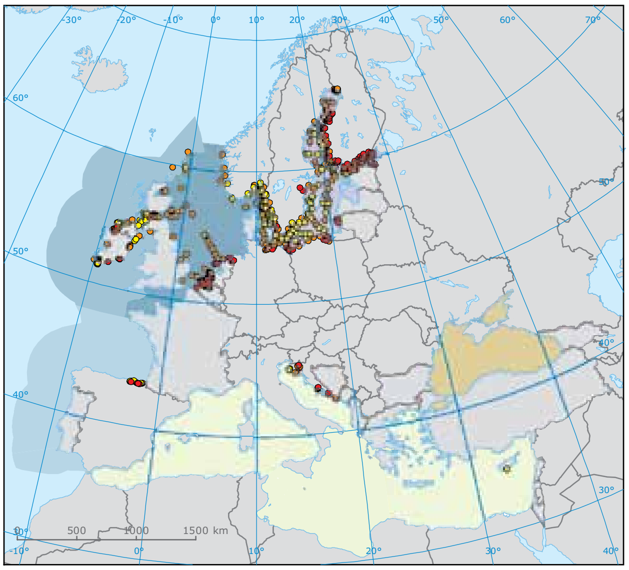
near major European river deltas; in the Gulf of Riga and the Gulf of Finland as well as along southern coastal areas of the Baltic Sea; in the Celtic Seas along Irish coastal waters; along the North Atlantic and Mediterranean coastal waters of France; and in areas close to river deltas or large urban agglomerations in the southern Adriatic Sea (along the Balkan coastal waters)and Black Sea.

Looking at changes over time, there have been no significant changes in nitrogen and chlorophyll-a concentrations in European seas between 1985 and 2010, as observed in the majority of the stations that reported to the EEA (84 % of the reported stations for nitrogen and 87 % for Chl-a). However, it should be noted that as with phosphate concentrations data availability is still an issue, in particular in the Mediterranean and Black Sea regions where little or no data for trend estimation is available.

Nevertheless, decreasing trends were observed in winter oxidised nitrogen concentrations in 14 % of all the reported stations, being most evident in the Baltic Sea (coastal waters of Germany, Denmark, Sweden and Finland, and open waters) and in the southern coasts of the Greater North Sea. Increasing trends (in 2 % of the stations) were mainly found in Croatian coastal stations. Over the same time period, summer chlorophyll-a concentrations showed increasing trends in 8 % of the reported stations and decreasing trends in 5 %. Increasing trends were mainly observed along the coastal waters of Finland in the Bothnian Sea and in the Gulf of Finland, and in the open waters of the Greater North Sea and Celtic Seas.

Map 3.3 Winter oxidised nitrogen (NO_2+NO_3) (a) and summer chlorophyll-a (b) in coastal and marine waters

(a) Winter oxidised nitrogen (NO_2+NO_3) concentrations in European seas



Winter oxidized nitrogen (NO_2+NO_3) concentrations in European seas, 2010
(µmol/l)

Baltic Sea
Baltic Sea
Low < 3.7 · Moderate 3.7–8.7 · High > 8.7

North-east Atlantic Sea
Celtic Seas
Low < 5.7 · Moderate 5.7–35.0 · High > 35.0

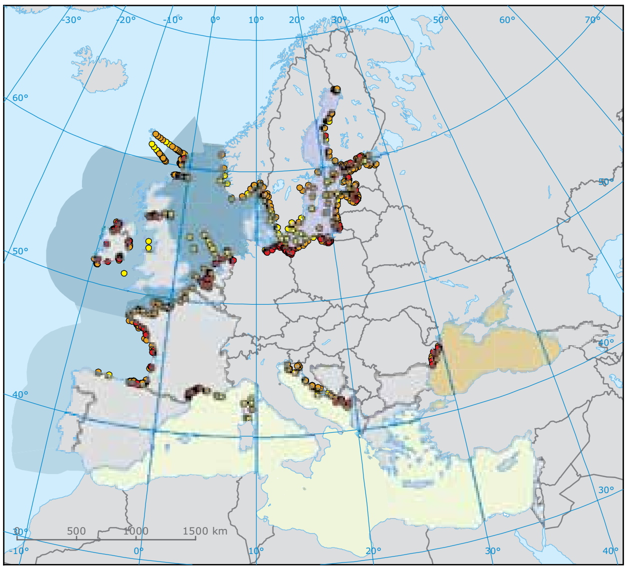
Greater North Sea
Low < 3.6 · Moderate 3.6–46.4 · High > 46.4

Bay of Biscay and the Iberian Coast
Low < 16.7 · Moderate 16.7–84.1 · High > 84.1

Mediterranean Sea
Mediterranean Sea
Low < 1.3 · Moderate 1.3–4.3 · High > 4.3

Black Sea
Black Sea

(b) Summer chlorophyll-a concentrations in European seas



Summer chlorophyll-a (Chla) concentrations in European seas, 2010
(µg/l)

Baltic Sea
Baltic Sea
Low < 2.8 · Moderate 2.8–12.2 · High > 12.2

North-east Atlantic Sea
Celtic Seas
Low < 2.0 · Moderate 2.0–6.5 · High > 6.5

Greater North Sea
Low < 1.1 · Moderate 1.1–8.9 · High > 8.9

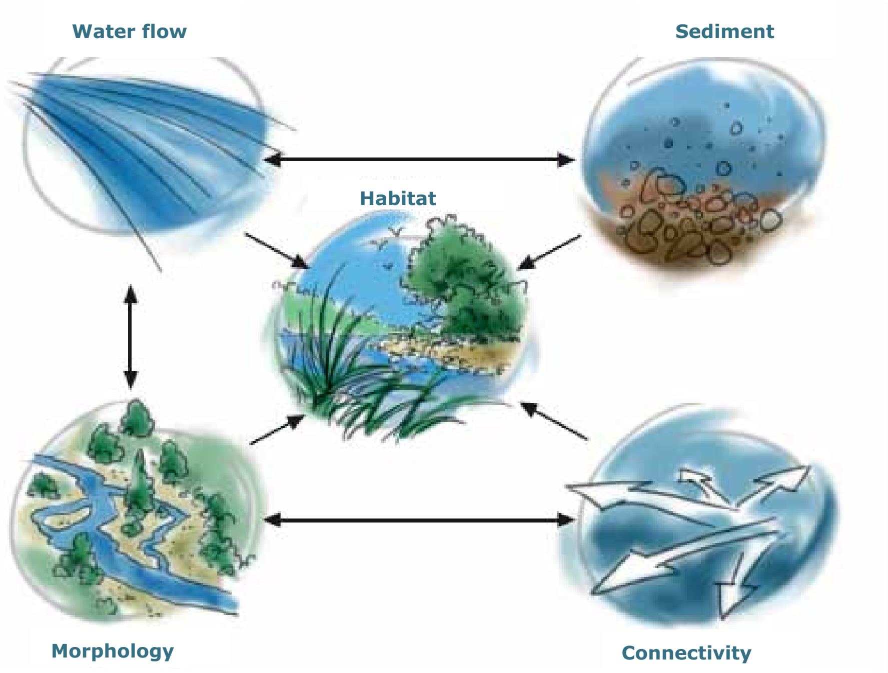
Bay of Biscay and the Iberian Coast
Low < 0.9 · Moderate 0.9–2.9 · High > 2.9

Mediterranean Sea
Mediterranean Sea
Low < 0.2 · Moderate 0.2–5.0 · High > 5.0

Black Sea
Black Sea
Low < 2.9 · Moderate 2.9–10.5 · High > 10.5

Source: EEA, 2012i and 2012k.

Figure 3.4 Relationship between habitats and hydrology (water flow), morphology, continuity and sediment processes



Source: Bourdin et al., 2011.

3.4 Hydromorphological pressures and impacts

For decades – sometimes centuries – humans have altered European surface waters (straightening and canalisation, disconnection of flood plains, land reclamations, dams, weirs, bank reinforcement, etc.) to enable agriculture and urbanisation, produce energy and protect against flooding. These activities result in damage to the morphology and hydrology of the water bodies, in other words to their hydromorphology. They also result in altered habitats, with significantly severe impacts on the status of aquatic environments.

Hydromorphological or habitat alterations are changes to the natural flow regime and structure of surface waters by modifications to: bank structures, sediment/habitat composition, discharge regime, gradient and slope. Hydromorphological degradation of riparian zones and floodplains also reduce their natural retention of pollutants and can thereby increase the vulnerability of European waters to pollution. The consequence of these pressures can impact aquatic ecological fauna and flora and can hence significantly impact the water status.

There are many human activities considered to be **driving forces** that result in **hydromorphological pressures** and eventually in **habitat alterations**.

Agricultural and forestry activities are in many places affecting the hydromorphological status of European water bodies. Water storage and abstraction for irrigated agriculture, particularly in southern Europe, have changed the hydrological flow regime of many river basins. In northern Europe, many landscapes have been affected by the digging of ditches and the drainage of lakes for agriculture and forestry. Intensification of agriculture has included many land reclamation projects affecting transitional and coastal waters, and has affected many lowland agricultural streams that were straightened, deepened and widened to facilitate land drainage and to prevent local flooding.

Urban developments have affected many rivers, lakes and coastal waters. During the last century, rivers in European cities were sealed in concrete, and habitats were lost. The hydromorphological processes within those systems remain strongly interrupted, even today. Lakes have been filled in, and coastal waterfronts have been heavily developed. Impervious surfaces such as pavements (roads, sidewalks, driveways and parking lots) and sewage collection systems have also changed the water flow regime.

Reservoirs are human-made lakes created by the damming of rivers to serve one or more purposes, such as hydropower production, water supply for drinking, irrigation, and flood protection. During the last two centuries, there has been a marked increase in both the size and number of large storage capacity reservoirs, especially with the development of hydropower and irrigation. There are currently about 7 000 large dams in Europe, and thousands more smaller dams.

Marine shipping and inland waterway transport play an important role in the movement of goods in Europe. Many thousands of kilometres of waterways connect hundreds of cities and industrial regions. Navigation activities and/or navigation infrastructure works are typically associated with hydromorphological pressures. The deepening of water bodies, including channel maintenance, dredging, removal or replacement of material is a major activity.

Flood defence works may cause significant pressures on hydromorphology. Today, many sections of major rivers and estuaries have dykes. The building of dykes resulted in the loss of floodplains and marshes as retention spaces for floodwater.

In many cases**, minerals are extracted** from surface water. Gravel and sand extraction have occurred in several European river basins, resulting in widespread channel adjustments in the last 100 years.

Construction, marine transportation and tourism, and altering coastal zones are causing considerable changes in physical coastal features, including sediment transport and erosion.

Altered habitats

There are many national examples illustrating that a large proportion of waters have been significantly modified. Only 21 % of German rivers, mainly in less populated areas, are still in their natural state or only slightly to moderately altered (BMU/UBA, 2010). In Denmark, the majority of streams have been directed into culverts or channels over the years (Sand-Jensen et al., 2006). Finland has about 159 000 km of rivers, of which more than 90 % are regulated or otherwise modified. Among other things, construction of hydroelectric power plants and dams, water regulation and flood control, dredging, clearing of river beds for log floating, and the digging of ditches have altered the natural state of these river systems (FGFRI, 2012). In Switzerland, below elevations of 600 m, 46 % of watercourses are heavily impacted in terms of structural diversity, and there are about 100 000 artificial barriers with a height difference of more than 0.5 m (FOEN, 2011b) (see Box 3.1).

Box 3.1 Hydromorphological state of Swiss rivers

Swiss rivers are highly degraded as a result of engineering measures, with monotonous habitats fragmented by artificial barriers.

- There is a 65 000 km river network with many watercourses in poor condition.
- Many water bodies are adversely affected by hydropower generation. There are 538 large hydropower plants and approximately 1 060 small hydropower plants.
- There are roughly 100 000 artificial barriers over 50 cm high, and several hundred thousand barriers under 50 cm high.
- The total number of man-made structures (e.g. dams and power plants) is 8 841.
- The average length of an unobstructed stretch of river is 650 m, with the number of barriers per river-kilometre being ranging from two (Canton Bern) to 11 (Canton Zurich)
- Eight species (fish and lamprey species excluding whitefish) have become extinct. For whitefish species, over 30 % of known species have become extinct.

Source: EAWAG, 2010.




Straightened and regulated shape streams, rivers © Peter Kristensen

River modification accelerated in the 20th century in Europe. Many rivers and streams were channelised and straightened, total stream length was shortened, and the number of oxbow lakes was reduced. Large rivers and their floodplains and coastal areas were among the first ecosystems to be occupied by human settlements. Land reclamation resulted in many rivers, riparian areas and coastal areas being designed to create land for industry and housing, make waters navigable, intensify agriculture, and protect against flooding.

The flood plain of the Upper Rhine, for example, was reduced by 60 % or 130 km^2 (BMU/UBA, 2010). River straightening measures lead to a shortening of the river length. On the Upper Rhine, this shortening led to a reduction of approximately 82 km, and on the Lower Rhine a reduction in length of approximately 23 km. This in turn led to an acceleration of run-off. Owing to the straightening and shortening of river courses, flood waves now travel faster and transport larger volumes of water per unit of time. The flow rate of the flood wave in the Rhine, for example, on the section between Basle and Maxau has been reduced from 64 hours to 23 hours (BMU/UBA, 2010).

Modified transitional and coastal waters

Transitional and coastal habitats have been altered in many ways; hydromorphological pressures such as dredging and land reclamation are activities that have weakened living conditions for natural habitats. In some sea regions, in the Mediterranean in particular, unsustainable fishing practices such

Modified transitional and coastal waters © Peter Kristensen

as trawling have impacted sensitive habitats like seagrass (*Posidonia*) beds and deep corals (EEA, 2006b). Increasing exploitation of sand and gravel for construction and beach development degrades natural coastal habitats (EEA, 2006a). Changes in river discharges (as a result of change in precipitation and temperature, water storage in reservoirs and canalisation) also impact upon coastal processes.

Water flow and water level regulation

The water flow regime and water level fluctuations are one of the major determinants of ecosystem function and services in river and lake ecosystems. Even though there can be high natural variation in flow regime (EEA, 2012d), many European rivers have their seasonal or daily flow regimes changed for various uses, with a significant impact on ecosystems. Many lakes and rivers have their water level regulated.

The water flows of the majority of rivers have been significantly modified through impoundments (dams and weirs) and compromised by abstractions, drainage return flows, maintenance of flows for navigation, and structures for flood control. Over-abstraction is causing low-flow river stretches, lowered groundwater levels and the drying-up of wetlands (EEA, 2010b and 2012d). In many locations, water demand often exceeds availability, and in many cases exploitation of water resources has led to significant degradation of freshwater biodiversity (EEA, 2010b and 2012).

The water flow and water level regulation depend on the uses to which a water body is put. Irrigation and storage for public water supply reservoirs generally store water during wet seasons and release it during dry seasons. Release of water from hydropower reservoirs depends on electricity demand. Flows downstream of hydropower plants may fluctuate daily when increased water volumes are channelled through turbines during periods of high electricity demand (hydropeaking). Flood prevention regulation often follows a pattern ensuring that some storage capacity is left empty to catch flash floods. When the major objective of the regulation is recreation or navigation, regulated water levels are often more stable than natural ones.

Barriers and transverse structures

Obstacles in rivers cause disturbances and have impacts on river continuity, which vary according to the height of the barrier and location. A major impact on a river could be caused by a single, very damaging structure or by the accumulated effects throughout the length of the river of a series of small structures, which may have only a small impact individually.

There are several hundred thousand barriers and transverse structures in European rivers. Some of them are large dams for hydropower production or irrigation storage reservoirs, but the majority are smaller obstacles.

Excessive sediment movement

Excessive sediment movement caused by erosion of soil and riverbeds is a factor affecting the ecological status of water bodies. Increased rates of erosion are caused by river maintenance and land-based activities, in particular agricultural cultivation and grazing practices, forestry, and construction. The direct effects of sediment movement include impairment of spawning gravels for fish, siltation of reservoirs and navigable waterways, obstruction of drains and river channels, and increasing flood risk. Many pollutants (metals, nutrients and organic) can also be retained and released from sediments.

Barriers and transverse structures in European rivers © Peter Kristensen

3.5 Conclusion and summary of results

Clean unpolluted water is essential for our ecosystems; plants and animals in freshwater react to changes in their environment caused by changes in water quality. Pollutants in many of Europe's surface waters have had detrimental effects on aquatic ecosystems and resulted in the loss of aquatic flora and fauna.

During the last 25 years, significant progress has been made in numerous European waters in reducing pollution: improved wastewater treatment, reduced volume of industrial effluents, reduced use of fertilisers, reduced or banned phosphate content in detergents as well as reduced atmospheric emissions. Water quality in Europe has therefore improved significantly in recent decades and the effects of pollutants have decreased. However, challenges remain because wastewater treatment implementation in some regions remains incomplete. Moreover, other significant sources of water pollution exist, especially in agriculture and urban storm flows. Despite improvements in some regions, diffuse pollution from agriculture in particular remains a major cause of the poor water quality currently observed in parts of Europe.

For decades, sometimes centuries, humans have altered European surface waters (straightening and canalisation, disconnection of flood plains, land reclamations, dams, weirs, bank reinforcements, etc.) to enable agriculture and urbanisation, produce energy and protect against flooding. These activities result in damage to the morphology and hydrology of the water bodies, and result in altered habitats with severe impacts on the status of the aquatic environments.

There are several hundred thousand barriers and transverse structures in European rivers. In many river basins, the continuity of the rivers is interrupted every second kilometre. Many watercourses have their seasonal or daily flow regimes changed for various uses (including damming for hydropower production and storage of irrigation water) that have a significant impact on aquatic ecosystems. Transitional and coastal habitats have been altered in many ways: by dredging, land reclamation and hard infrastructure for coastal protection and erosion management.

The WFD requires that all the issues mentioned above are addressed, in order to ensure that by 2015 all water bodies hold good status.

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4 Ecological status and pressures

Chapter 4 summarises the results on ecological status, pressures and impacts for each surface water category: rivers, lakes, transitional waters, and coastal waters. The information is based on data reported by Member States along with their first RBMPs.

The basic information unit is water bodies. For each water body, there is information on status, pressures and impact. This information has been aggregated to European, country and RBD level, and is presented as:

- percentage and number of water bodies in the different classes of ecological status;
- percentage and number of water bodies affected by different significant pressures and impacts.

The data sources, methodologies and uncertainties related to this assessment of status and pressures from the RBMPs are explained in Chapter 2. In addition, a more detailed report describing further aspects of the results and methodologies is available (EEA ETC/ICM, 2012a).

4.1.1 Ecological status and potential

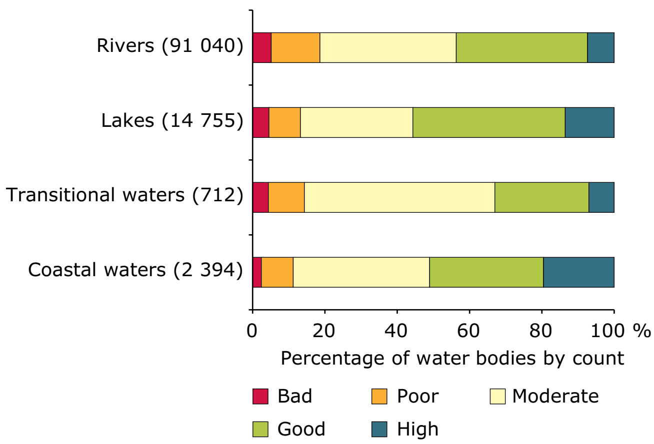
Ecological status or potential is a measure of the quality of the structure and functioning of surface water ecosystems. Ecological status is based upon classification of the biological elements (phytoplankton, phytobenthos, benthic fauna, macrophytes and fish) and supporting hydromorphological, physico-chemical quality elements and non-priority pollutants. The main objective of the WFD is that all surface waters should hold good or high ecological status by 2015. The current status classification constitutes the baseline from which future improvements towards the objective of the WFD are measured.

Figure 4.1 shows the distribution of ecological status or potential for the different types of water bodies (rivers, lakes, transitional waters, and coastal waters).

Overall, more than half of the total number of classified surface water bodies in Europe are reported to hold less than good ecological status or potential.

For rivers, more than 51 000 water bodies (56 % of the classified water bodies), or 630 000 km (64 % of total river length) hold less than good ecological status or potential. For lakes, the overall status is somewhat better than in rivers, but there remain 44 % or almost 6 500 lake water bodies in less than good ecological status or potential. Lakes are in better condition than rivers because 60 % of the reported lake water bodies are in Sweden and Finland, and hold a generally better status as the population density and agricultural pressures are relatively low in those countries.

Figure 4.1 Distribution of ecological status or potential of classified rivers, lakes, coastal and transitional waters



Notes: See the EEA ETC/ICM technical report for more details and the methodology used for assessing ecological status or potential (EEA ETC/ICM, 2012a). The number of water bodies is provided in parentheses. The results are calculated as a percentage of the total number of classified water bodies.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_STATUS.

The worst status is found in transitional waters, where two thirds of the water bodies hold less than good ecological status or potential. In coastal waters, the situation is somewhat better: half of the water bodies are reported to be in less than good ecological status or potential. The worse status in transitional waters compared to coastal waters is due to their proximity to land-based pollution sources, including accumulated loading from the upstream river basins. Moreover, transitional waters are exposed to extensive hydromorphological pressures caused by land reclamation, erosion control and flood protection, as well as infrastructure like ports that cause altered habitats in these water bodies.

Ecological status or potential in different river basin districts

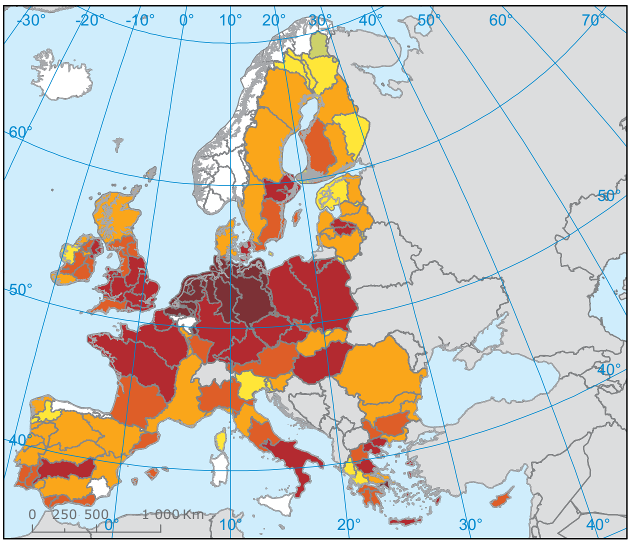
The worst ecological status or potential in **river and lake water bodies** is reported in RBDs in north-western Europe. In northern Germany, the Netherlands and Belgium (Flanders), more than 90 % of water bodies hold less than good ecological status/potential (see Map 4.1(a)). Many other RBDs also have more than 70 % of their rivers and lakes in less than good status.

Map 4.1 also illustrates differences in ecological status within individual Member States. For example, ecological status is better in northern Finland and Sweden compared to the southern parts of these countries. Similarly, the Scottish RBD and the Rhône RBD have better ecological status than the rest of the RBDs in the United Kingdom and France respectively.

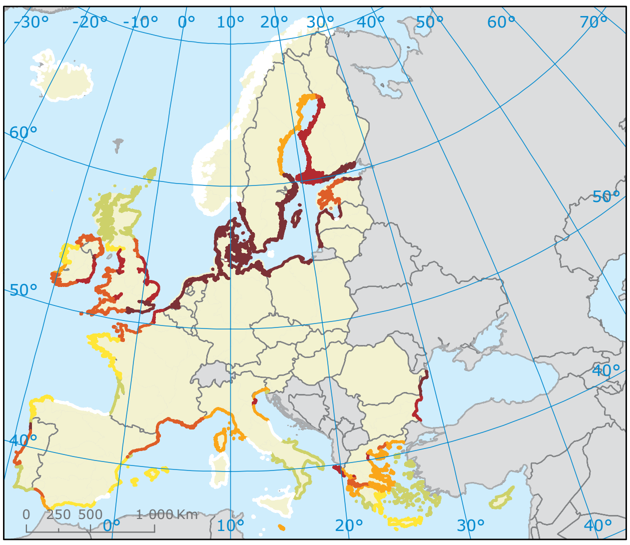
For **coastal and transitional waters**, RBDs with high a proportion of water bodies in poor ecological status are found bordering the Baltic Sea and the Greater North Sea (Map 4.1(b)). Also, in the EU part of the Black Sea (Romania and Bulgaria), the situation is generally poor, with more than 70 % of classified water bodies reported to be in less than good status. A better ecological status or potential in coastal and transitional waters is found in RBDs bordering the Mediterranean and bordering the more open waters of the Atlantic Ocean, such as in Scotland.

Map 4.1 Proportion of classified surface water bodies in different RBDs holding less than good ecological status or potential, for rivers and lakes (a) and for coastal and transitional waters (b)

(a) Rivers and lakes



(b) Coastal and transitional waters



Percent of classified water bodies in less than good ecological status or potential

< 10 % | 10–30 % | 30–50 % | 50–70 % | 70–90 % | ≥ 90 % | No data

Notes: See the EEA ETC/ICM technical report for more details and the methodology used for assessing ecological status or potential (EEA ETC/ICM, 2012a). The results are calculated as a percentage of the total number of classified water bodies.

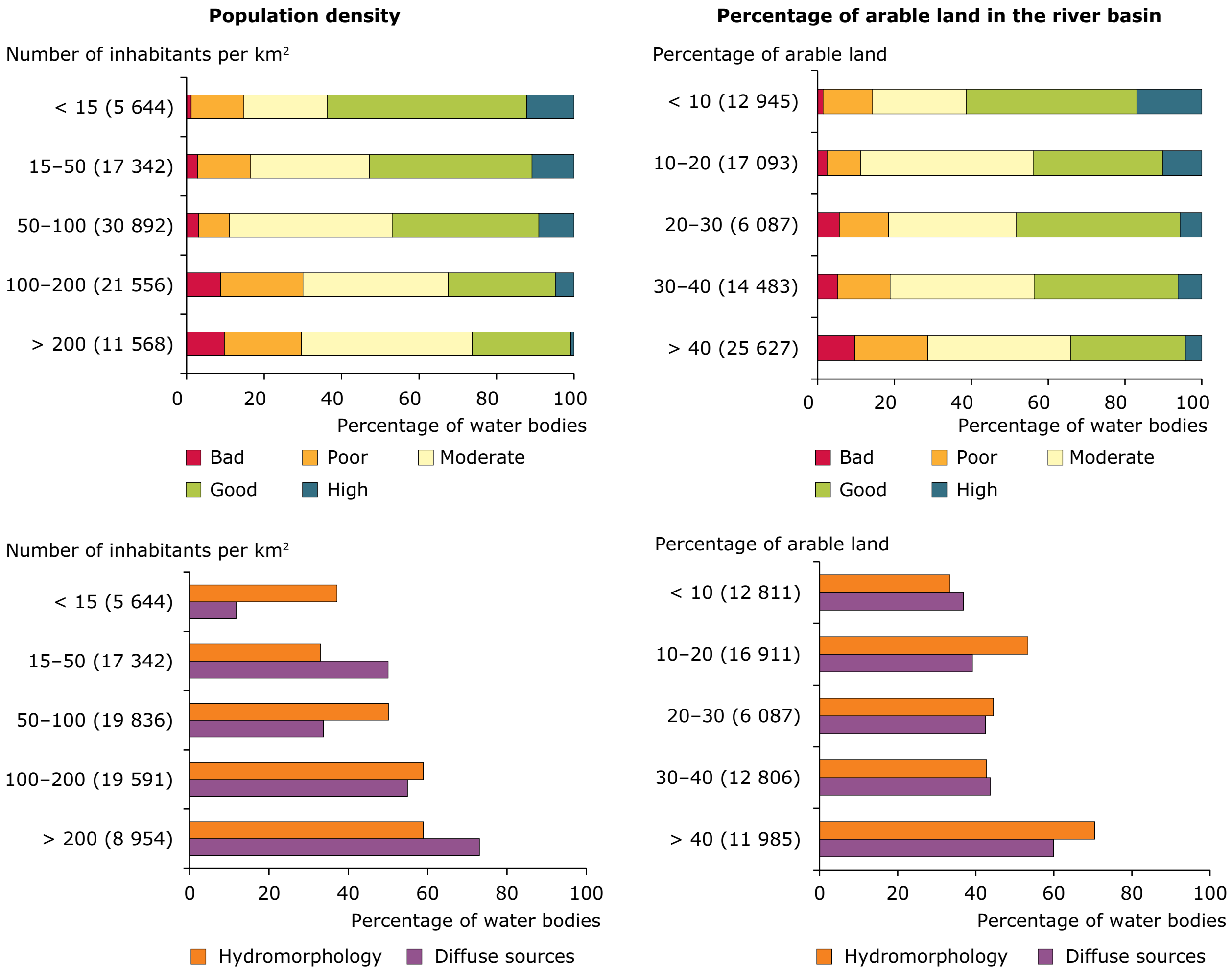
Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_STATUS.

4.1.2 *Ecological status and pressures and drivers in RBDs*

There are more than 90 000 river water bodies classified under the WFD. They have been grouped according to the overall population density and percentage of arable land in the RBDs in which they are located (Figure 4.2). The results provide a crude overview of the drivers affecting the ecological status.

With higher population density and an increased proportion of arable land, the ecological status of river water bodies deteriorates and the pressure increases, both for diffuse pollution and for hydromorphological pressures (Figure 4.2). The proportion of classified river water bodies in less than good status ecological status or affected by pressures rises from less than 40 % to 70 % when population density and the proportion of arable land climbs from the lowest to the highest category. This pattern is a clear indication that population density and proportion of arable land are two major drivers responsible for the pressures affecting the ecological status or potential of European rivers.

Figure 4.2 Ecological status/potential and pollution/hydromorphological pressures of classified river water bodies, according to population density and percentage of arable land in the river basin



Notes: See the EEA ETC/ICM technical report for more details and the methodology used for assessing ecological status and pressures (EEA ETC/ICM, 2012a). The designation of river water bodies to population density or arable land categories is made at RBD level, i.e. all water bodies in the same RBD are in the same category. The number of classified river water bodies in the different population density categories or arable land categories is indicated in parentheses.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_STATUS and http://discomap.eea.europa.eu/report/wfd/SWB_PRESSURE_STATUS.

4.2 Main pressures and impacts affecting ecological status for all water categories

The WFD requires that Member States collect and maintain information on the type and magnitude of 'significant pressures' affecting each water body. The common understanding of a 'significant pressure' is that it constitutes any pressure that on its own, or in combination with other pressures, may lead to a failure to achieve the WFD objectives of achieving good status.

Figure 4.3 illustrates, for each of the four surface water categories, the proportion of water bodies:

- with **no pressures** and **no impacts** identified (blue shading);
- with **pollution** (diffuse and point source) **pressure** and **impacts related to pollution** identified;
- with **hydromorphological pressures** and impact resulting in **altered habitats** identified;
- with **other pressures and impacts** identified.

4.2.1 Water bodies with no significant pressures and impacts

Half of lake water bodies (48 %) had **no significant pressures** reported, followed by 42 % of coastal water bodies with no pressures identified. Only one third of the river water bodies and one fifth of the transitional water bodies have no pressures reported. The proportion of water bodies without pressures generally corresponds to the proportion of water bodies classified as having good or high ecological status or potential.

4.2.2 Pollution pressures and impacts

Pollution pressures comprise all emissions to surface waters from point and diffuse sources, including nutrients, organic matter, acidifying substances and hazardous substances from local, regional or long-range transboundary pollution sources.

Generally speaking, 30 % to 50 % of surface water bodies are affected by **pollution pressures**, with diffuse sources being the most important pollutant pressure (see Figure 4.3). More than 40 % of river and coastal water bodies are affected by diffuse sources; whilst 20 % to 25 % of them are also subject to point source pollution. 46 % of transitional waters are affected by point sources, and 34 % of transitional waters are affected by diffuse sources. A lower proportion of lake water bodies is reported to be affected by pollution sources, reflecting the disproportionately large number of lakes reported from Sweden and Finland.

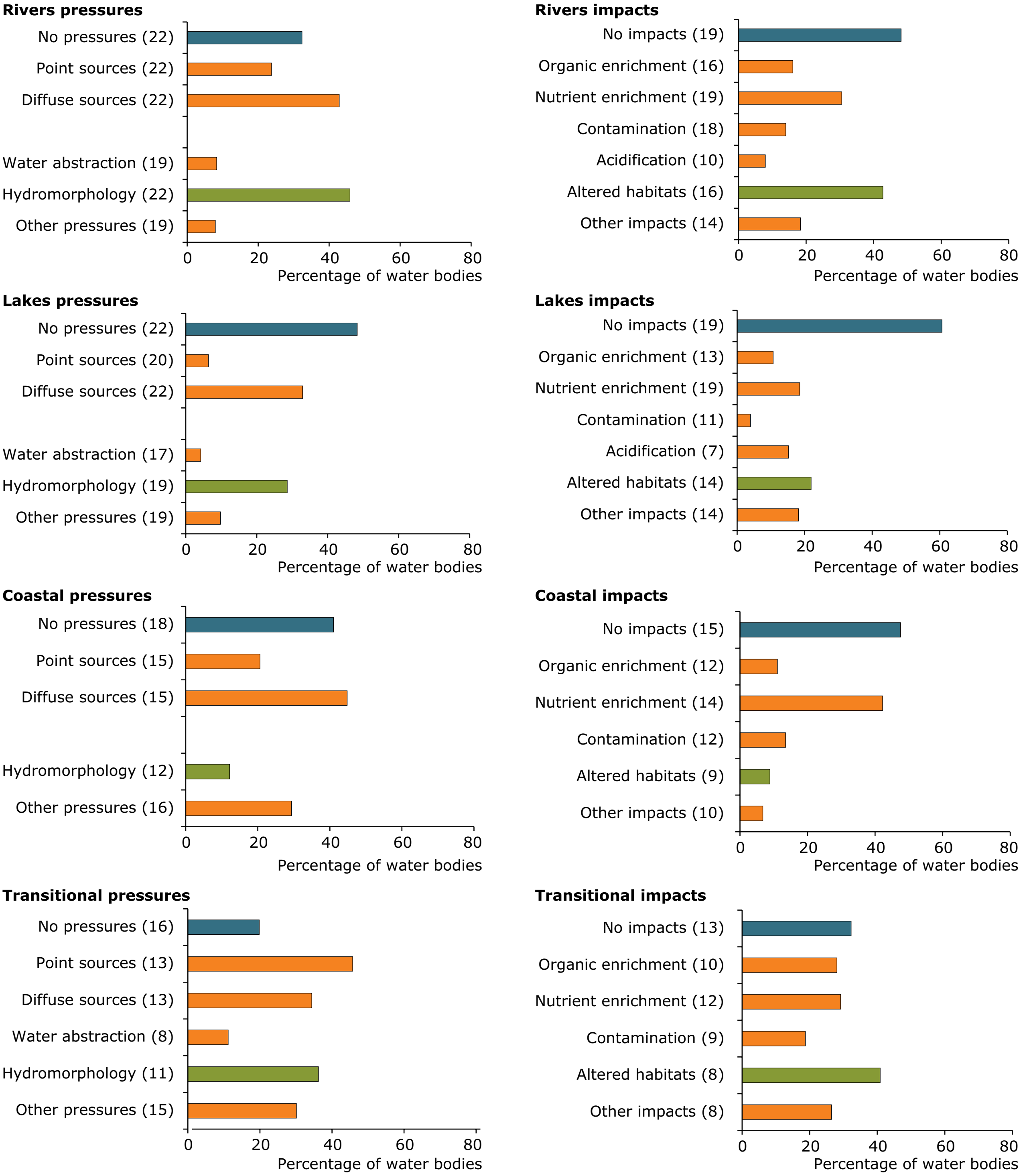
The highest pollution pressures in **river and lake water bodies** are reported in RBDs in the Netherlands and Belgium (Flanders), as well as in southern Italy, south-eastern England, and parts of northern Germany, where more than 90 % of the water bodies are exposed to pollution pressures (see Map 4.2 (a)). For **coastal and transitional waters**, the worst areas, where more than 90 % of water bodies are reported to be exposed to pollution pressures, are in the Baltic region, the Greater North Sea region, southern Portugal and the Romanian part of the Black Sea region (see Map 4.2 (b)).

Impacts caused by pollution pressures

Nutrient enrichment causing eutrophication is most important impact of these pollution pressures (see Figure 4.3, right column). Coastal waters have the highest proportion of water bodies suffering from nutrient enrichment (42 %), while lakes are the least affected, with less than 20 % of lakes reported to suffer from nutrient enrichment. **Organic enrichment** due to pollution by oxygen-consuming substances is reported to affect between 10 % and 15 % of rivers, lakes and coastal water bodies, and is more important in transitional waters, where the proportion of affected water bodies is close to 30 % (Figure 4.3). The latter is consistent with the high proportion of transitional water bodies exposed to point source pollution.

Other pollution and water quality impacts reported (Figure 4.3) are as follows: **acidification** from long-range transported air pollution affects 10 % of river water bodies and 17 % of lake water bodies in the few (7 to 10) Member States reporting this impact. **Contamination by priority substances and contaminated sediments** affect less than 20 % of all classified water bodies. The chemical status of water bodies is further described in Chapter 5.

Figure 4.3 Proportion of total number of classified water bodies with identified significant pressures (left column) and impacts (right column), for rivers, lakes, coastal waters, and transitional waters

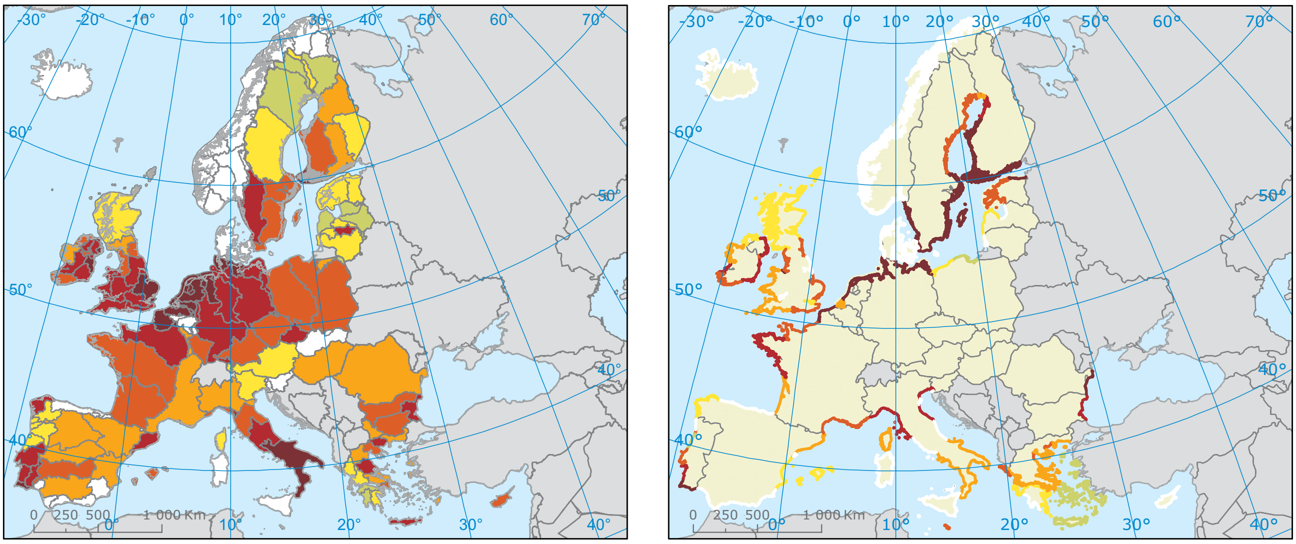


Notes: See the EEA ETC/ICM technical report for more details and the methodology used for assessing pressures and impacts (EEA ETC/ICM, 2012a).The percentage is calculated against the total number of classified surface water bodies in Member States reporting the specific pressure or impact type. The proportion of water bodies without any pressures or impacts is illustrated using blue bars. The number of Member States included is indicated in parentheses.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_PRESSURE_STATUS and http://discomap.eea.europa.eu/report/wfd/SWB_IMPACTS_STATUS.

Map 4.2 **Proportion of classified water bodies in different RBDs affected by pollution pressures, for (a) rivers and lakes and for (b) coastal and transitional waters**

(a) Rivers and lakes | (b) Coastal and transitional waters



Percent of classified water bodies affected by point and/or diffuse pressures

< 10 % | 10–30 % | 30–50 % | 50–70 % | 70–90 % | ≥ 90 % | No data

Notes: See the EEA ETC/ICM technical report for more details and the methodology used for assessing pressures (EEA ETC/ICM, 2012a).

A water body is considered to be affected by pollution pressures if it is reported with the aggregated pressure type 'Point sources' and/or 'Diffuse sources' and/or any of the corresponding disaggregated pressure types (e.g. urban wastewater, industry emissions or agriculture diffuse pollution). Swedish surface water bodies are defined as not affected by diffuse pollution pressures if the only reported diffuse pollution pressure is airborne mercury contamination.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_PRESSURE_STATUS.

Assessment pollution pressures

The results show that a large proportion of the water bodies, particularly in regions with intensive agriculture and high population density, hold poor ecological status and are affected by pollution pressures.

As described in Chapter 3, regulations and measures have significantly reduced point source pollution in recent decades. Nevertheless, pollution is still being caused by the overflow of wastewater from sewage systems as well as by discharges from wastewater treatment plants and industries. 20 % to 25 % of water bodies still have point sources as a significant pressure. The five Member States (Poland, Ireland, Belgium (Flanders), the Czech Republic and the United Kingdom) with the highest proportion of river water bodies affected by point sources (more than 45 %) generally have a lower degree of wastewater treatment than many other Member States (EEA, 2012l).

Despite some progress in reducing agricultural inputs of pollutants, the diffuse pollution from agriculture is still significant in more than 40% of Europe's water bodies in rivers and coastal waters, and in one third of the water bodies in lakes and transitional waters. This suggests a need for increased attention if good water quality and ecological status is to be achieved. The RBDs and Member States with a high proportion of water bodies affected by diffuse pollution are found in north-western Europe in particular, and correspond to the regions with high fertiliser input and high river nitrate concentration (see Section 3.3 and Map 3.2).

Chapter 7 further discusses the challenge of reducing pollution and improving water quality.

4.2.3 *Hydromorphological pressures and altered habitats*

Numerous human structures and activities have resulted in vast hydromorphological modifications, which have greatly impacted the ecological function of European surface waters. In the RBMPs, the majority of EU Member States indicate that urban development, flood defence, power generation including hydropower, inland water navigation, straightening, and land drainage for agriculture are important pressures affecting the hydromorphological status of water bodies.

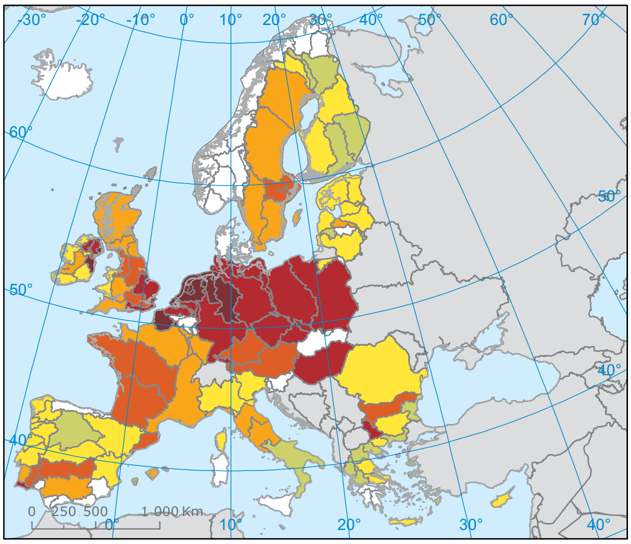
Hydromorphological pressures and altered habitats are reported for a large proportion of classified water bodies, particularly in rivers (more than 40 %) and transitional waters (40 %) and one third of the lake water bodies (see Figure 4.3).

The hydromorphological pressures **in rivers and lakes** are reported to be most severe in RBDs in the Netherlands, Germany, Poland, Hungary and south-east England, and less severe in RBDs in Finland, the Baltic countries and Romania (Map 4.3(a)). In **coastal and transitional waters,** the hydromorphological pressure is considerably less than in freshwater bodies, and is mainly a problem along the Greater North Sea coast of Germany, the Netherlands and Belgium, as well as along the southern coast of Italy (see Map 4.3(b)).

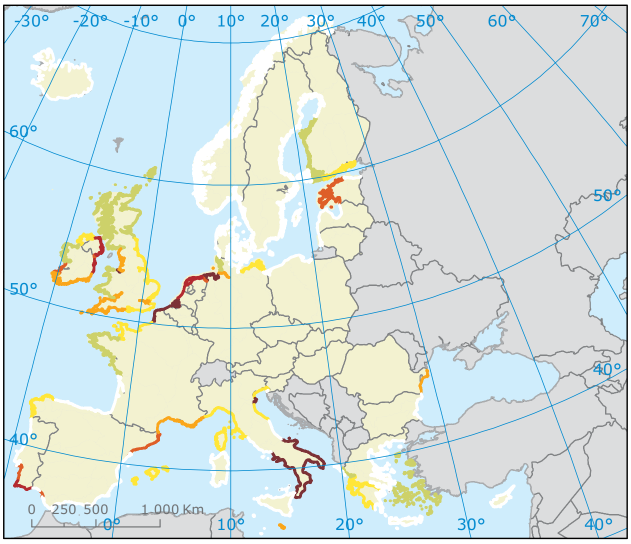
The river flow regime (seasonal variation in flow) and water level fluctuations are two of the major

Map 4.3 Proportion of classified water bodies in different RBDs affected by hydromorphological pressures for (a) rivers and lakes and for (b) coastal and transitional waters

(a) Rivers and lakes



(b) Coastal and transitional waters



Percent of classified water bodies affected by hydromorphological pressures

< 10 % | 10–30 % | 30–50 % | 50–70 % | 70–90 % | ≥ 90 % | No data

Notes: See the EEA ETC/ICM technical report for more details and the methodology used for assessing pressures (EEA ETC/ICM, 2012a).

A water body is considered to be affected by hydromorphological pressures if it is reported with any of the aggregated pressure types 'Water abstraction', 'Water flow regulations and morphological alterations of surface water', 'River management', 'Transitional and coastal water management', 'Other morphological alterations' and/or any of the corresponding disaggregated pressure types.

The coastal waters of the Baltic have a low proportion of water bodies affected by hydromorphology pressures, except for Estonia, which reported more than half of its coastal water bodies as having hydromorphological pressures. This is an example of inaccurate reporting: Estonia has misinterpreted the pressure category 'Transitional and coastal water management'; the Estonian RBMPs do not indicate hydromorphology as a major coastal water pressure.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_PRESSURE_STATUS.

Box 4.1 Ecological flows

The quantity, quality and timing of water flows required to sustain ecosystems and the services they provide are collectively referred to as **ecological flows**. Ecological flows are an important mechanism to protect and enhance the status of aquatic ecosystems and promote sustainable water use, thus contributing to the achievement of EU water policy goals.

The establishment of ecological flows serves to maintain essential processes of healthy river ecosystems and good ecological status of water bodies. Where water resources are overallocated or overexploited, ecological flow requirements impose a reduction (a cap) for water withdrawal, which the water-intensive economic sectors have to bear.

determinants of ecosystem function and services in river and lake ecosystems. Several of the RBMPs report that water abstractions are a significant pressure affecting the hydrology and flow regime in the RBD. Overall, 8 % of European river water bodies are affected by water abstraction pressures. Four Member States (Poland, Bulgaria, Spain and France) identified pressure from water abstraction that affected more than 20 % of their river water bodies. About 4 % of lake water bodies are affected by water abstraction pressures.

The main challenge in managing water flows and water levels is to meet the reasonable needs of the different water users, while leaving enough water in the environment to conserve river, lake and wetland habitats and species (see Box 4.1) (EEA, 2012d).

Barriers and transverse structures

There are several hundred thousand barriers and transverse structures in European rivers (Table 4.1). Some of them are large dams for hydropower production or irrigation storage reservoirs, but the majority are smaller obstacles. In Germany for example, it has been estimated that there are some 200 000 transverse structures, and in France the estimate is that there are 120 000 barriers. In many catchments, the continuity of the rivers is interrupted by one barrier every second kilometre.

Table 4.1 Barriers in selected countries and river basins

In **Austria** there are around 27 000 barriers in river networks with a catchment area greater than 10 km^2 (Zitek, 2009).
In **Belgium**, 779 barriers have been identified on a 3 000 km long priority network of rivers. In addition, many barriers are found on other rivers (Biodiversity Indicators, 2011).
In the **Czech Republic**, around 6 000 barriers above 1 m have been identified: 2 153 in the Danube RBD, 2 805 in the Elbe RBD, and 1 065 in the Odra RBD (Czech Republic MoE, 2005).
The **Dutch Rhine RBMP** identified over 9 000 dams, including over 700 in flowing waters. The Dutch Meuse RBMP identified more than 2 000 dams, half of them in flowing waters. The weirs and dams are needed for flood protection and for regulating water levels for different functions (such as urban use, agricultural use and nature). Only a small part is made passable for fish (VROM et al., 2009a and 2009b).
In **France**, more than 60 000 structures — dams, locks, weirs and mills — have been recorded on rivers and are potential obstacles to river continuity. In total, it is estimated that the river networks are affected by 120 000 transversal structures. In some catchments such as the Upper Rhine and Rhône river the density of obstacles is high, with more than 200 obstacles per km^2 (ONEMA 2011).
There are currently thought to be some 200 000 transverse structures in **Germany**. In relation to the overall length of Germany's network of watercourses of around 400 000 km, the continuity of rivers is therefore interrupted around every second kilometre by a technical structure (BMU/UBA, 2010).
There are over 2 500 weirs and impoundments, and 5 000 culverts on **Scottish rivers** (SEPA, 2007).
In the **Slovak RBMP**, 779 barriers inpassable to fish have have been identified. Only 84 of these have functional fish passes (Ministry of Environment of the Slovak Republic 2009).
In **Sweden**, 3 875 out of 15 598 river water bodies (25 %) and 1 372 of 7 252 lake water bodies (19 %) are affected by continuity interruptions. In the northern Baltic Sea RBD, for example, there are 945 identified dams, 2 825 other barriers, and nearly 5 000 road crossings that may act as barriers (Swedish RBMPs, 2010).
In **Switzerland**, there are approximately 100 000 artificial barriers over 50 cm high, and several hundred thousand barriers under 50 cm high (FOEN 2010b).
A total of 1 688 barriers are located in the **large rivers in the Danube system** with catchment areas greater than 4 000 km^2. Of these, 600 are dams/weirs, 729 are ramps/sills, and 359 are classed as other types of interruptions. Only 756 are currently reported as being equipped with functional fish migration aids. Therefore, 932 continuity interruptions (55 %) remain a hindrance for fish (ICPDR, 2009).

Morphology

In the RBMPs, there are many examples illustrating that a large proportion of waters has been significantly modified. River modification accelerated in the 20th century in Europe. Many rivers and streams were channelised and straightened, total stream length was shortened, and the number of oxbow lakes was reduced. Many lowland rivers in western Europe have been substantially modified to aid land drainage, supporting the intensification of agriculture. Some examples of waters that have been significantly modified follow below.

- The intensification of agricultural production in rural areas triggered large-scale drainage of most of the Danish land area through major drainage schemes that led to straightening and channelisation of more than 90 % of all Danish streams (Sand-Jensen et al., 2006). Moreover, numerous small streams were culverted to facilitate easier access to fields for farm management.

- A 2011 report on the state of river habitats in England and Wales showed that river channels have been extensively modified across England, Wales and the Isle of Man (Environment Agency, 2011). Over many centuries, rivers have been straightened, widened, deepened and dammed, mainly to improve drainage of land for housing, industry and farmland, and to reduce the risk of local flooding. As a result, river and bank-side habitats have become impoverished and the variety of wildlife they support has declined.

- In Austria, only about one third of the total length of the main rivers remains free flowing. The remainder has been impounded or otherwise modified for hydroelectricity generation or flood protection and erosion control (Lebensministerium, 2010).

- Almost every ditch and stream in Finland has been straightened for agriculture and forestry. Many natural streams have been widened to increase drainage, or deepened and straightened for agriculture (Laitinen and Jormola, 2008).

- The morphological changes of rivers in Germany were recorded by the 2001 morphological water structure map prepared by LAWA in collaboration with the Federal Environment Agency (BMU/UBA, 2010). Results showed that only 21 % of Germany's rivers and streams — predominantly in less populated regions — are still in a semi-natural state, i.e. with little to moderate modification by humans.

Several RBMPs found disconnection of rivers, transitional and coastal waters from their riparian zone. Land reclamation has resulted in many rivers, riparian areas and coastal areas being designed to create land for industry and housing, make waters navigable, intensify agriculture, and protect against flooding. The large European rivers generally have large parts of their floodplains separated off from the river and restricted by dykes, mainly due to flood defence structures and land reclamation.

Transitional and coastal habitats have been altered in many ways: forms of hydromorphological pressures such as dredging and land reclamation are activities that have weakened living conditions for natural habitats (see Box 4.2).

Box 4.2 The Scheldt estuary in the Netherlands and Belgium

The RBD Scheldt encompasses parts of Belgium and the Netherlands and a small part of north-western France. The Scheldt estuary has a large tidal range and consists of a mixture of channels and large tidal flats that are exposed during low tide. After the flood disaster of 1953, the decision was taken to improve flood protection in the Scheldt estuary. Most transitional water bodies, with the exception of the western Scheldt, were closed off completely or have a reduced water exchange with the North Sea. Therefore these water bodies were converted into basins with a strongly regulated hydrological regime and salinity.

The main pressures in the RBD are related to the use of hard infrastructure for coastal protection and erosion management. The transitional and coastal waters in the Dutch and Belgian parts of the Scheldt RBD are among the most heavily navigated in the world, containing two major shipping routes in the North Sea, with the port of Antwerp, the second largest seaport in Europe, in the upper Scheldt estuary.

As a result of the massive hydromorphological and other pressures, there is hardly any water body holding good ecological status/potential.

Box 4.3 Reduced sediment transport and the Ebro delta

The delta of the Ebro River is a site of high economic and environmental importance. Almost 50 000 people live on the delta, and several economic activities (fisheries, aquaculture, agriculture in the form of rice farms, and tourism) are associated with the ecosystems of the delta.

Existing dams in the Ebro River currently trap approximately 95 % of the suspended sediment load as compared the beginning of the 1900s when there were only few dams in the river system. In the last century, the discharge of the river, have decreased by approximately 30 %.

The decrease in river discharge at its mouth also leads to salt-water intrusion within the river system, and because the sedimentation rate has been reduced between 3 mm and 15 mm per year to between 0.1 mm and 4 mm per year, the lack of accretion is leading to coastal retreat and land subsidence. This situation may be aggravated by the increasing sea level rise due to climate change.

Source: Ibáñez et al., 1996; Ibáñez and Prat, 2003.

Excessive sediment movement

Excessive sediment movement is a factor affecting the ecological status of water bodies. River maintenance and land-based activities such as agricultural cultivation and grazing practices, forestry and construction are causing increased erosion and sediment transport. The impacts of excessive sediment movement include impairment of spawning gravels for fish, siltation of reservoirs and navigable waterways, obstruction of drains and river channels, and increasing flood risk. The siltation of spawning gravels has been increasingly cited as an important cause of declining fish species in many parts of Europe (Kemp et al., 2012).

In river basins with many large reservoirs, a large proportion of the natural sediment transport is trapped, resulting in a much lower load of sediments to coastal deltas (Box 4.3). Downstream of dams, the lack of sediment transport result in net-erosion of the river bed. Examples of such erosions are evident in the Rhine, the Isar and the Elbe: they have become up to 7 m deeper, up to 8 m deeper and up to 1.7 m deeper, respectively (BMU/UBA, 2010). Insufficient sediment in rivers, estuaries, and coastal waters causes the erosion of important habitats such as wetlands, mudflats, salt marshes and beaches.

4.3 Designation of heavily modified and artificial water bodies

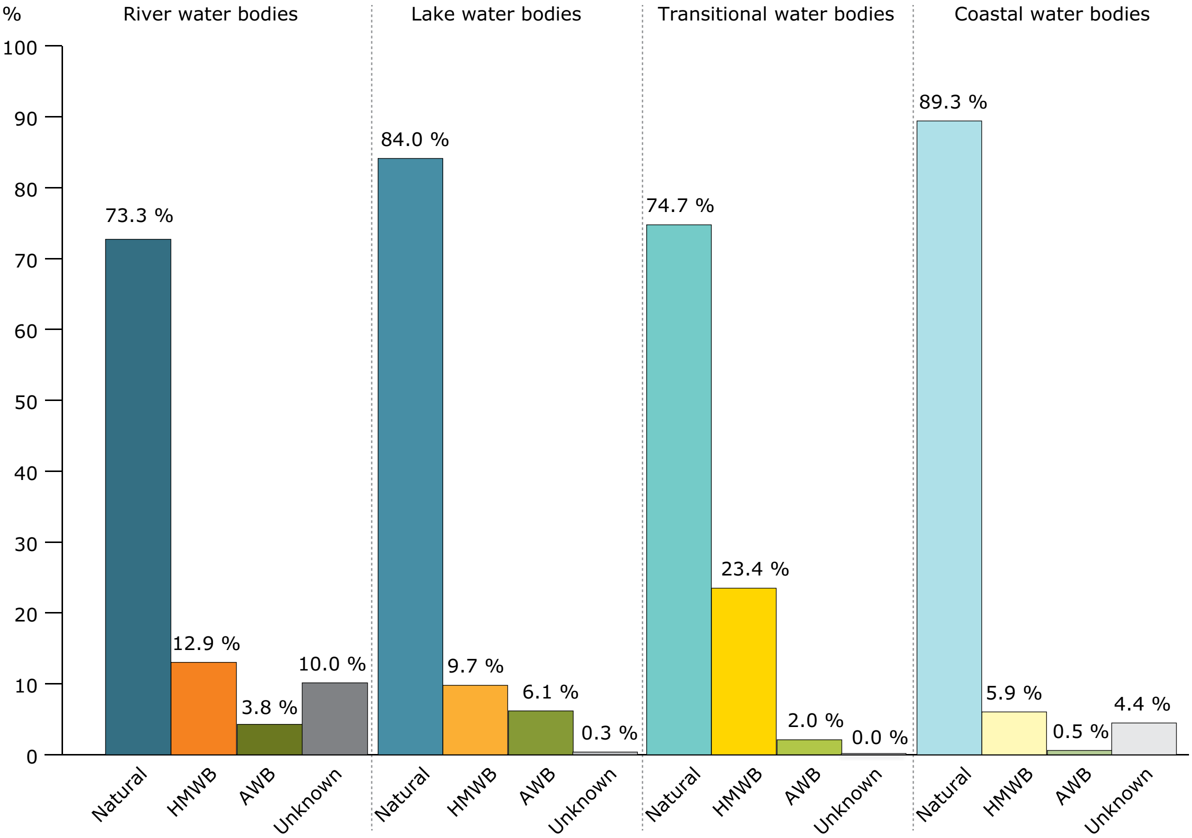
In the case of water bodies that have undergone hydromorphological alteration, the WFD allows Member States to designate some of their surface waters as Highly Modified Water Bodies (HMWBs) or AWBs (Artificial Water Bodies). Unlike in the case of natural type water bodies, where Member States have to achieve good ecological status, in the case of HMWBs and AWBs Member States have to meet a different standard: good ecological potential. The objective of good ecological potential is similar to that of good status, but it takes into account the constraints imposed by social and/or economic uses.

In many river basins, the upper stretches in mountainous areas, highland areas, and often in forest areas remain largely in their natural state. However, the lower stretches, often passing large cities and intensive agricultural land, are modified by embankments and other public works. These lower areas are usually designated as heavily modified waters. Other examples of heavily modified water bodies are inland waterways, and reservoirs on rivers, or lakes. Heavily modified transitional and coastal water have often been altered by land reclamation or dredging due to urban, transport, and agricultural developments.

Overall, 16.4 % of European water bodies were designated as HMWBs or AWBs during the first RBMPs (Figure 4.4). This is probably a conservative estimate, as some Member States have indicated that the designation process has not been completed. Two Member States, Denmark and Italy, have not finalised the designation as natural, HMWB or AWB and reported most of the water bodies to be of an unknown status.

Artificial water bodies can include canals, reservoirs or open-cast mining lakes. More than 6 % of lakes and around 4 % of river water bodies have been identified as artificial. However, only a few of the transitional and coastal waters are listed as being AWBs.

Figure 4.4 Percentage of natural, heavily modified, artificial and unknown status for river, lake, transitional and coastal water bodies



Note: See the EEA ETC/ICM technical report for more details on HMWBs and AWBs (EEA ETC/ICM 2012b). All water bodies are included. WBs: water bodies.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_HMWB_AWB.

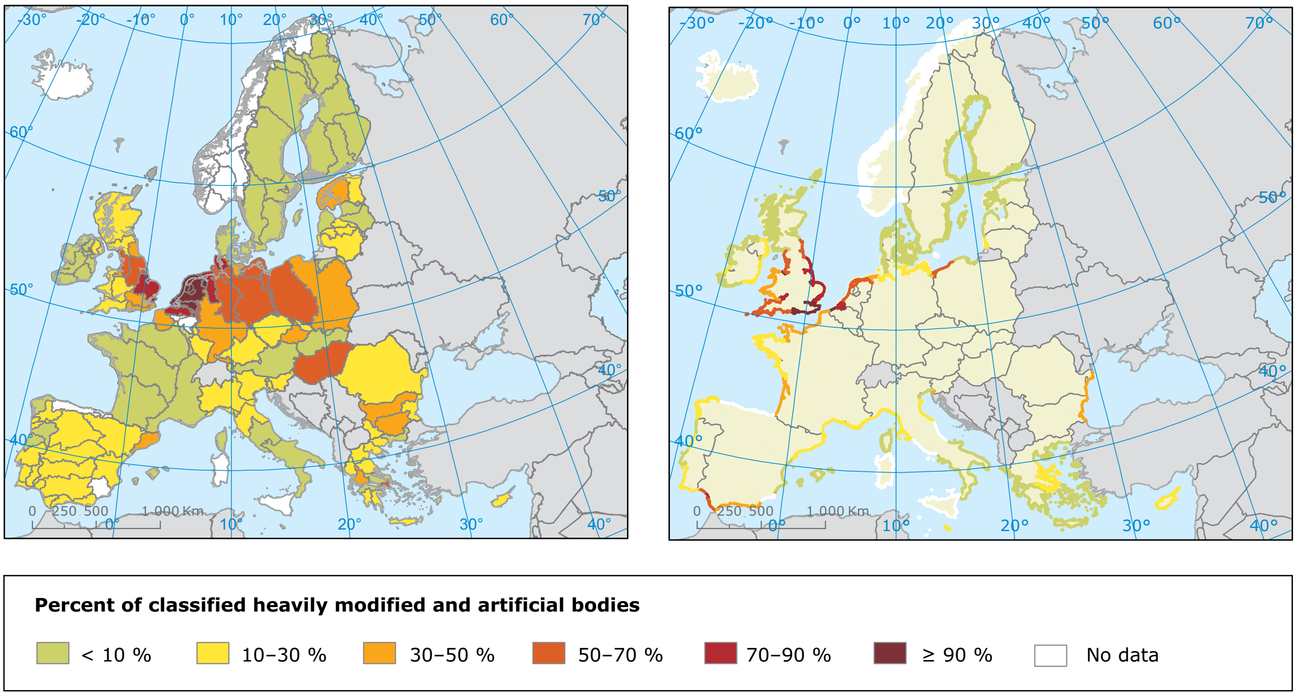
Designation varies widely between Member States (Map 4.4). For rivers, the Member States and RBDs with the highest proportion of designated HMWBs and AWBs are the Netherlands, Belgium, Hungary and Germany. Other Member States such as Finland, France, Slovakia, Sweden and Ireland designated only 5 % or less of their river water bodies as these two types.

In the case of lakes, the highest percentage (above 60 %) of designated HMWBs or AWBs are in Belgium, the Czech Republic, the Netherlands, Bulgaria, France, the United Kingdom, Hungary and Italy. The Member States designating less than 5 % lakes as HMWBs and AWBs are Sweden, Estonia, Latvia, Ireland and Finland.

Heavily modified and artificial water bodies are clearly associated with densely populated, urbanised areas with industrial areas and ports. In mountainous regions, a high proportion of HMWBs can be found in RBMPs with many reservoirs and much water storage for hydropower and irrigation. The coastal zones of the North Sea have a high proportion of designated coastal (and in particular transitional) HMWBs and AWBs (Map 4.4).

Map 4.4 Proportion of heavily modified and artificial water bodies for rivers and lakes and transitional and coastal waters

(a) Rivers and lakes (b) Coastal and transitional waters



Note: See the EEA ETC/ICM technical report for more details on HMWBs and AWBs (EEA ETC/ICM 2012b). All water bodies are included.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_HMWB_AWB.

Assessment of hydromorphological pressures

The WFD is the first piece of European environmental legislation to address hydromorphological modifications and their impacts on water bodies. A water body with good water quality will not achieve its full potential as a habitat for wildlife if the morphology is degraded or if the water flow is markedly changed.

Hydromorphological pressures and altered habitats are reported for a large proportion of classified water bodies, particularly in rivers (more than 40 %) and transitional waters (40 %) and one third of the lake water bodies.

Hydromorphological pressures are mainly due to hydropower, navigation, agriculture, flood protection and urban development. Chapter 7 further discusses the challenge of reducing the impacts from these sectors and cooperating with the sectors on measures to active good status.

4.4 Ecological status, pressures and impacts across Member States and sea regions

This section provides information at the Member State level on ecological status and pressures, with subsections for each water category: rivers, lakes, transitional waters, and coastal waters. In Figures 4.5 and 4.6, each water category is presented in the same way, showing two sets of figures comprising all the classified water bodies in each country. The figures are ranked according to two criteria:

- **Ecological status class distribution**. Countries are ranked from top to bottom: those with the highest proportion of good and high ecological status/potential at the top, and those with the lowest proportion at the bottom.

- **Proportion of water bodies with hydromorphological and pollution pressures reported**. Countries with no bar in the figure have not reported any significant pressures for any water body.

4.4.1 *Ecological status and pressures of rivers*

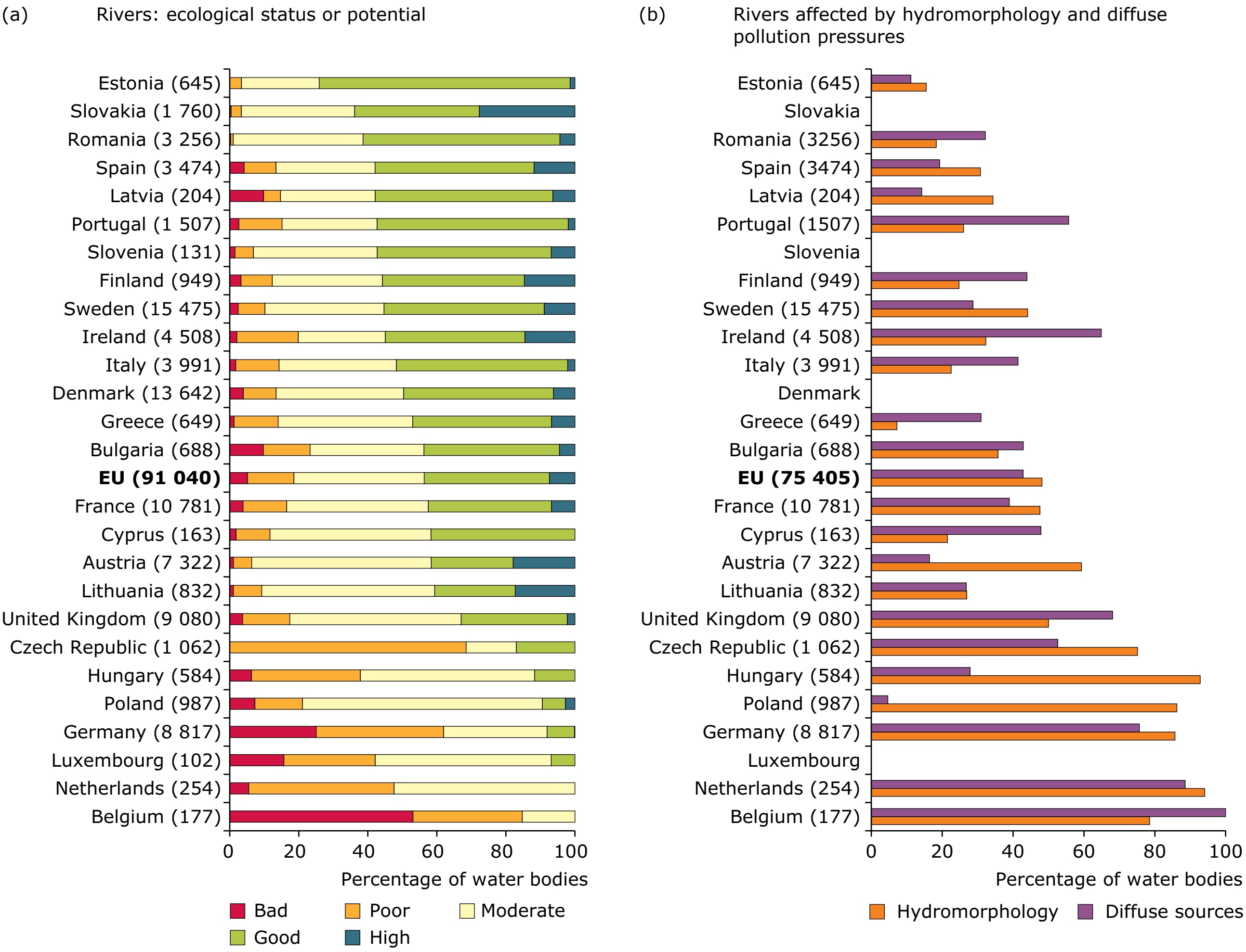
The ecological status or potential of rivers varied: some Member States have more than half of their river water bodies in at least good ecological status/potential (Estonia to Ireland in Figure 4.5(a)), while other Member States (Czech Republic to Belgium (Flanders)) have less than 20 % in good ecological status.

There are unexplained differences in status between some neighbouring Member States, e.g. Lithuania and Latvia, or Hungary and Romania. This may partly be caused by the use of different assessment approaches.

The central and north-western European Member States, with high population density and intensive agriculture, generally have a high proportion of river water bodies in less than good ecological status. The highest proportion of river water bodies with good ecological status or potential is mainly found in more sparsely populated Member States with less arable land, e.g. northern Europe, and other parts of Europe (Romania, Spain, Portugal, Slovenia, Slovakia, Ireland and Italy).

There is a strong correlation between the ranking of Member States by proportion of good or high ecological status, and the proportion of river water bodies per Member State being affected by diffuse pollution and hydromorphology pressures (Figure 4.5(b)).

Figure 4.5 Ecological status or potential of classified river water bodies in different Member States (a), and proportion of river water bodies affected by diffuse pollution and hydromorphology pressures (b)



Notes: See the EEA ETC/ICM technical report for more details and the methodology used for assessing ecological status and pressures (EEA ETC/ICM 2012a). Member States are sorted by proportion of good or better ecological status or potential. The number of river water bodies is provided in parentheses.

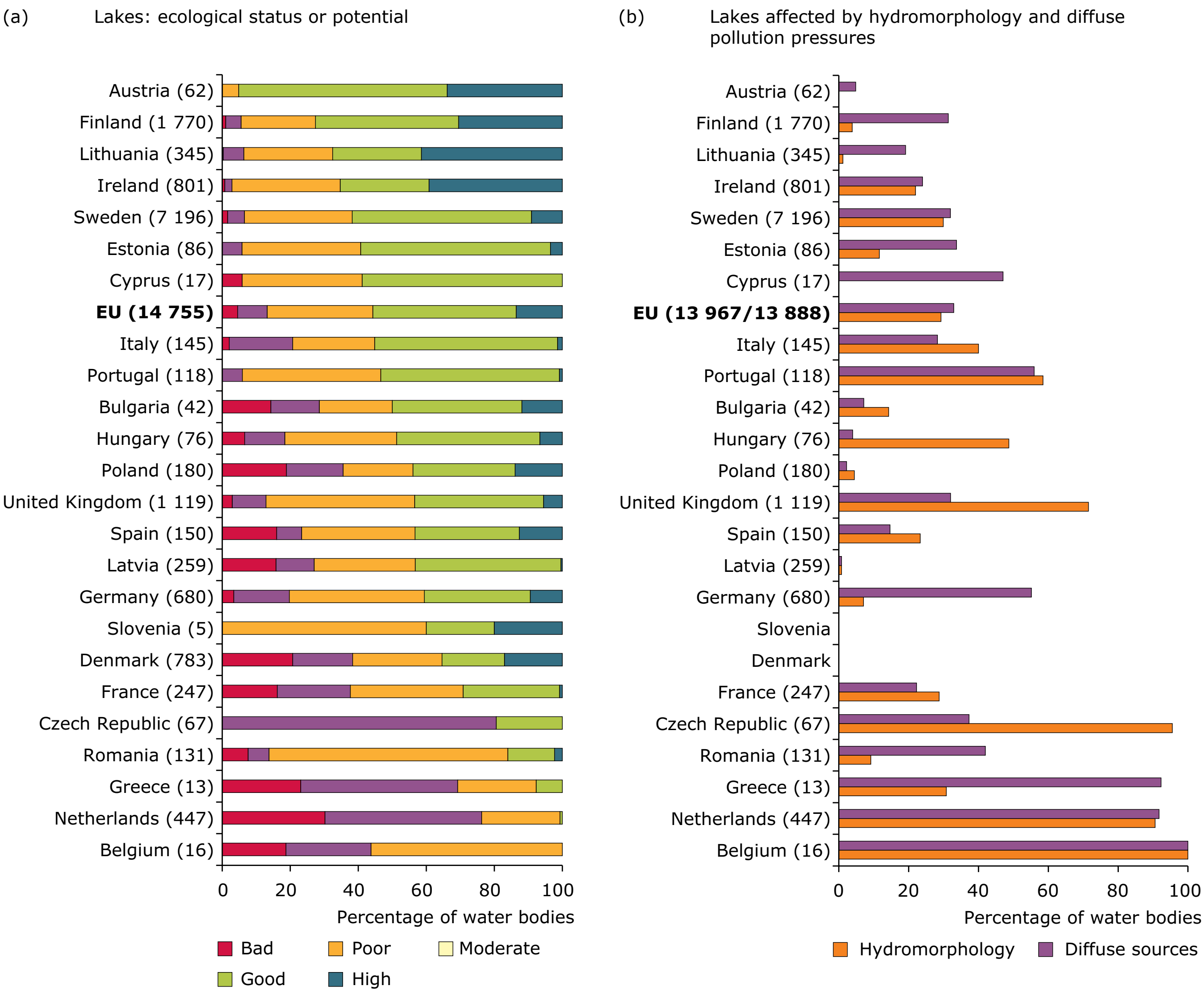
Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_STATUS and http://discomap.eea.europa.eu/report/wfd/SWB_PRESSURE_STATUS.

4.4.2 *Ecological status and pressures of lakes*

The highest proportion of lake water bodies with good ecological status or potential is found in Austria, and also in northern Europe (Sweden, Finland, Estonia and Lithuania). In Ireland and Cyprus, the majority of lake water bodies are also reported to be in good or better ecological status or potential (see Figure 4.6(a)). Member States with high population density and intensive agriculture generally have less than half of their lake water bodies in good or better ecological status or potential.

The proportion of lake water bodies affected by diffuse pollution and hydromorphological pressures (Figure 4.6(b)) generally corresponds to the proportion in good ecological status as shown in Figure 4.6(a).

Figure 4.6 Ecological status or potential of lake water bodies in different Member States (a), and proportion of lake water bodies affected by diffuse pollution and hydromorphology pressures (b)



Notes: See the EEA ETC/ICM technical report for more details and the methodology used for assessing ecological status and pressures (EEA ETC/ICM 2012a). Member States are sorted by proportion of good or better ecological status or potential. The number of lake water bodies is provided in parentheses.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_STATUS and http://discomap.eea.europa.eu/report/wfd/SWB_PRESSURE_STATUS.

4.4.3 Ecological status and pressures of transitional and coastal waters

Generally, ecological status is better for coastal waters than transitional waters (Figure 4.7(a) and (d)). Also the proportion of coastal waters affected by significant pressures (Figure 4.7(b) and (e)) and impacts (Figure 4.7(c) and (f)) are lower than for transitional waters.

Eight Member States (Sweden, Lithuania, Latvia, Poland, Netherlands, Germany, Belgium (Flanders) and Romania) have all **transitional water bodies** in less than good ecological status. More than 80 % of the transitional water bodies reported by Greece and France in the Mediterranean, and by Bulgaria and Romania in the Black Sea hold less than good status (Figure 4.7(a)). The best situation for **transitional water bodies** is reported in the region from the Celtic Sea to the Iberian coast, where there are almost no water bodies reported to be in bad status, and also very few holding poor status. For the United Kingdom and Ireland, however, a large proportion of transitional water bodies are reported to have moderate status.

All **coastal water bodies** in eight out of 21 Member States (Lithuania, Latvia, Denmark, Poland, Belgium, Netherlands, Germany (the part draining in Greater North Sea) and Romania) are in less than good ecological status (Figure 4.7(d)). Cyprus and Slovenia are the only countries where all coastal waters hold good and high status. The worst situation for **coastal waters** is seen in the Baltic Sea countries. In the Greater North Sea and in the EU part of the Black Sea, the ecological status is also not good for most of the Member States. The best ecological status for **coastal waters** is found from the Celtic sea to the Iberian coast, and in the Mediterranean. In these areas, between 60 % and 90 % of coastal waters are reported to hold good or high ecological status.

In the Baltic Sea and Greater North Sea, a high proportion of both coastal and transitional water bodies are affected by **pollution pressures** (Figure 4.7(b) and (e)). In the other sea regions, between 30 % and 60 % of the transitional and coastal waters are reported as affected by pollution pressures, except for the coastal waters of the Mediterranean, where the pollution pressure is lower.

Significant **hydromorphological pressures** are reported for **transitional water bodies** in three sea regions: the Greater North Sea, the Celtic Sea to the Iberian Coast, and the Mediterranean Sea. None of the countries in the Baltic Sea and Black Sea reported information on hydromorphological pressures. More than a third of the coastal water bodies in Estonia, the Netherlands, the German North Sea coast, Portugal, Malta and Romania are reported as affected by hydromorphological modifications.

Figure 4.7 Ecological status/potential of and proportion of water bodies affected by pollution and hydromorphological pressures for transitional (left panel (a, b, c)) and coastal (right panel (d, e, f)) water bodies, by sea region

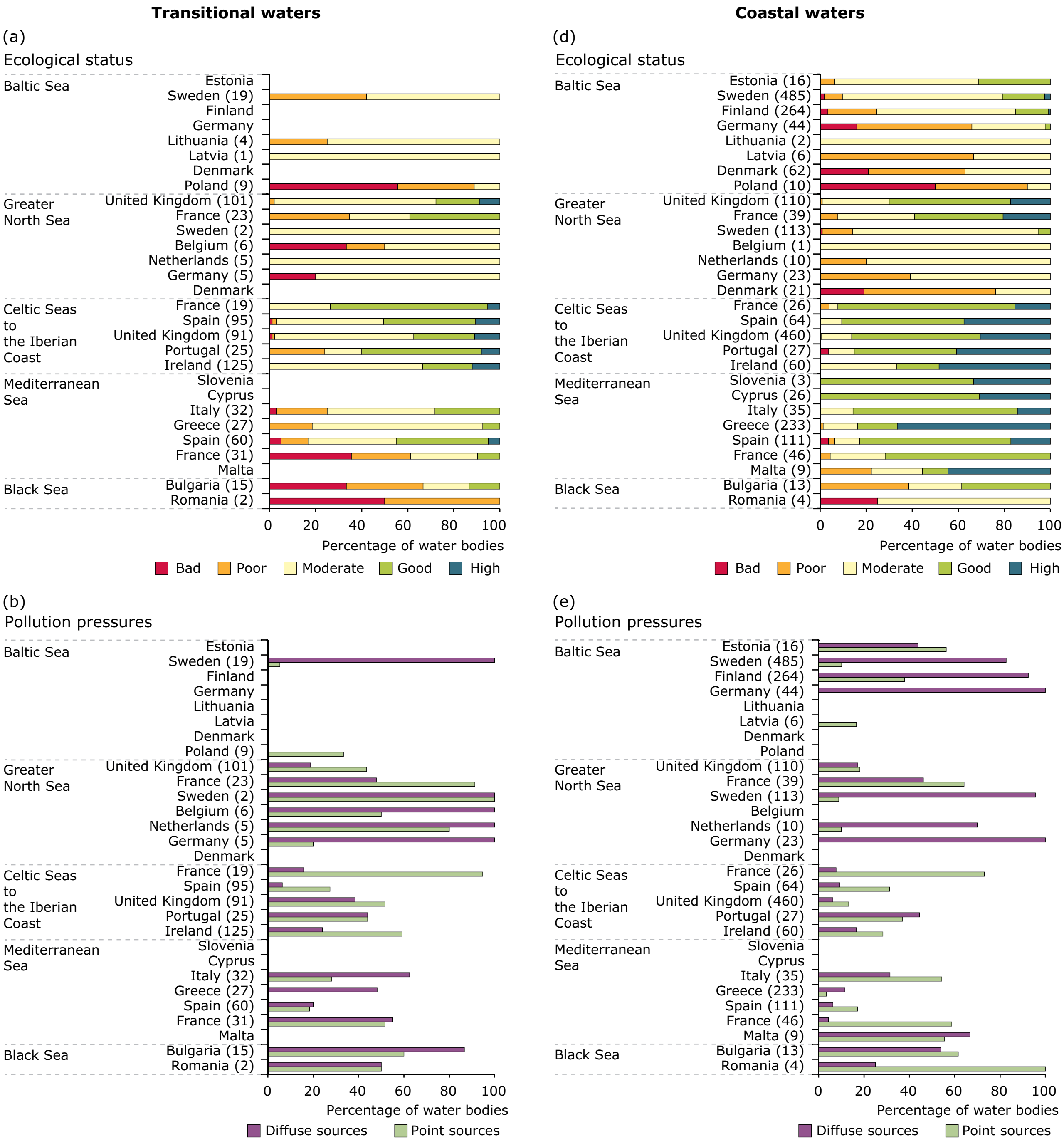
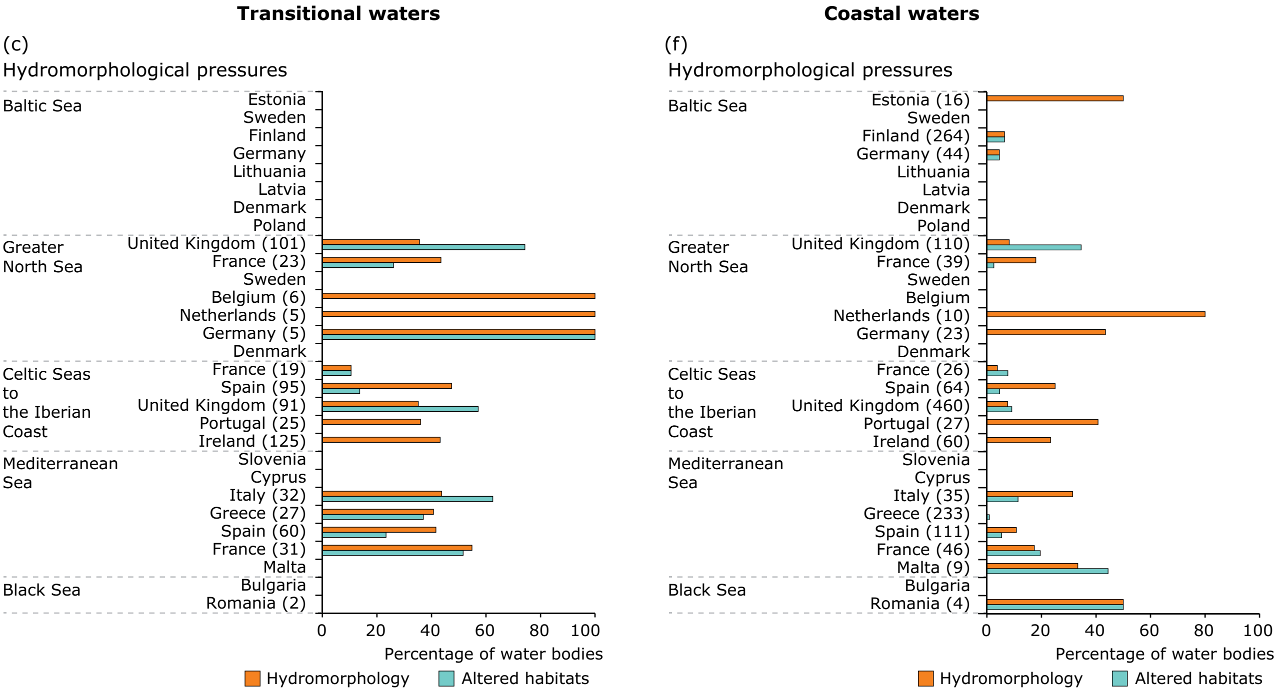


Figure 4.7 Ecological status/potential of and proportion of water bodies affected by pollution and hydromorphological pressures for transitional (left panel (a, b, c)) and coastal (right panel (d, e, f)) water bodies, by sea region (cont.)



Notes: See the EEA ETC/ICM technical report for more details and the methodology used for assessing ecological status and pressures (EEA ETC/ICM 2012a). The number of water bodies is provided in parentheses.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/SWB_STATUS; http://discomap.eea.europa.eu/report/wfd/SWB_PRESSURE_STATUS and http://discomap.eea.europa.eu/report/wfd/SWB_IMPACT_STATUS.

5 Chemical status

5.1 Introduction and background

Hazardous substances in fresh and marine water can harm aquatic life and pose a risk to human health. In 2011 the EEA published a report entitled *Hazardous substances in Europe's fresh and marine waters — an overview* (EEA, 2011b). The following section summarises the 2011 assessment results and updates it with information on the chemical status of surface and groundwater reported by Member States via the first RBMPs. More details can be found in the 2011 report, the ETC/ICM technical report (EEA ETC/ICM, 2012a), and in the European Commission's staff working document on WFD implementation (EC, 2012a).

Hazardous substances can have detrimental effects on aquatic biota. For example, substances with endocrine-disrupting properties can impair reproduction in fish and shellfish, while the effects of organochlorines on marine life are well documented, as is the toxicity of metals and pesticides to freshwater biota. Such impacts diminish the services provided by aquatic ecosystems, including the provision of food.

Humans can be exposed to hazardous substances in water, through ingesting contaminated drinking water and consuming contaminated freshwater fish and seafood. The exceedance of regulatory levels in seafood has been documented for several hazardous substances in the seas around Europe. Some substances, for example TBT and dichlorodiphenyltrichloroethane (DDT), persist in aquatic environments long after they have been phased out.

Hazardous substances are emitted to fresh and marine waters through a range of pathways and from a variety of sources, including industry, agriculture, transport, mining and waste disposal, as well as from our own homes. The range of substances includes household chemicals such as personal care products and medicines, a wide range of industrial chemicals, substances released by the transport sector, building and construction materials, and pesticides used in gardens. Many hazardous substances are directed to municipal wastewater treatment plants. However, the treatment process typically results in incomplete removal. Storm overflows, including combined sewer overflows, discharge a range of hazardous substances to waterways.

Pesticides used in agriculture have been widely detected in surface and groundwater. Veterinary medicines and any metabolites may be released to soil directly, by animals at pasture, or indirectly through the application of animal manures and slurries to land via fertilisers.

Mining exerts a localised but significant pressure upon the chemical quality of water resources in parts of Europe, particularly with respect to the discharge of heavy metals. Landfill sites and contaminated land from historical industrial and military activities can be a source of pollution for the aquatic environment. Without appropriate remedial action, ground and surface waters can also be polluted.

Once released to freshwater, hazardous substances can be transported downstream by rivers and ultimately discharged to coastal waters. Moreover, cities and many wastewater treatment plants discharge directly to coastal waters. In addition to substances emitted from land-based sources and deposition from the atmosphere, hazardous substances are also released directly into the marine environment. Shipping, harbour and port activities, offshore oil exploration, and aquaculture all emit a variety of hazardous substances.

5.2 European overview of chemical status

The chemical status of surface waters is assessed for compliance with environmental standards on substances that are listed in the WFD (Annex X) and the Environmental Quality Standards (EQS) Directive 2008/105/EC. These priority and priority hazardous substances include metals, pesticides and various industrial chemicals. The Groundwater

Directive establishes a regime to assess groundwater chemical status, providing EU-wide quality standards for nitrate and pesticides, and requiring standards to be set at national level for a range of pollutants. This section summarises the chemical status of groundwater and surface waters. However, the results should be interpreted cautiously, since chemical monitoring as reported in the first RBMPs was incomplete, and information is not always comparable between Member States.

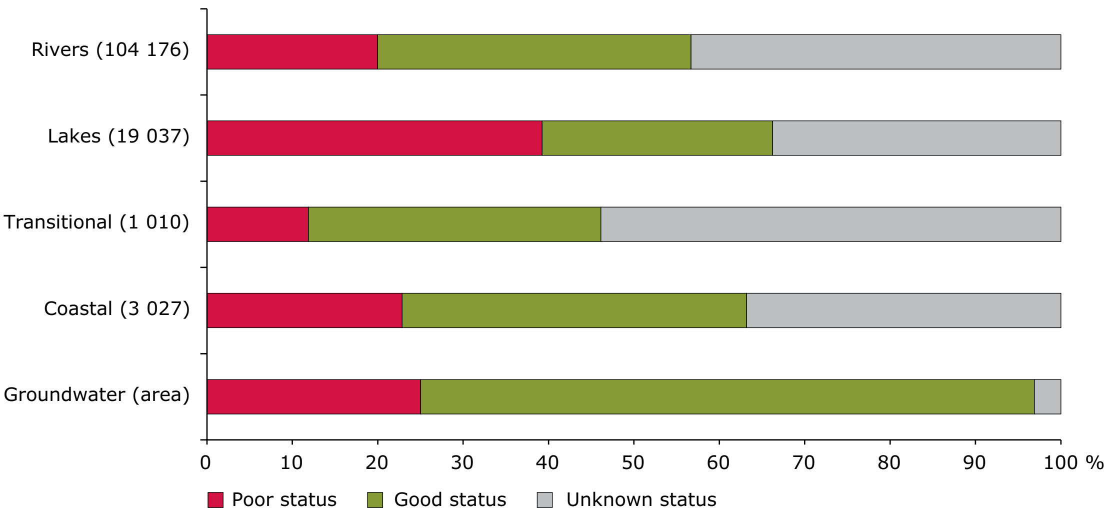
The chemical status of more than 13 000 groundwater bodies has been reported across Europe, encompassing 25 different Member States (Figure 5.1). Good chemical status is apparent in 72 % of them (by surface area) whilst about 25 % are in poor status. Approximately 3 % of groundwater bodies are classified as having unknown chemical status. 60 % of instances of poor chemical status are accounted for by an exceedance of a quality standard (threshold value) for one or more pollutants. Other important causal factors include the deterioration in quality of waters for human consumption and saline intrusion.

The chemical status of 123 000 surface freshwater bodies (104 000 rivers and 19 000 lakes) has been evaluated across 26 Member States across Europe, with 43 % of rivers and 44 % of lakes (by count) being classified as good, and 6 % and 2 % respectively being in poor status. However, these overall statistics do not include the results from Sweden (see note to Figure 5.1).

Notably, the chemical status of 51 % of the rivers and 54 % of the lakes remains unknown. The main reasons for the high percentage of surface water bodies with reported unknown chemical status are that the status assessment methods have not yet been fully developed, or that there were not enough monitoring data in this first RBMP cycle.

Chemical status for more than 4 000 transitional and coastal water bodies has been reported across 16 and 22 Member States respectively. Poor chemical status is reported in 10 % of transitional and 4 % of coastal water bodies, whilst good status is reported in 35 % and 51 %, respectively. The amount of 'unknown' status water bodies reported is notable: 55 % of transitional and 46 % of coastal water bodies are classified in this category.

Figure 5.1 Percentage of rivers, lakes, groundwater, transitional and coastal waters in good, poor and unknown chemical status



Note: Number of Member States contributing to the data set: groundwater (25); rivers (26); lakes (24); transitional (16) and coastal (22). Percentages shown for rivers, lakes, transitional and coastal are by water body count. Groundwater percentages, however, are expressed by area. The number of water bodies is provided in parentheses.

Data from Sweden are excluded from surface water data illustrated in the figure. This is because Sweden contributed a disproportionately large amount of data, and classified all its surface waters as having poor status, since levels of mercury found within biota in both fresh and coastal waters exceed quality standards.

Source: WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/GWB_STATUS and http://discomap.eea.europa.eu/report/wfd/SWB_STATUS.

Chemical groups causing poor status

In 54 % of the groundwater bodies in Europe that have poor chemical status, excessive nitrate concentration is responsible. Pesticides are the cause of 20 % of groundwater bodies with poor chemical status, whilst the Groundwater Directive's Annex II pollutants (other 'common' groundwater pollutants) account for 34 %. It should be noted that more than one chemical group can cause failure to reach good status in any single water body. In general, shallow groundwater 'horizons' (where the water table is closer to the surface of the earth) are more likely to exhibit poor chemical status than deeper horizons (where the water table is further below the surface of the earth).

Those surface water bodies across Europe that exhibit poor chemical status are typically subject to pollution from a range of different chemicals, including heavy metals, industrial chemicals and pesticides deriving from a variety of sources. 'Other pollutants', a category that includes a mix of individual chemical types including PAHs and TBT compounds, are the causal factor for nearly 52 % of European **river water bodies** classified as being in poor chemical status, whilst heavy metals account for 20 %, and pesticides about 16 %. For lakes, heavy metals are the dominant pollutant, accounting for more than 60 % of water bodies in poor status.

'Other pollutants' are the causal factor for 57 % of those **transitional water bodies** classified as holding poor chemical status, followed by heavy metals (43 %), pesticides (16 %) and industrial pollutants (20 %). In **coastal waters**, 'other pollutants' accounts for 53 % of water bodies in poor status, followed by heavy metals (50 %) and industrial pollutants (19 %).

5.3 Chemical status by Member State and RBD

This section overviews chemical status across the water body categories at both national and RBD level. A national ranking is provided, based on chemical status. The diagrams, maps and assessment text are based only upon those water bodies with known chemical status.

5.3.1 Groundwater

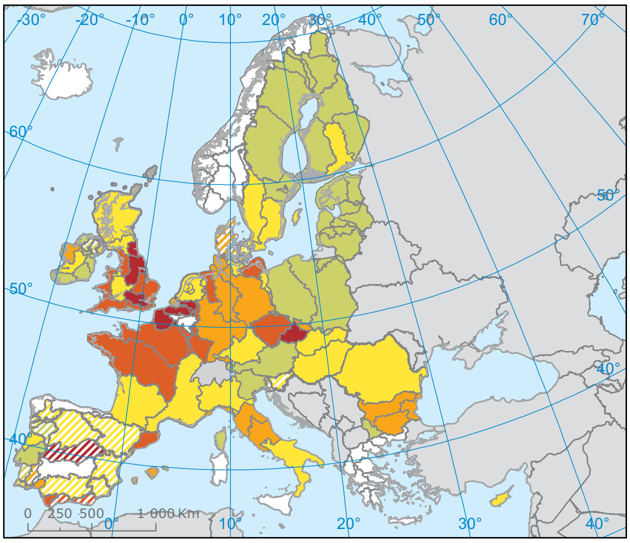
A total of 16 Member States have more than 10 % of groundwater bodies in poor chemical status (by area), whilst this figure exceeds 50 % in Luxembourg, the Czech Republic, Belgium

Figure 5.2 Chemical status of groundwater bodies

Note: Groundwater bodies in unknown status are not accounted for in the red and green bars that represent the percentage for poor and good status respectively. The reported total area covered by groundwater bodies/the area in poor status/the area in unknown status (in 1 000 km²) per Member State is shown in parentheses. Denmark and Slovenia did not report the area of groundwater bodies, whilst 164 of 385 (43 %) Danish groundwater bodies were reported as holding poor chemical status, and 4 of 21 (19 %) Slovenian groundwater bodies were reported as holding poor chemical status.

Source: Based on data available in WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/gwb_status.

Map 5.1 **Chemical status of groundwater bodies per RBD — percentage of groundwater body area not achieving good chemical status**



Percent of classified groundwater bodies with poor chemical status

< 10 %

10–30 %

30–50 %

50–70 %

70–90 %

≥ 90 %

No data

RBDs with unknown area of groundwater bodies (count instead of area used) are hatched

Note: Groundwater bodies in unknown status are not included in the calculation of the percentage of poor chemical status.

Source: Based on data available in WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/gwb_status.

(Flanders) and Malta (see Figure 5.2). A high proportion of the groundwater bodies holding poor chemical status are found in the RBDs in central north-western Europe (Map 5.1), with many RBDs in the region having more than half of groundwater bodies in poor chemical status.

Excessive levels of nitrate are the most frequent cause of poor groundwater status across much of Europe. Agriculture is the primary source of this nitrate, deriving from the input of mineral and organic fertilisers and subsequent leaching to groundwater. Pesticides and a range of other chemicals such as heavy metals are also causes of poor groundwater status across Europe. The threshold values to assess groundwater chemical status vary markedly between Member States for certain pollutants.

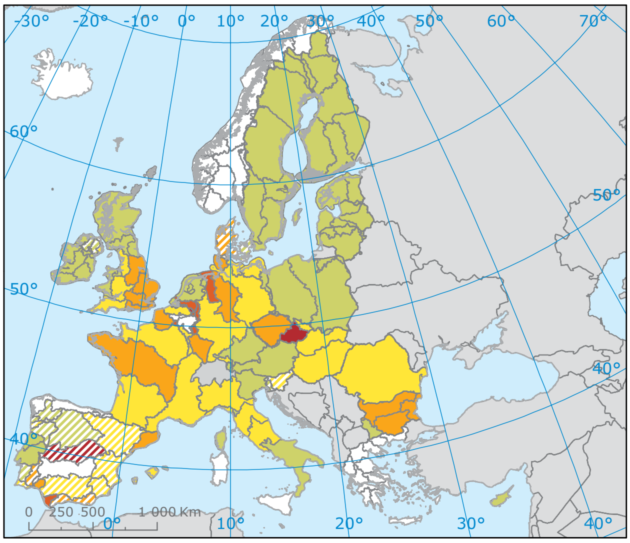
Nitrate in groundwater

Pollution from nitrate is a major cause of poor groundwater chemical status across Europe, with agricultural sources typically having the greatest significance. The major nitrogen inputs to agricultural land are generally from inorganic mineral fertilisers and organic manure from livestock. The highest total fertiliser nitrogen application rates — mineral and organic combined — generally occur in western Europe, although high nitrogen fertiliser application rates are not exclusive to this region (Grizzetti et al., 2007; Bouraoui et al., 2011). Application rates are generally in excess of what is required by crops and grassland, resulting in a nitrogen surplus (Grizzetti et al., 2007). The magnitude of the surplus is the potential amount that can leach to groundwater as nitrate. Nitrate leaching in this way gives rise to the poor groundwater chemical status illustrated above.

Improvement in groundwater nitrate water quality will take time because of transport processes in soils and groundwater and the renewal rate of groundwater, which can be substantial. As a result, reported timescales for restoration of groundwater quality reflect this time lag, ranging from 4 to 8 years in Germany and Hungary to several decades for deep groundwater in the Netherlands (EC, 2010b). This time lag is one reason why some groundwater bodies may not achieve good status by 2015 or beyond, even if all necessary measures are implemented by Member States.

Map 5.2 Percentage of groundwater body area not achieving good chemical status due to nitrate (a) and total nitrogen input from organic and inorganic fertilisers (b)

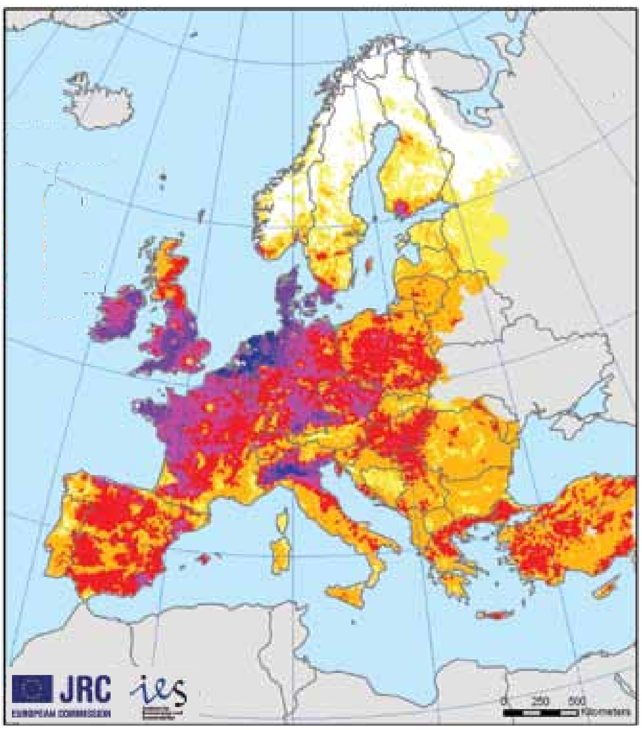
(a)



Percent of classified groundwater bodies with poor chemical status due to nitrates

- < 10 %
- 10–30 %
- 30–50 %
- 50–70 %
- 70–90 %
- ≥ 90 %
- No data
- RBDs with unknown area of groundwater bodies (count instead of area used) are hatched

(b)



Total nitrogen fertilizer for year 2005 (kg/ha)

- 0
- 1–10
- 11–40
- 41–80
- 81–120
- 121–170
- > 170
- Outside data coverage

Note: Groundwater bodies of unknown status are not included in the calculation of the percentage of poor chemical status due to nitrate.

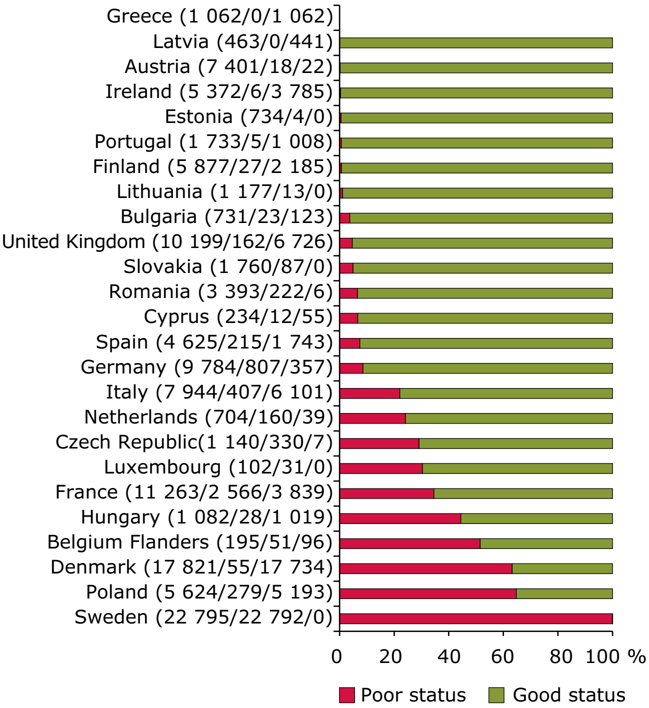
Source: Nitrate in groundwater map based on data available in WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/gwb_status. Map on organic and inorganic nitrogen fertilisers: Bouraoui et al., 2011.

5.3.2 Rivers and lakes

A total of 10 Member States report poor chemical status in more than 20 % of their rivers and lakes, whilst in Hungary, Belgium (Flanders), Denmark, and Poland, this figure rises to above 40 %, reaching 100 % in Sweden (Figure 5.3). These figures exclude the many rivers and lakes across Europe with an unknown chemical status; unknown status exceeds 50 % in 10 countries.

Excluding data for Sweden (to avoid distortion of results) indicates that the 'other pollutants' group is the most frequent overall cause of poor status in rivers. 18 Member States identified this group as problematic, particularly in Belgium (Flanders), Germany, France and the United Kingdom. A substantial number of rivers also fail to reach good status due to this pollutant group in the Czech Republic, the Netherlands and Romania. Within the 'other pollutant' grouping, PAHs are identified as problematic by 11 Member States including most of the RBDs in France, all British RBDs except for those in Scotland, the Belgian Scheldt and the Czech and German parts of the Elbe. PAHs result from incomplete combustion processes, and are subject to long-range transport in the atmosphere. As a result, subsequent deposition and adverse impacts upon aquatic environments may occur a great distance from the original point of emission.

Figure 5.3 Chemical status of rivers and lakes

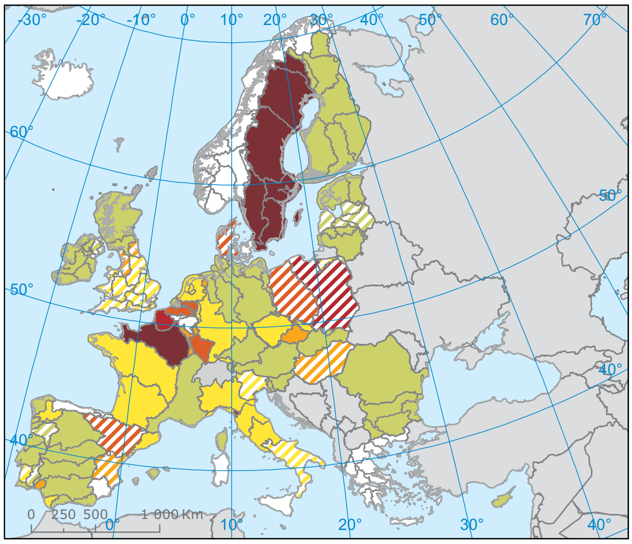


Note: Rivers and lakes of unknown chemical status are not accounted for in the red and green bars that represent % of water bodies in poor and good chemical status respectively.

The number of water bodies per Member State/number of water bodies in poor status/number of water bodies in unknown status are shown in parentheses.

Source: Based on data available in WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/swb_status.

Map 5.3 Chemical status of rivers and lakes per RBD — percentage of water bodies not achieving good chemical status



Percent of classified surface water bodies with failure to achieve good chemical status for rivers and lakes

< 10 %
10–30 %
30–50 %
50–70 %
70–90 %
≥ 90 %
No data
Hatched polygons are used for districts with less than 20 % classified water bodies

Note: Surface water bodies in unknown status are not included in calculating the percentage of poor chemical status. RBDs with high proportion (more than 80 %) of water bodies with unknown chemical status are hatched.

Source: Based on data available in WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/swb_status.

TBT, used primarily as an anti-fouling biocide for boats and ships, is also one of the 'other pollutants'. It is identified as problematic by 10 Member States. Despite now being banned in Europe, high levels of TBT are still found in Europe's rivers, reflecting the historical use and persistence of this substance. TBT is a particular issue in the Belgian part of Scheldt, the Rhône in France, and the Humber and Thames RBDs in the United Kingdom.

Heavy metals are identified as problematic by 21 Member States, and are the dominant cause of poor status in rivers across 12 Member States, but are especially dominant in Sweden, Denmark, Bulgaria, the Czech Republic, Spain, Finland, northern and central Italy and Romania. A total of 15 Member States highlight cadmium as a cause of poor status. Due to its threat to both environmental and human health, cadmium is classified as a priority hazardous substance.

Industrial pollutants are the predominant reason for poor chemical status in rivers within Estonia, Lithuania and Slovakia, and they are a significant factor in a number of other countries. Within this group, DEHP, widely used as a plasticiser, is identified by eight Member States as being problematic, whilst both octylphenol and nonylphenol are also an issue in certain rivers.

Pesticides are the predominant cause of poor chemical status in rivers in Luxembourg, whilst a substantial number of water bodies also fail to reach good status due to pesticides in France, Belgium (Flanders), the Czech Republic, Germany, Spain, Hungary, Italy, the Netherlands, Romania and the United Kingdom.

Overall, pesticides contribute to poor status in 16 Member States. Diuron is identified as a cause of poor status in seven Member States. Whilst diuron has been banned as an active substance in plant protection products across most of Europe, it is still widely used as a biocide agent in construction materials and cooling systems. Other problematic pesticides identified include the herbicides alachlor and isoproturon, which together contribute to poor status in 11 Member States.

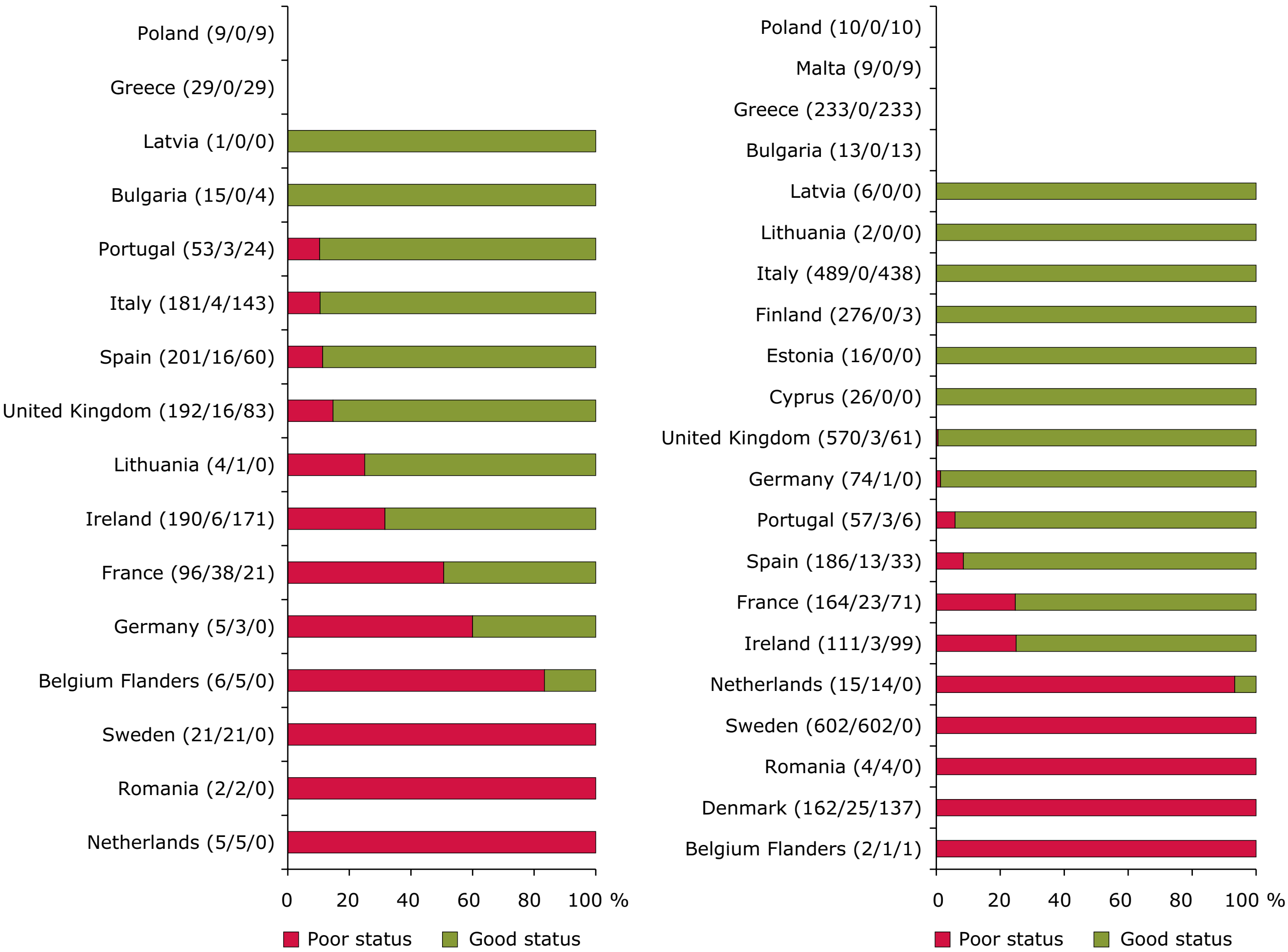
5.3.3 Transitional and coastal waters

Six Member States (France, Germany, Belgium (Flanders), Sweden, Romania and the Netherlands) report poor chemical status in **transitional waters** (excluding those of unknown status) to be 50 % or more (Figure 5.4(a)). 'Other pollutants' are the most frequent cause of poor chemical status in transitional waters across Europe, and they are the most frequent cause of poor status within Belgium (Flanders), Germany, France, the Netherlands and the United Kingdom. TBT is one of those 'other pollutants' identified as problematic. It is the main cause of poor status in transitional waters in six RBDs of the United Kingdom, and is a contributing factor elsewhere, including the Belgian-Scheldt, the

Figure 5.4 Percentage of transitional (a) and coastal (b) water bodies in poor and good chemical status, by count of water bodies

(a) Transitional water bodies

(b) Coastal water bodies



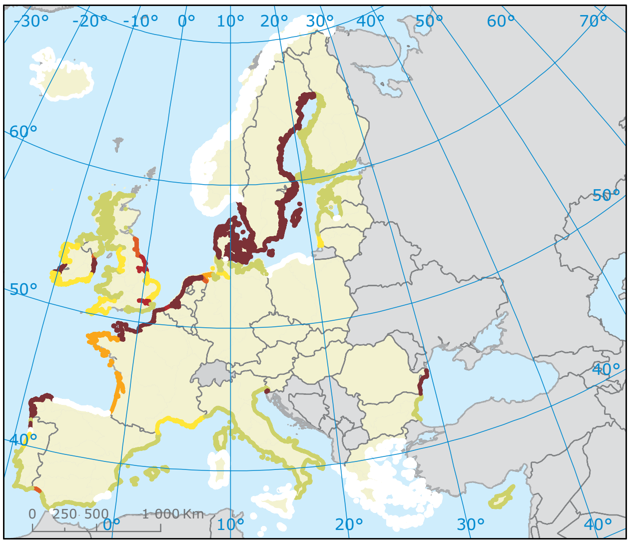
Note: Transitional and coastal waters with unknown chemical status are not accounted for in the red and green bars that represent the percentage of water in poor and good status respectively. The number of water bodies per Member State/number of water bodies in poor status/number of water bodies in unknown status are shown in parentheses.

Source: Based on data available in WISE-WFD database, May 2012. Detailed data are available at http://discomap.eea.europa.eu/report/wfd/swb_status.

Nemunas in Lithuania, the north and south Baltic RBDs of Sweden, and the Loire in France. PAHs contribute to poor status in transitional waters in Romania, France and Belgium.

Heavy metals are the most frequently reported cause of poor chemical status in Swedish and Spanish transitional waters. In the case of Spanish waters, heavy metal pollution is linked to mining discharges. Mercury is a cause of poor status in some Swedish transitional waters, although the problem is not as widespread as for Swedish freshwaters. In France, heavy metals cause poor status in transitional waters of the Rhône, Loire and Seine RBDs. Heavy metals are also problematic in the northern Apennines RBD in Italy and in the Romanian Danube.

Map 5.4 Chemical status of transitional and coastal waters per RBD — percentage of water bodies not achieving good chemical status



Percent of classified surface water bodies with failure to achieve good chemical status for transitional and coastal waters

< 10 %
10–30 %
30–50 %
50–70 %
70–90 %
≥ 90 %
No data

Note: Surface water bodies with unknown status are not included when calculating the percentage of poor chemical status. RBDs with a high proportion of water bodies with unknown chemical status are hatched.

Source: Based on data available in WISE-WFD database, May 2012. Member State results on chemical status are available at http://discomap.eea.europa.eu/report/wfd/swb_status

Some industrial pollutants are also identified as a cause of poor chemical status in transitional waters. DEHP, for example, is a cause of poor status in the Rhône and Loire RBDs in France and the Nemunas RBD in Lithuania, whilst nonylphenol is identified as problematic in transitional waters of Portugal and Belgium. In Irish transitional waters, brominated diphenyl ether causes poor chemical status.

Transitional waters with the poorest chemical quality across Europe are typically those subject to pollution from a range of individual pollutants. For example, the Seine in France reports heavy metals, pesticides and PAHs to be an issue, whilst in the Belgian-Scheldt, 12 chemicals including mercury, pesticides, PAHs, TBT and the industrial chemical nonylphenol are all a cause of poor status. Similarly, the Romanian part of the Danube RBD is polluted by the heavy metals cadmium, lead and nickel, as well as by a range of PAHs and some pesticides.

Six Member States report their **coastal waters** to be in 100 % good chemical status, although in five others (the Netherlands, Sweden, Romania, Denmark and Belgium (Flanders)), poor status exceeds 90 % of those water bodies with a known chemical status (Figure 5.4b). A variety of pollutant groups typically contribute to poor status in coastal waters, reflecting a diverse range of sources.

5.4 Legislation continues to play an important role but challenges remain

Chemical legislation within Europe has led to positive outcomes. For example, the IPPC Directive has resulted in a reduction in emissions of metals to air and water. And controls on the production, use and disposal of polychlorinated biphenyls has led to declines in concentrations of those substances in marine biota. Legislation implemented more recently, including the WFD and REACH regulations (Registration, Evaluation, Authorisation and Restriction of Chemicals) will play a critical strengthening role in addressing hazardous substances in water. However, despite the comprehensive suite of legislation adopted in Europe, some important challenges remain.

Information regarding the sources and emissions of many hazardous substances remains incomplete, limiting the scope for identification and targeting of appropriate measures. The EQS Directive requires each Member State to establish an inventory of emissions, discharges, and losses of priority substances. It is critical that this be fully implemented.

Some hazardous substances tend to accumulate in sediment and biota, rendering concentrations in these matrices higher, and therefore more detectable and measurable than they are in water. If measurements are made only in the water column, the risk to the aquatic environment may be underestimated. At least one example exists of different matrices being used across different Member States for the same chemical, resulting in assessments of chemical water quality that are not directly comparable. Harmonisation at EU level is therefore needed.

For some pollutants, awareness of potential effects has only emerged recently, and scientific understanding may still be incomplete. These 'emerging pollutants' include substances that have existed for some time, such as pharmaceuticals and personal care products, but also relatively new ones such as nanomaterials. Policymakers need more information on the levels and effects of these emerging pollutants. Better understanding is also required with regard to the effects of chemical mixtures found in the more polluted water bodies of Europe.

In the absence of appropriately strong measures, climate change is likely to adversely affect chemical water quality over the coming decades. For example, more intense rainfall is predicted to increase the flushing of hazardous substances from both urban and agricultural land, whilst depleted river flows will reduce contaminant dilution capacity and lead to elevated concentrations of hazardous substances.

Reducing hazardous substances in water requires strong implementation of the current legislation, but also the adoption of more sustainable production and use of chemicals, both in Europe and beyond. This global approach would not only benefit Europe's environment but also reduce detrimental effects across other parts of the world, because a growing proportion of goods consumed within Europe are produced outside its borders. Adopting sustainable green chemistry techniques can also play an important role, as these have also been shown to generate financial benefits. However, there is currently no comprehensive EU legislation addressing this area.

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6 Protection of Europe's aquatic ecosystems and their services

Chapter 4 illustrated that the ecological status of many water bodies is poor and that numerous pressures impact European water ecosystems and biodiversity. The results show that aquatic biodiversity is affected by pollution and degraded water quality, as well as the loss and alteration of habitats. The EU policies on water, the marine environment, nature, and biodiversity are closely linked. Together they form the backbone of environmental protection of Europe's ecosystems and their services.

One of the main objectives of the WFD is to take an integrated view of aquatic ecosystems and to protect them using a holistic approach. It is therefore worthwhile to consider the results of the first round of WFD RBMP reporting and the current implementation of the nature legislation in the light of future developments under the Biodiversity Strategy 2020 (EC, 2011a).

6.1 Joint benefits of coordinated nature conservation and water management

The WFD and the Marine Strategy Framework Directive (MSFD) make cross-references to the BHDs (Birds and Habitats Directive) to ensure that the protected areas established through the Natura 2000 network are integrated into the management strategies of both river basins and marine areas.

Also, the various objectives of good status set the basis for relevant measures to achieve this status ([2]). These measures are mutually beneficial and will enhance the protection of biodiversity and ecosystem services. There are no specific dates mentioned in the nature directives for meeting the conservation objectives. The Habitats Directive stipulates that Member States need to maintain or restore species and habitats at favourable conservation status. However, the new EU Biodiversity Strategy to 2020 (EC, 2011a) includes a sub-target to improve the conservation status of habitats and species by 2020 together with a 'restoration sub-target' to restore at least 15 % of degraded ecosystems. This target is relevant to wetland ecosystems as well.

Both the BHD and the WFD aim at ensuring healthy aquatic ecosystems while at the same time ensuring a balance between water and nature protection and the sustainable use of natural resources. A more detailed description of the relationship between the WFD and nature directives is described in the FAQ (EC, 2011b).

The MSFD extends EU water legislation to the marine environment, and constitutes the environmental component of Europe's new cross-sector Integrated Maritime Policy (EC, 2008e). The MSFD follows an approach similar to that of the WFD. It calls on EU Member States to ensure the 'good environmental status' of all Europe's marine regions and sub-regions in a similar fashion to the WFD's 'good status' of freshwater and coastal waters.

Ensuring good environmental status involves protecting marine ecosystems. The MSFD states that fishing and other activities should not push the populations of commercially exploited fish and shellfish beyond their safe limits, and that non-indigenous species should not affect ecosystems.

([2]) Under the WFD, good status is measured as good ecological status. Under the MSFD, good status is measured as good environmental status. Under the Habitats Directive, good status is measured as good conservation status. Under the Birds Directive, good status is measured by adequate populations of naturally occurring wild bird species. Article 2 of the Birds Directive obliges Member States to take requisite measures to maintain the population of bird species referred to in Article 1 of the directive, i.e. all species of naturally occurring birds in the wild state in the Member States' European territory, 'at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level'.

Good environmental status also requires physical, chemical and acoustic conditions that support healthy ecosystems. Any noise from human activities should be compatible with the health of the marine environment and its ecosystems. Meeting these requirements will protect renewable marine resources and may require changes in human activity and practices, such as ending the overexploitation of fish resources.

The 23 EU Member States with sea coasts are obliged to develop marine strategies to ensure the good environmental status of marine regions and sub-regions, similar to the RBMPs being prepared under the WFD. By 2012, Member States will need to make preliminary assessments of Europe's seas by determining the characteristics of good environmental status, identifying targets and indicators to be achieved and setting up monitoring programmes. By 2015, they will need to have developed a programme of measures (PoM) for each marine region and sub-region. Each programme will set out the actions to achieve good environmental status by 2020 or to maintain good status where it already exists.

The following section provides information on the current status of the nature directives regarding water-related ecosystems and habitats, their main pressures, and protection of small water bodies and protected areas. The joint benefits of coordinated nature conservation and water management are subsequently discussed.

Ecosystem services

Rivers and lakes provide essential ecosystem services to humans, such as clean water, flood prevention, food production and freshwater storage (IUCN, 2008). Freshwater ecosystems in Europe are rich in biodiversity with habitats that include large and small rivers, alpine and lowland rivers, floodplains, lakes, and ponds. They also include freshwater marshes, peatlands, and man-made water bodies such as canals and reservoirs. These different systems also interact with groundwater and the surrounding wetlands. Around 250 species of macrophytes and a similar number of fish species inhabit European inland surface waters, and a significant number of birds, fish and mammals depend on wetlands for breeding or feeding.

As an interface between land and sea, European coastal and transitional waters provide food and play an important role as fish nursery habitats. They also provide natural filters for pollution and storage of carbon, and act as a buffer against coastal erosion, natural hazards and storms. Coastal and transitional waters are important for tourism and recreation. European coasts consist of natural and artificial environments. They are very rich ecosystems, providing vital and highly dynamic resources for nature, but are often also the most urbanised areas of countries.

6.2 Relevant aquatic habitats in the Natura 2000 network

The Natura 2000 network (EC, 2012e) is an EU-wide network of nature protection areas established under the 1992 Habitats Directive (HD). The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. It comprises Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive, and the Special Protection Areas (SPAs) designated under the 1979 Birds Directive. However, the need to maintain or restore the habitat types and species of the Community interest at favourable conservation status is not limited to Natura 2000 sites, but covers habitat types and species across the whole territory of the Member State concerned.

The Natura 2000 network contains more than 26 000 sites and covers around 18 % of the EU terrestrial territory as well as significant areas of sea. Information on the sites is available in the Natura 2000 database available at http://www.eea.europa.eu/data-and-maps/data/natura-2 or via the Natura 2000 viewer (http://natura2000.eea.europa.eu).

For each Natura 2000 site, national authorities have submitted a standard data form since 1994 that contains an extensive description of the site and its ecology. The Natura 2000 sites may include several habitats of Community interest including river and lake habitats (e.g. Fenno-Scandinavian natural rivers and natural dystrophic lakes and ponds), and coastal habitats (e.g. coastal lagoons). These habitats are comparable to the WFD surface water categories: rivers, lakes, transitional and coastal waters.

Natura 2000 sites are designated to protect habitat types and species listed on Annexes I and II of the HD. Annex I includes nine types of river habitats (6 000 records in the Natura 2000 database); nine types of lake habitats (8 700 records) and five types of coastal or transitional water habitats (2 400 records). For rivers, the most frequently noted habitats are 'water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation', of which there are 3 260 records. For lakes (also known as standing waters), there are three different habitat types covering natural eutrophic lakes that account for more than a third of the lake habitat records. Coastal lagoon and estuary habitat types are comparable to the WFD transitional water bodies.

For the moment, the two processes for the designation of aquatic habitat types under Natura 2000 and the WFD water types are run in parallel, but there is not enough coordination between the two processes. The Natura 2000 aquatic habitat types and WFD water types will provide a good basis for a coordinated assessment of status, pressures and impact, and will result in co-benefits for both processes. In addition, this coordination is a necessary basis for the forthcoming ecosystem assessment.

Protected areas register of the WFD and Natura 2000 sites

Article 6 of the WFD requires Member States to establish a register of protected areas covered by other EU environmental legislation, including the protected areas of the BHDs. Article 4 requires Member States to achieve compliance with the standards and objectives set for each protected area in terms of habitats and species directly dependent on water by 22 December 2015.

An initial analysis by the ETC/BD shows that most of the Member States included into the WFD register more than 50 % of the Natura 2000 sites designated within their territory (compared to all Natura 2000 sites of the Member States). Greece, Hungary, and Slovakia included all of their Natura 2000 sites in the WFD register. The lowest proportions of Natura 2000 sites included in the WFD register were seen in Belgium, Malta, and the Czech Republic.

The total protected areas under the Habitats Directive (SCIs/SACs ([3])) ranged mostly between 10 % and 15 % of the RBD area. Comparing large international RBDs (> 50 000 km^2), the relative abundance of HD protected areas ranges between 1 % of the total RBD territory within the Seine RBD and 24 % within the Ebro RBD. The relative abundance of Birds Directive protected areas (SPAs) ranges between 2 % of the total RBD territory within the southern Apennines RBD and 21 % within the Ebro RBD. The mean coverage of RBDs by Birds Directive protected areas was found to be 10 %.

The substantial differences in the proportion of water-dependent Natura 2000 sites included in the WFD Register result from the lack of unified methods for Member States to identify 'water-dependent' sites at the EU level. Potentially, many water-dependent Natura 2000 sites are omitted from the WFD Register and vice versa a number of Natura 2000 terrestrial dry sites are included, although their dependency on the water environment is negligible or none. Clear guidance is needed for the Member States.

Protection of small water bodies

The protection of small water bodies is a concern (Box 6.1). The WFD protects all waters. However, in the delineation and selection of water bodies, many Member States have used size thresholds that exclude small water bodies without necessarily taking into account their importance in the basin (EC, 2012a). Some Member States have explicitly included smaller water bodies if they are protected under other legislation or if they are ecologically important in the basin.

In order to protect small water bodies, there is now an urgent need to raise awareness about their ongoing destruction and their many beneficial functions to society. This awareness raising should boost political recognition of their importance for maintaining a healthy and diverse aquatic environment. Coordinated activities with the protected habitats under the nature directives and WFD activities may also help to ensure the protection of these valuable small water bodies.

([3]) Sites of Community Importance and Special Areas of Conservation are the protected areas designated under the Habitat Directive.

Box 6.1 Protecting small water bodies

Small inland water bodies (streams and ponds) are abundant in most European countries. 80 % of the millions of kilometres of river network in Europe consist of small rivers, commonly known as headwaters, creeks, streams, brooks, or wadeable rivers. On a European scale, there is no overview of the exact number of ponds, but a few country-specific estimates clearly show their importance. Thus, in Switzerland there are approximately 32 000 smaller ponds sized between 0.01 ha and 5 ha; (Oertli et al., 2005). Similarly, in Great Britain there are about 400 000 sized between 0.0025 ha and 5 ha (Biggs et al., 2005). In Denmark there are just under 120 000 ponds ranging from between 0.01 ha and 5 ha (Søndergaard et al., 2005).

From an ecological point of view, small rivers are extremely valuable: they provide habitats for a wide range of plants and animals and retain and transform pollutants, thereby reducing the pollution load of downstream river stretches (EEA, 1994). For example, about half of the most important European species of freshwater fish depend on streams for spawning, and the majority of them never leave the stream. Ponds have a wide range of functions important for society, including water supply (watering livestock, irrigation and protection against fire), hydrological regulation, elimination of nutrients, fish production, recreation, and the provision of refuge to wildlife.

Unfortunately, due to human activities, the ecological condition of small water bodies is poor in many places in Europe. Small rivers and ponds with a small volume of water have only a limited ability to dilute and retain pollution, and therefore they are highly susceptible to inputs of even small amounts of pollutants from their surroundings, such as pesticides from agriculture. In addition, dry periods and water abstraction can greatly reduce their water flow and water level. Their natural physical state is often deteriorated. In the lowlands, many streams have been altered from natural, meandering channels into straight drains to enhance the draining of agricultural fields, and many barriers are affecting connectivity. More than 50 % of ponds have vanished from the European landscape, and in some areas the rate of loss reaches 90 %.

6.3 Conservation status of aquatic habitats and species

The Natura 2000 network of protected areas has a crucial role in delivering the favourable conservation target of the Habitats Directive, and the WFD has a clear link to 'water-dependent Natura 2000 sites' requesting them to be part of a register of protected areas (WFD Art. 6). But it is important to know that the target to reach favourable conservation status under the Habitats Directive applies not only to habitat types and species occurring in the Natura 2000 sites, but also in the wider countryside. This is why the WFD, if adequately implemented, can potentially significantly support the achievement of the the target for aquatic species and habitat types.

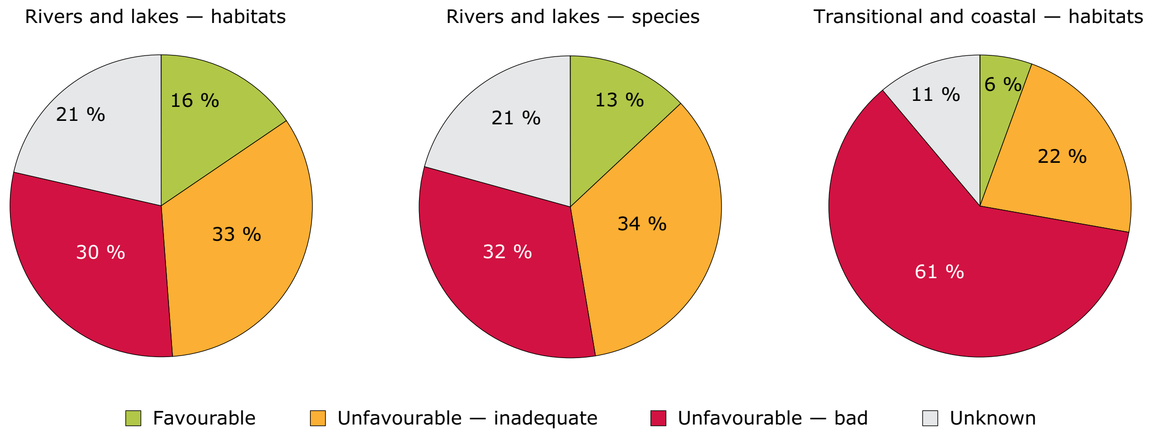
The conservation status ([4]) of **river and lake habitats and species** of Community interest is generally unfavourable (EEA, 2010d). Only 16 % of the assessments for the river and lake habitat types and 13 % of the inland water species held favourable conservation status (Figure 6.1). For rivers and lake habitats, 63 % of the assessments show unfavourable conservation status. For species, 66 % of the assessments show unfavourable conservation status. More than one fifth of the river and lakes habitats and species have unknown conservation status.

Habitat types of Community interest considered **as coastal and transitional waters** are at risk in Europe. Some 83 % of the assessments of conservation status of Annex I coastal and transitional habitats are unfavourable, and 11 % of the assessments are unknown (Figure 6.1).

The European Red Lists of Threatened Species published by the International Union for Conservation of Nature (IUCN) in 2011 found that 44 % of all freshwater molluscs, 37 % of freshwater fish, and 23 % of amphibians now fall into the threatened category (Cuttelod et al., 2011; Freyhof and Brooks, 2011).

([4]) The Habitats Directive requires that every six years Member States prepare reports to be sent to the European Commission on the implementation of the directive. The Article 17 report for the period 2001-2006 for the first time includes assessments on the conservation status of the habitat types and species of Community interest.

Figure 6.1 Conservation status of river and lake habitat types and species, and conservation status of coastal and transitional waters habitat types of European interest



Note: Geographical coverage: EU except Bulgaria and Romania.

Source: EEA ETC/BD, 2008.

Box 6.2 Examples of threatened species

The freshwater pearl mussel (*Margaritifera margaritifera*), an Annex II and V species of the Habitats Directive (HD), holds Unfavourable Conservation Status across Europe. The current IUCN conservation status is 'critically endangered' (Cuttelod, 2011). The freshwater pearl mussel is a highly sensitive water-dependent species that is declining because of sedimentation and eutrophication impacts in rivers, as well as destructive pearl fishing and the illegal pearl trade. It showed marked declines all over Europe during the 20th century, leaving small populations scattered across EU territories. Despite the declines, Ireland and Scotland continue to have very significant responsibility for the conservation of the species, as they hold a high share of the global population (SNH, 2012).

In Ireland they have combined measures established in RBMPs with more focused, catchment-specific measures that should result in synergies and maximise the potential to restore pearl mussel habitats and achieve both Habitats Directive and WFD objectives. Because the pearl mussel is one of the most sensitive water-dependent species, achievement of water conditions suitable for restoring this mollusc to favourable conservation status will also support the conservation of other sensitive water-dependent habitats and species in the catchments. This will ensure the restoration and maintenance of good status (Sides, 2010).

The Eurasian Otter (*Lutra lutra*) serves as a relatively good indicator for unpolluted natural freshwater ecosystems in a good ecological status (Bedford, 2009). The Eurasian Otter is found in European rivers, lakes and marshes as well as coastal waters. The position of the otter in the food chain makes it a vulnerable species, but it is also indicative of abundant fish and the health of aquatic environments.

The species was once widespread, but in the last century the inland water populations in particular decreased dramatically during last century in many countries (EEA, 2005a). In France for example, the otter population has gradually declined from the 1930s (Ministère du développement durable, 2012). The main causes for its decline are hunting, but river pollution and wetlands draining, primarily related to intensive agriculture, have also contributed to its decline.

There are now signs of recovery in a few countries such as Denmark, France, Sweden and the United Kingdom. Nevertheless, otters are still absent or sparse in many countries (EEA, 2005a; EEA ETC/BD, 2009).

6.4 Most frequent pressures affecting aquatic habitats

Through the conservation status reporting (2001–2006) under the Habitats Directive, EU-25 Member States have reported the main pressures affecting the conservation status of habitats in rivers, lakes, transitional waters and coastal waters. The main pressures identified are similar to the pressures and impacts reported via the WFD RBMPs (see Chapter 4).

Results from Member State reporting under the Habitats Directive indicate that more than 70 % of the lake and river habitat types are affected by either modification of hydrographic functioning, biocenotic evolution (eutrophication and invasion of alien species) or pollution (Figure 6.2(a)). This is similar to the results from the RBMPs showing that the pressures reported to affect most surface water bodies are pollution from diffuse sources causing nutrient enrichment, and hydromorphological pressures causing altered habitats.

Habitat types considered as coastal and transitional waters are most frequently affected by biocenotic evolution (eutrophication and by invasion of species) or urbanisation activities (Figure 6.2(b)). Coastal habitats are fragile, and are being destroyed to make way for housing, industry, agricultural land, and infrastructure for tourism and transport.

Invasive alien species (IAS) should be considered a significant water management issue, and in some areas the presence of certain species will affect the chances of achieving the WFD objective of good or high ecological status/potential (Box 6.3). RBMP activities on invasive species should be coordinated with EU and national strategies to address invasive species, with the aim of preventing further deterioration in the ecological quality of water bodies.

6.5 Habitats and Water Framework Directives' measures

The Habitats Directive takes an integrated approach: it recognises that the Natura 2000 network needs to be ecologically coherent in order to ensure the long-term survival of many species and habitats. Member States need to establish the necessary conservation measures that correspond to the ecological requirements of the natural habitat types and the species present on the sites. They also need to take appropriate steps to avoid the deterioration of natural habitats and the habitats of species for which the areas have been designated. If required, appropriate Natura 2000 management plans may specifically be designed for the sites or integrated into other development plans (e.g. the RBMPs).

As many aquatic habitats and species of Community interest are also related to WFD water bodies or water-dependent systems, the measures proposed under BHD and WFD may be partly the same. Therefore the measures need to be coordinated between the responsible authorities for nature conservation and water management. In addition, there may be many joint benefits of measures.

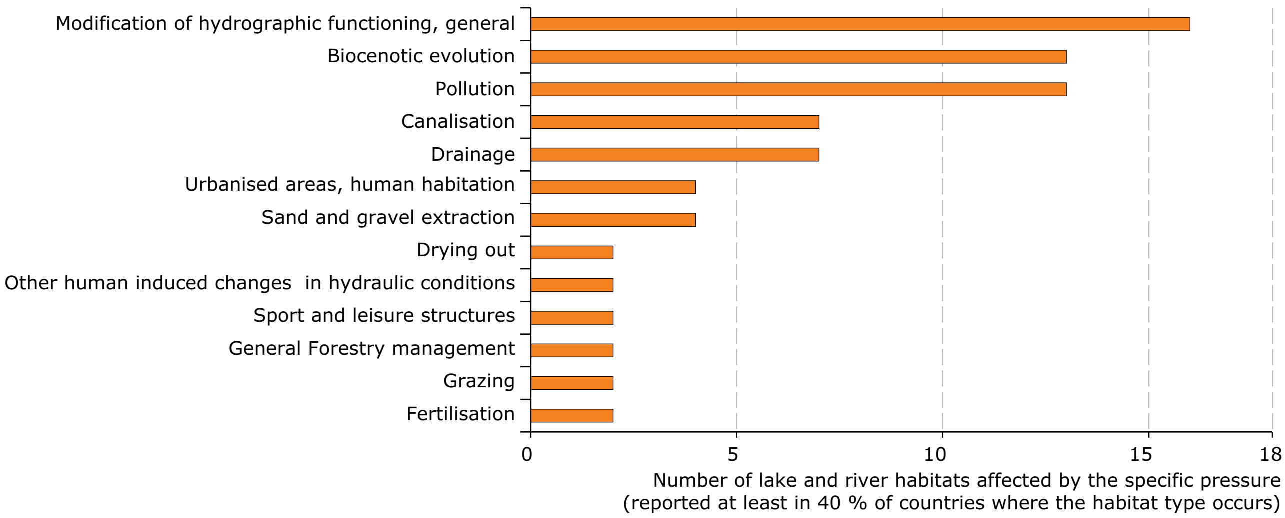
The WFD provides the framework and support for implementing measures required at catchment level to achieve the objectives of Habitats Directive, which would be difficult to achieve under this latter directive alone (see also the pearl mussel example in Box 6.2). Where relevant, the PoM established via the RBMPs need to include measures under other relevant EU legislation such as the BHDs. Measures needed under these directives can be included either directly in the RBMPs, or they can be included in the relevant Natura 2000 management plan as a reference. They could also be included in other conservation instruments containing Natura 2000–related conservation measures. These WFD measures may be important in approaching the 2020 targets for aquatic habitats and species and reaching the 'restoration sub-target' to restore at least 15 % of degraded ecosystems.

Restoring and preserving aquatic ecosystems: multiple benefits for the WFD and BHDs

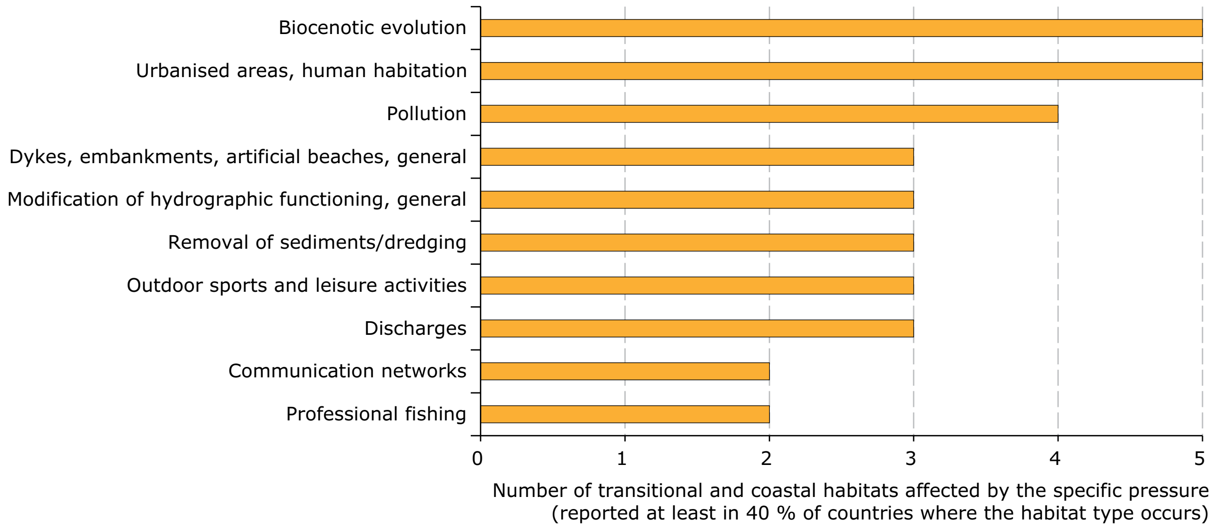
Until the last 20 to 30 years, the main focus of physical water management in many parts of Europe was on providing flood protection, facilitating navigation, and ensuring the drainage of agricultural land and urban areas. Nowadays, physical water management also includes ecological concerns, such as maintaining the functions of waters. This broader ecological perspective includes activities such as 'making room for the river', a concept pioneered in the Netherlands, which involved removing dikes and allowing rivers more room to periodically flood. Other activities under this perspective include river restoration or floodplain and riparian zone rehabilitation, 'coastal zone restoration projects', Integrated Coastal Zone Management, and the instalment of buffer strips — areas of land covered by vegetation that filter nutrients and slow down the rate of water run-off.

Figure 6.2 The 10 most frequently reported pressures by EU-25 Member States, for (a) lake and river habitat types and (b) transitional and coastal habitats

(a) Lake and river habitat types



(b) Transitional and coastal habitats



Note: (a) The statistics cover 18 lake and river habitat types.

(b) The statistics cover five coastal and transitional habitat types.

Geographical coverage: EU except Bulgaria and Romania.

'Biocenotic evolution' can be accumulation of organic material, eutrophication, acidification or invasion of species.

The reported data on pressures from 2001 to 2006 were not ranked by importance of the different pressures, and there were no limitations on how many pressures could be reported by Member States. In addition, the list of pressures and threats used for the 2001–2006 reporting period may have left too much room for interpretation on which pressure to list in each case. Therefore, the above results are only indicative of main pressures identified. Reporting on pressures will be improved for the next Habitats Directive reporting cycle.

Source: ETC/BD, 2008 and 2012, based on Member State conservation status reporting (2001–2006) under the Habitats Directive.

Box 6.3 Alien species

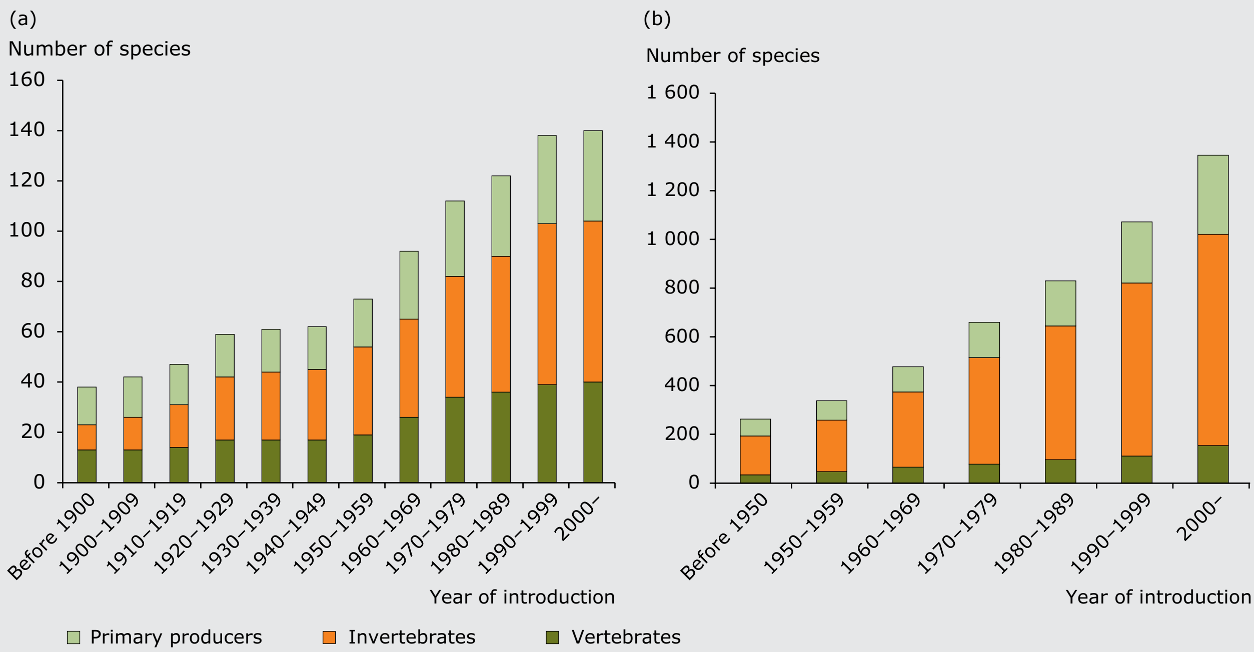
Many alien species ([5]) have been recorded in pan-European lake and river ecosystems including around 300 freshwater invertebrates and more than 130 fish. An analysis of trends made for 11 countries shows an important increase in the number of alien species (see Figure 6.3 (a)) (EEA, 2009 and 2010c).

More than 1 360 marine alien species have been observed in European seas, of which almost 1 100 have been introduced since 1950 (Figure 6.3 (b)). These consist primarily of invertebrates (873) — mostly crustaceans and molluscs, followed by primary producers (326) — plants and micro-organisms, and vertebrates (161) — mostly fish. The rate of introductions is continually increasing, with almost 300 new species reported since the year 2000.

Invasive alien species (IAS) are plants and animals that have deliberately or accidentally been introduced outside their natural range. By spreading quickly, they threaten native wildlife and can cause economic damage. Some species pose serious threats to our natural biodiversity and have economic impacts, for example for flood risk management, water transfer schemes, and fisheries management. Their presence and unabated spread can be an important pressure on the ecological status of many water bodies. Once established, they are difficult or impossible to control. Examples include the plant Japanese knotweed (*Fallopia japonica*), the mammal American mink (*Neovison vison*), the fish topmouth gudgeon (*Pseudorasbora parva*) and the crustacean American signal crayfish (*Pacifastacus leniusculus*).

Some Member States (e.g. Austria and Germany) have not included impacts of IAS in their first RBMPs, even if they consider it to be a major pressure affecting aquatic ecosystems. In several RBMPs, invasive species have been identified as a significant impact that can affect the possibilities of achieving good ecological status. In the Thames RBD (United Kingdom), for example, approximately 56 % of rivers and 11 % of lakes are impacted by the presence of IAS (Environment Agency, 2009). In other RBMPs like the Scottish RBD and the Swedish Bothnian Bay RBD, invasive species are seen as impacting less than 1 % of the surface water bodies (SEPA, 2010 and Swedish RBMPs, 2010).

Figure 6.3 Cumulative number of alien species established in freshwater environment in 11 countries (a); and cumulative number of marine alien species (MAS) in European seas, from 1950 to 2010 (b)



Sources: (a) EEA, 2010; (b) EEA, 2013b.

([5]) Non-indigenous species (NIS) (synonyms: alien, exotic, non-native, allochthonous) are species, subspecies or lower taxa introduced outside their natural range (past or present) and outside their natural dispersal potential.

The European Commission is developing a strategy for an EU-wide Green Infrastructure (EC, 2010a). Green infrastructure is the umbrella term given to a series of measures that make use of natural systems to improve the environment. In terms of water policy, green infrastructure includes measures such as restoration of wetlands and forests. This can help store water in the ground, reducing the likelihood of both floods and water scarcity. A green infrastructure will help reconnect existing nature areas and improve overall ecological quality, and both the WFD and BHDs would benefit from green infrastructure projects. Rivers are an important element of green infrastructure; restoring rivers and floodplains can be important for achieving good status.

Several EU LIFE projects have restored river dynamics and reconnected floodplains, thus improving the ecology of the river and its ecosystem functions (EC, 2007b). A LIFE Nature project has revitalised an important Danube floodplain area near the Austrian town of Hainburg, bringing back plant and animal species (ICPDR, 2006). After removing 3 km of the former embankment, the river has been allowed to fashion its own banks for the first time in 100 years. The project has supported the green infrastructure associated with the river by restoring areas containing valuable ecosystems, thus increasing the ecological value of the river and maximising the ecosystem services provided by this section of the Danube.

The 'LIFE+ Lippeaue' project (LIFE+ Lippeaue, 2012) aims at improving the link between the River Lippe and its floodplain. The Lippe is a river of 215 km in length, draining a catchment of 4 800 km^2 in North Rhine-Westphalia. The land use in the catchment is dominated by agriculture, with significant areas of human settlement and forestry. The river receives discharges of treated wastewater, diffuse pollution from agriculture, cooling water from the power industry and salt-water drainage from coal mining. Past development has encouraged the channelisation of the river, which was cut unnaturally deep, requiring bank reinforcement. The combined effect of this activity was to disconnect the river from its natural floodplain.

In 1990, the state of North Rhine-Westphalia started a programme of floodplain restoration aimed at preserving and restoring floodplains and stream systems as natural veins in the landscape. The programme comprises a wide range of individual measures appropriate to the stream type and its local ecology that together deliver the development goals set for the river system. Today, large parts of these rivers and floodplains are Natura 2000 sites and the many measures implemented contribute both individually and in combination to the achievement of the objectives of the BHDs and WFD.

Natural water retention measures (NWRMs) aim to safeguard natural storage capacities by restoring or enhancing natural features and characteristics of wetlands, rivers, floodplains, etc. and by increasing soil and landscape water retention and groundwater recharge (Stella Consulting, 2012) (Box 6.4). Most of these measures are beneficial in reducing both floods and droughts, and in improving the aquatic habitats and ecological status of water bodies.

Conservation plans for restoring the populations of threatened fish species

It is known that populations of several fish species such as eel, sturgeon, salmon, whitefish and

Box 6.4 Natural Water Retention Measures

A European Commission project on Natural Water Retention Measures identified 21 NWRMs, divided into four categories.

1. **Forest measures:** Continuous Cover Forestry (CCF); maintaining and developing riparian forests; and afforestation of agriculture land.
2. **Urban measures:** buffer strips and swales; permeable surfaces and filter drains; infiltration devices; and green roofs.
3. **Agricultural measures:** restoring and maintaining meadows and pastures; buffer strips; soil conservation crop practices; no or reduced tillage; winter green fields; early sowing; and traditional terracing.
4. **Water storage measures:** basins and ponds; wetland restoration and creation; floodplain restoration; re-meandering; restoration of lakes; natural bank stabilisation; and artificial groundwater recharge.

Source: Stella Consulting, 2012.

lampreys declined in European inland waters the during 20th century (Freyhof and Brooks, 2011). Due to the decrease in their stocks and numbers, several inland fish species are listed in Annex II, IV and V of the Habitats Directive as species of Community interest. The conservation status of Europe's eight sturgeon species is particularly worrying. All but one of these species is 'critically endangered' (Freyhof and Brooks, 2011).

A major cause of reduced population was poor water quality, but as water quality and oxygen conditions have improved, a greater 'obstacle' for recovery has emerged in the form of physical barriers to migration. Due to barriers such as dams weirs, and low flow stretches, migration of fish is impaired in many European rivers, with negative effects for the long-term survival of natural populations.

Several European river basins have master plans or conservation plans for restoring the population of threatened fish species and restoring river continuity.

- The programme 'Rhine 2020' including the 2009 'Master plan for migratory fish in the Rhine' aims at restoring the ecological continuity of the Rhine from Lake Constance to the North Sea. It also aims at the recolonisation of priority tributaries with certain migratory fish (ICPR, 2012). Once the connected habitats of the Rhine and its tributaries have ecological continuity, animals may move upstream and downstream and plants may be carried downstream by the currents.

- Migratory fish species such as the sturgeon are good indicators of the ecological condition of the entire Danube River Basin (ICPDR, 2010a). The Danube and its tributaries are key migration routes. The Iron Gate I and II Dams, part of the Gabcikovo Dam, and the chains of hydropower plants in Austria and Germany represent migration barriers for fish such as sturgeon. In particular, the impact of the Iron Gate I and II Dams has resulted in sharp declines in most Danube sturgeon species, with significant regional economic impacts on the productivity of fisheries. As a response, the ICPDR via the international RBMP has started an initiative to restore river and habitat continuity.

These plans are often the basis for the RBMPs' measures against obstacles and transverse structures.

6.6 Conclusions and summary

The EU policies on water, the marine environment, nature, and biodiversity are closely linked. Together, they form the backbone of environmental protection of Europe's ecosystems and their services. One of the main objectives of the WFD is to take an integrated view of aquatic ecosystems and to protect them using a holistic approach. It is therefore worthwhile to consider the results of the first round of WFD RBMP reporting and the current implementation of the nature legislation in the light of future developments under the Biodiversity Strategy 2020 (EC, 2011a).

Both the nature directives and the WFD aim at ensuring healthy aquatic ecosystems, while at the same time ensuring a balance between water and nature protection, and the sustainable use of natural resources. For the moment, the two processes for the designation of aquatic habitat types under Natura 2000 and the WFD water types are run in parallel, but there is not enough coordination between the two processes. The Natura 2000 aquatic habitat types and WFD water types will provide a good basis for a coordinated assessment of status, pressures and impact, and will result in co-benefits for both processes. In addition, this coordination is a necessary basis for the forthcoming ecosystem assessment.

In order to protect small water bodies, there is now an urgent need to raise awareness about their ongoing destruction and to highlight their many beneficial functions to society, with a view to increasing political recognition of their importance for maintaining a healthy and diverse aquatic environment. Coordinating the activities of the WFD and the nature directives in the implementation of protected area policy may also help to ensure the protection of these valuable small water bodies.

As many habitats and aquatic species are related to WFD water bodies or water types, the measures proposed under the BHDs and the WFD may partly be the same. Therefore, there is a need for coordination between the responsible authorities for nature conservation and water management. In addition, there may be many joint benefits of measures.

Restoring and preserving aquatic ecosystems has multiple benefits for the WFD and BHDs. This includes activities such as 'making room for the river'; river restoration or floodplain rehabilitation; 'coastal zone restoration projects'; and Integrated Coastal Zone Management. The forthcoming strategy for an EU-wide Green Infrastructure (EC, 2010) will help reconnect existing nature areas and improve the overall ecological quality, and both the WFD and BHDs would benefit from such projects.

7 Challenges for achieving good status of waters

The status and pressure assessments in the previous chapters revealed that many European water bodies currently fail the WFD's objective of achieving good ecological and chemical status.

The most critical areas, according to the assessment of the WFD information, are the issues of diffuse pollution and hydromorphological alterations. However, there is also a big challenge in the area of water resource management as can be seen from other EEA and Commission reports and assessments (EC, 2012a). Water Resources Management aims at optimizing the available natural water flows, including surface water and groundwater, to satisfy the competing needs. This challenge cannot be reviewed using direct WFD reporting alone, but calls for a wider assessment, as set out in the EEA report on water management in the context of vulnerability (EEA, 2012d). In the following sections, trends and challenges, possible solutions and further perspectives that emerge from the status assessment are brought together. They summarise and conclude the findings and results provided in Chapters 3 to 6.

7.1 Current trends and future challenges

The issue of hydromorphological alterations is certainly an area where the WFD brought in the most significant new elements of water management. While the focus in the 1980s and 1990s was placed on water quality, the WFD introduced into water legislation the concept of structural integrity of water bodies and how this integrity affects the functioning of water bodies as a habitat. Consequently, the assessment of status and pressures was also a new field of development for Member States.

The status and pressure assessment made in Chapter 4 shows that hydromorphological pressures are the most commonly occurring pressures in rivers, lakes and transitional waters, affecting more than 40 % of all river and transitional water bodies, and 30 % of lake water bodies. This highlights the large amount of hydromorphological alterations that water ecosystems were subjected to over the past several hundreds of years, but particularly in the recent 50 years, and reflects the great deal of work still required to enable ecosystems to function in all their structural aspects. Section 7.5 gives a further outlook of the challenges and problems in this area, as well as some possible measures that can be taken to improve it.

In Chapter 4, it was found that pollution pressures were reported as affecting a high proportion of water bodies. Both pollution from diffuse sources and point sources resulting in nutrient enrichment and organic enrichment were found to be a cause for not achieving good ecological status. Chapter 4 also highlights the large share of water bodies having poor ecological status, particularly in areas with high agricultural intensity and high population density. This suggests that agricultural management and urban agglomerations are the most evident driving forces of water pollution. However, the results from Chapter 3 also indicate considerable success in reducing the discharge of pollutants to Europe's waters, leading to water quality improvements that can be attributed mostly to improvements in the treatment of urban wastewater. In particular, densely populated areas have seen significant improvements in water quality.

By comparison, chemical pollution has also significantly improved in the last 30 years, but the situation as regards the priority substances introduced by the WFD is not clear. Declines in emissions have been observed for some hazardous chemicals such as heavy metals from point sources. Declines have also been observed in some pesticides, as a result of restrictions on their use (EEA, 2011b), but the persistence of some restricted substances means that they will be present in the water environment for decades. Other substances such as pharmaceuticals and personal care products, often referred to as emerging pollutants, are increasingly being found in water bodies across the EU. Measures to reduce pollution by hazardous substances were further discussed in Chapter 5.

The information provided in the RBMPs on chemical status is not sufficiently clear to establish a baseline for 2009. The assessment of chemical status presents a large proportion of water bodies with unknown status. Monitoring is clearly insufficient and inadequate in many Member States, where priority substances are not all monitored, and the number of water bodies being monitored is very limited (EC, 2012a).

Figure 7.1 illustrates the improvements made by basic measures like the UWWTD up to the first RBMPs. It shows trends in a combination of water quality information reported by water bodies under the EEA WISE-SoE reporting and the ecological status information from the WFD reporting of water bodies. The figure illustrates the trend in total ammonium, total phosphorus and nitrate concentrations in river water bodies, grouped by ecological status or potential. For all three pollutants, there has been an improvement. Linear projections of this trend for rivers indicate that if the trend continues, total ammonium and total phosphorus, water quality may achieve levels comparable to good ecological status around 2015 and 2027 (Figure 7.1(a) and (b)). This assumes that implementation of the UWWT Directive and other emissions reduction policies are continued.

For nitrates, the current decreasing trend is too slow to approach the level of water quality comparable to at least good ecological status in 2027. This implies that additional measures are needed to reduce diffuse pollution if the majority of water bodies are to have nitrate levels comparable to high or good ecological status in 2027.

The linear projections in Figure 7.1 are a simple projection of continued implementation and upgrading of current measures. If the measures planned in the RBMPs are stricter and they are implemented in the first RBMP period, the improvement in water quality may be faster. Conversely, if the RBMPs are not ambitious, and there are delays in implementing the measures, the above projections may be too optimistic.

The EEA plans to further explore the trends in water quality, including taking into account Member States' 2012 reports on progress in implementing measures as well as information provided on implementation of the UWWT and Nitrate directives.

7.2 Objectives and current goals for achieving good status

The objectives in the WFD stipulate that good status must be achieved by 2015. Extending the deadline beyond 2015 is permitted for one or more of the following reasons (exemptions):

- the required improvements cannot technically be achieved within that period;
- achieving the improvements is disproportionately expensive;
- natural circumstances obstruct timely improvement.

With this framework, the WFD provides flexibility in achieving the objectives in the most cost-effective way, and introduces a possibility for priority setting in the planning. However, the results in the previous chapters and the trend analysis shown above suggest that the efforts needed to cover the current gap and to fulfil the objectives need to be intensified in most cases.

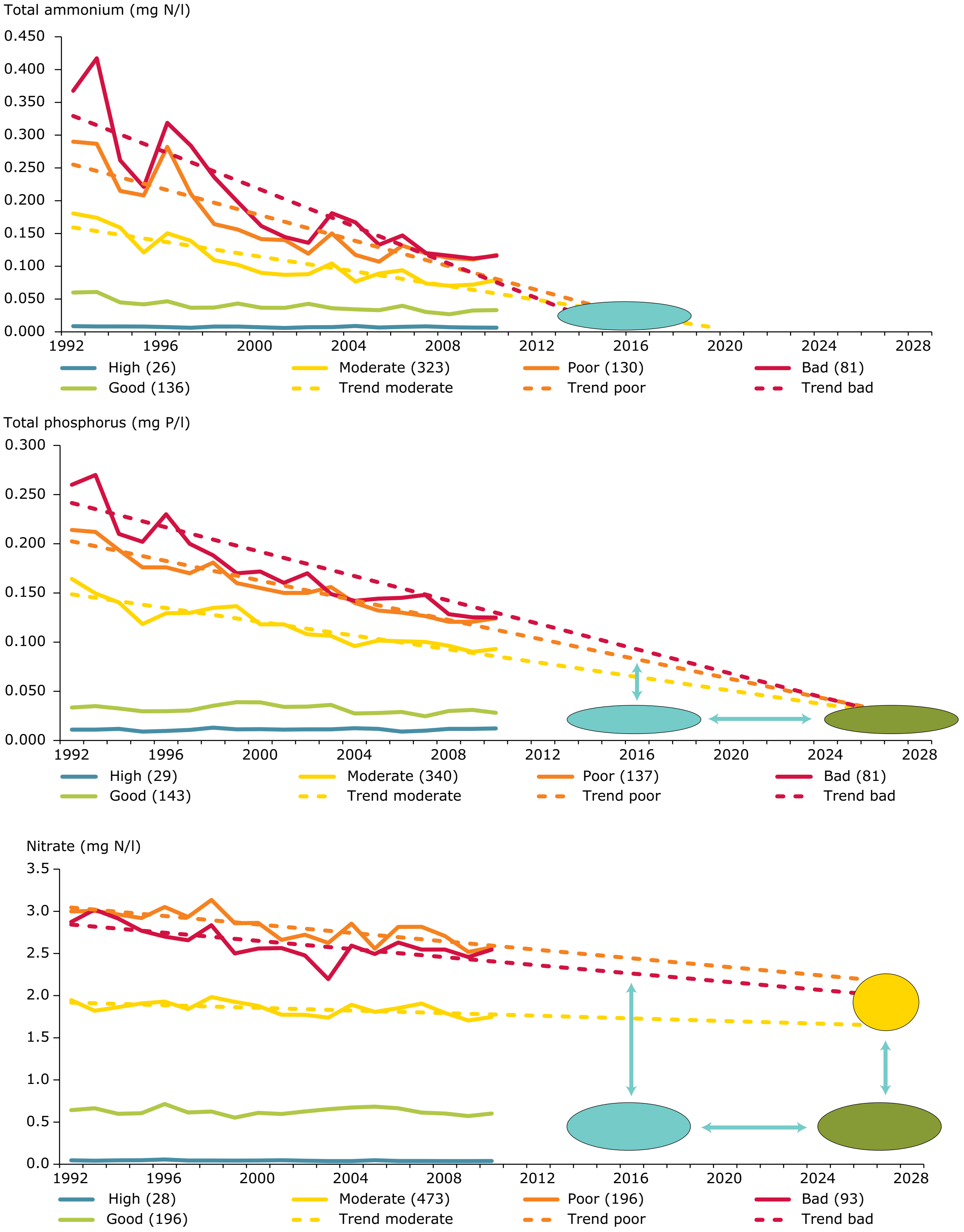
The Commission has analysed the objectives and expectations to reach good status (EC, 2012a). A summary of the results are presented in the following.

In 2009, 42 % of **surface water bodies** were in good or high **ecological status,** and in 2015, 52 % of water bodies are expected to reach good status (Table 7.1) (EC, 2012a). This is far from meeting the objective and only constitutes a modest improvement in ecological status. It is difficult to estimate the percentage of water bodies that will achieve good status in 2021 and 2027, as Member States have rarely provided such information in the RBMPs.

The information provided on the **chemical status of surface waters** was limited and inconsistent (see Chapter 6). More than 40 % of surface water bodies are reported as having 'unknown chemical status'. The assessment of chemical status for water bodies with known status is not fully comparable. Therefore, it is not possible to present a reliable picture of surface water chemical status and expected progress at EU level.

For groundwater, 80 % of **groundwater bodies** were already in good **chemical status**, and 87 % held good **quantitative status** in 2009 (Table 7.1) (EEA ETC/ICM, 2012a; EC, 2012a). For 2015, an increase in groundwater bodies achieving good status is

Figure 7.1 Trend in median total ammonium, total phosphorus and nitrate concentration of river water bodies, grouped by ecological status/potential class



Note: Concentrations are expressed as a median of annual mean concentrations. Up to three-year gaps of missing values have been interpolated or extrapolated. Only complete series with no missing values after this interpolation/extrapolation are included. The number of time series/river stations is shown in parentheses. The trend for 1992 to 2010 for each of the ecological quality classes has been linearly extended to 2027 — or when the concentration level becomes negative.

Source: WISE-WFD database, May 2012 and EEA Waterbase Rivers Version 8 (EEA, 2012n).

Table 7.1 Water bodies in good status in 2009 and 2015

	Number of Member States	Number of water bodies	Water bodies in good status or potential 2009 (%)	Water bodies in good status or potential 2015 (%)	Progress 2009–2015 in %
Ecological status of surface waters	21 ([a])	82 684	42 %	52 %	10 %
Chemical status of surface waters	Information unclear to establish the 2009 baseline ([b])				
Quantitative status of groundwater ([c])	24 ([d])	12 022 (5 197)	89 % (85)	96 % (92)	7 % (7)
Chemical status of groundwater ([c])	24 ([d])	12 022 (5 197)	83 % (68)	89 % (77)	6 % (9)

Notes: ([a]) Ecological status: Greece and Spain are excluded from the calculations due to lack of plans. Finland, Poland and Italy are excluded from the calculation due to high numbers of surface water bodies holding unknown status. Denmark is excluded as it did not report exemptions and therefore it is not possible to estimate the expected status in 2015. Information included from Portugal refers to draft plans. Information from Belgium refers to Flanders and coastal waters only. Information for Ireland and Slovenia is extracted from the RBMPs as it was not reported to WISE.

([b]) Chemical status: More than 40 % of the surface water bodies are reported as having 'unknown chemical status'. The assessment of chemical status for the other 60 % of water bodies is not comparable. Therefore, it is not possible to present a reliable picture of surface water chemical status and expected progress at EU level.

([c]) Groundwater: Numbers in parentheses are calculated excluding Finland and Sweden, both of which reported a large proportion of groundwater bodies (around half of the EU total) that are largely in good status.

([d]) Groundwater: Spain and Greece are excluded from the calculations due to lack of plans. Denmark is excluded as it did not report exemptions, and therefore it is not possible to estimate the expected status in 2015. Information included from Portugal refers to draft plans.

Source: EC, 2012a. Based on data available in WISE-WFD database 2012 — Member State results on status is available at http://discomap.eea.europa.eu/report/wfd/swb_status_2015 and http://discomap.eea.europa.eu/report/wfd/gwb_status_exemptions.

foreseen: 89 % and 96 % of groundwater bodies will have good chemical status and good quantitative status, respectively.

The Commission's review of the RBMPs found that in general, many of the RBMPs are not very ambitious concerning their environmental objectives, and exemptions have been extensively applied (EC, 2012a). Approximately 72 % of surface water bodies in less than good ecological status are subject to an exemption, and will not achieve good status in 2015. Likewise, 88 % of surface water bodies having poor chemical status in 2009 are subject to an exemption, and will not achieve good status in 2015.

More than 95 % of the exemptions relate to the deadline extension. Where deadlines for achieving the environmental objectives are extended beyond 2015, it is largely unclear when the objectives will be reached.

While Member States are relatively clear about the types of pressures their river basins are subjected to, there is a lack of precise information on how these pressures will be addressed and to what extent the selected measures will contribute to the achievement of the environmental objectives by 2015.

The emphasis on basic measures and existing regulations, with voluntary approaches prevailing, may result in a 'business as usual' approach, and jeopardise the fulfilment of the WFD objectives. More details on Members States' and RBMPs' objectives and measures are available in the Commission's WFD Staff Document (EC, 2012a).

7.3 Possible solutions and measures

To meet the objectives of the WFD, we need to manage the water environment by reducing those pressures causing water bodies to be at less than good status, and preventing increases in pressures that would cause deterioration of status. Reducing pressures in a sustainable way will enable the water environment to recover, and will place Europe and Member States in a better position to cope with other pressures such as climate change and invasive species impacts.

The PoM (Box 7.1) included in the RBMPs describe the actions that must be taken to bring water bodies into 'good status'. The key measures are:

- reducing emissions of pollution into water bodies by better wastewater treatment and implementation of good agricultural practice;
- hydromorphological functioning via restoration and changed land-use (e.g. buffer strips);
- ensuring ecological flows;
- removing migratory obstacles and transverse structures such as weirs in order to restore river continuity.

Most of the water challenges faced by aquatic ecosystems can be addressed through better implementation of the extensive legislative framework on water in place, and by enhancing the integration of water policy objectives into other policy areas such as the CAP, the Cohesion and Structural Funds, and the policies on renewable energy and transport.

Over 2011 and 2012, the Commission examined the measures included in the RBMPs and evaluated if the PoM set out for the different RBMPs are sufficient to achieve the objectives of the WFD. The following sections address the driving forces causing the pressures and possible ways to influence them. Selected results on the measures in the RBMPs have been included, and more details can be found in the Commission's Staff working document (EC, 2012a).

7.4 Measures for reducing pollution

The considerable success in reducing the discharge of pollutants into Europe's waters in recent decades shows that we are on the right track towards reducing pollution from urban and industrial wastewater and agricultural sources.

7.4.1 Point source pollution

To protect water from pollution, a comprehensive range of legislation has been established in Europe. The WFD has set a clear target to reduce pollutants by the basic measures on compliance with the requirements of the UWWT Directive and Nitrates Directive. However, there remain significant gaps to bridge before achieving water quality levels consistent with good status. Full implementation of these directives will improve water quality and aid, although not necessarily guarantee, the achievement of good ecological status under the WFD. Supplementary measures are necessary in cases where the basic measures are not sufficient to allow the WFD objectives to be reached.

Box 7.1 Programme of measures

Article 11 of the WFD requires each Member State to establish a programme of measures (PoM) 'for each river basin district, or for the part of an international river basin district within its territory,' and to implement such measures by 2012. The effectiveness of the PoM is subject to review at six-year intervals, beginning in 2015. The WFD distinguishes between basic and supplementary measures.

- **Basic measures**, which comprise the minimum water body protection development requirements, are already defined in existing EU directives or serve to meet basic water management requirements, including those laid out in Directive 91/271/EEC concerning **urban wastewater treatment**, Directive 91/676/EEC relating to **nitrate pollution**, and Directive 80/778/EEC concerning **drinking water**.
- **Supplementary measures** are necessary in cases where the basic measures are not sufficient to allow the WFD objectives to be reached. Such measures can include construction programmes; rehabilitation projects; legislative, administrative and fiscal instruments; and educational projects.

Wastewater treatment must continue to play a critical role in the protection of Europe's water, although significant investment will be required simply to maintain infrastructure in many European countries (OECD, 2009). Cohesion Policy funds can continue to make an important contribution by co-financing improvements to wastewater treatment (EC, 2009b).

Continuing improvement in the level of pollutant removal from urban wastewater discharges is anticipated, driven by requirements under the UWWT Directive and national legislation. Compliance with the UWWT Directive is already relatively high in the older Member States. As for each of the newer Member States, country-specific deadlines for compliance were established in the accession treaties, and range from 2010 to 2018. As a consequence, improvements in both connection rates to sewers and treatment and improved treatment levels are likely to be realised for these countries over the coming years, provided that the directive is actually implemented.

The overall burden on the treatment processes can be reduced through a greater control on pollutants at source. This approach is environmentally beneficial, particularly with respect to pollutants for which the treatment process was not specifically designed. But it is also beneficial in terms of cost-effectiveness (EEA, 2005b and 2012a). Full-cost pricing for wastewater services will help drive controls at source. The possibilities for source control are varied and often specific to particular pollutants. For example, the availability of alternative cleaning agents has enabled the use of phosphate-free industrial and domestic detergents, significantly reducing phosphate levels in wastewater treatment plants.

Another important area for reduction at source is in the field of chemicals, including household personal care chemicals and pharmaceuticals. Improved efforts to retain these chemicals in wastewater treatment plants with better wastewater treatment should go hand in hand with clear efforts to reduce them at source, by raising consumer awareness, adjusting consumption patterns (for pharmaceuticals, by establishing take-back schemes), and encouraging industries to adjust the composition of their products.

7.4.2 Diffuse pollution

Agricultural sources of nutrients and other pollutants are still important, and call for increased attention in order to achieve good water quality and ecological status in water bodies. Cost-effective measures to tackle agricultural pollution already exist, and these need to be implemented through the WFD, while full compliance with the Nitrates Directive is also required. EU Member States have now established nitrate vulnerable zones with one or more action programmes on their territories, with almost all such programmes incorporating the nitrogen manure application threshold of 170 kg/ha/year (EC, 2010b). However, implementation of the Nitrates Directive is still incomplete and, even where full compliance has been carried out, sufficient improvement in nitrate water quality will take some time because of the lag in the transport processes in soils and groundwater. Other agricultural pollutants, particularly phosphorus and pesticides, must also be addressed.

Recent reforms of the CAP have resulted in a general decoupling of agricultural subsidies from production and the implementation of a cross-compliance mechanism, whereby farmers must comply with a set of statutory management requirements, including those that relate to the environment. A range of other measures for the improvement of water quality have also been suggested in the recent CAP reforms and include the improvement of manure storage, the use of cover crops, riparian buffer strips, and wetland restoration. The CAP reforms also recognise the importance of educational and advisory programmes for farmers. Implementation of these CAP measures could play a key role in addressing diffuse pollution from agriculture. The forthcoming reform of the CAP provides an opportunity to further strengthen water protection. The opportunities include adding further requirements from the WFD or the Directive on Sustainable Use of Pesticides into the CAP cross-compliance mechanism.

Agricultural measures in the programme of measures

Member States have included a range of technical, economic and non-technical supplementary measures focused at agricultural pollution in their PoM (EC, 2012a; Dworak et al., 2010). The reduction or modification of fertiliser application, a basic measure also required under the Nitrates Directive, is the most commonly found technical measure, followed by measures to reduce pesticide application. Non-technical measures such as training and educational measures (awareness raising or increased knowledge or research) are also very common, and are present in more than 50 % of all PoM. Among the few river basins that include economic instruments targeting agriculture in their PoM, compensation for land cover is the most often applied economic instrument, and is used in around one third of RBMPs. Nutrient trading was found in only one RBD and fertiliser taxes in six RBDs.

It is not clear whether the proposed agricultural diffuse pollution measures will lead to a significant reduction of pollution emissions and ultimately to the achievement of good status. The majority of the RBMPs identified diffuse pollution as a significant pressure, and one of the causes for not achieving good status. There is a relatively low proportion of RBMPs with concrete measures against diffuse pollution. It will therefore be necessary to put extra focus on diffuse pollution measures in the reform of the CAP and the next RBMPs.

Measures focused on reducing pollution from other diffuse sources

RBMPs also identified storm water overflows and diffuse pollution from households not connected to sewage systems as significant pressures. Other pressures in some of the RBMPs include mining (present and historic abandoned sites), contaminated land including waste deposits and landfills, and atmospheric deposition of pollutants.

Potential measures in relation to pollution from scattered dwellings and storm water overflows are to upgrade the sewage systems with storage basins and to increase infiltration of rainwater in urban areas. Different mitigation measures can be used to reduce pollution from mining and contaminated sites. In order to reduce atmospheric deposition of nitrogen and hazardous substances, measures at source and to reduce emissions of atmospheric pollutants are needed.

Measures to reduce pollution by hazardous chemicals and to achieve good chemical status are discussed in Section 5.4.

7.5 Restoring altered habitats and reducing hydromorphological pressures

Europe's waters are affected by major modifications, such as water abstractions; water flow regulations and morphological alterations; straightening and canalisation; and disconnection of flood plains. These are called hydromorphological pressures. These pressures can impact aquatic ecological fauna and flora, and can therefore significantly degrade ecological status.

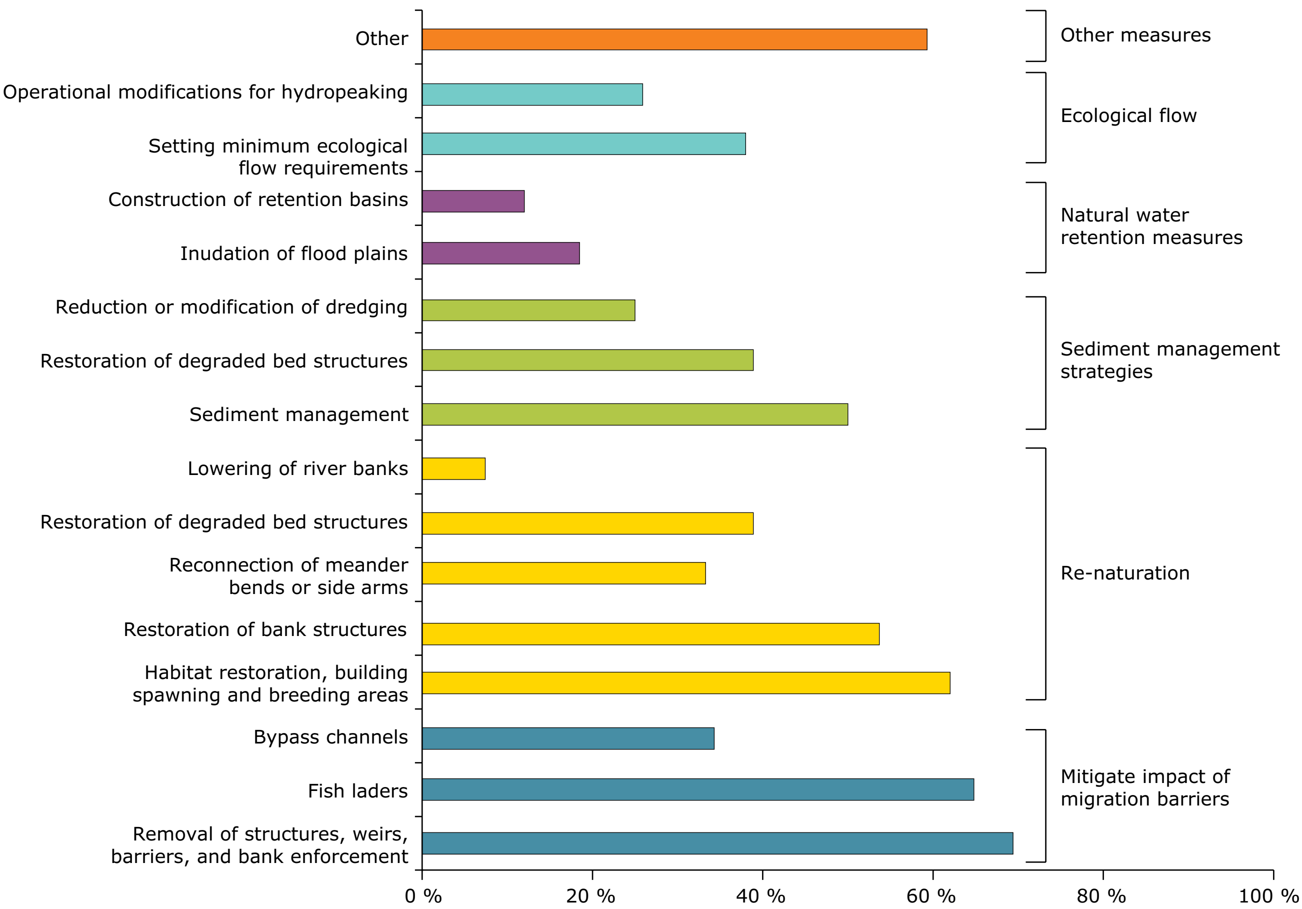
The WFD is the first piece of European environmental legislation that addresses hydromorphological modifications and their impacts on water bodies. It requires action in those cases where hydromorphological pressures affect ecological status, interfering with the achievement of the WFD objectives. If the morphology is degraded or the water flow is markedly changed, a water body with good water quality will not achieve its full potential as a habitat for wildlife. Hydromorphological pressures are mainly attributable to hydropower, navigation, agriculture, flood protection and urban development.

The restoration of hydromorphological conditions in river basins such as river continuity concerns the basin and the full length of the river, from marine structures through to upstream hydraulic structures, and must involve all public and private stakeholders concerned.

In nearly all RBMPs assessed (96 % of RBDs), there are hydromorphological measures proposed in the PoM (EC, 2012a). Measures related to hydromorphological improvements in the RBMPs are mainly supplementary measures. In Figure 7.2, the different hydromorphological measures have been divided into five groups. Around two thirds of the RBMPs had measures to mitigate the negative impact of mitigation barriers, for example through the removal of obstacles and the installation of fish passes.

Some measures focused on 're-naturation' of aquatic habitats, including the reinstatement of some degree of meandering and the reconnection of oxbow lakes to rivers. These re-naturation measures also included remediation schemes for channelised sections, and habitat remediation, i.e. the improvement of physical habitats including the restoration of bank structures and riverbeds. Measures related to sediment management strategy were also relatively common.

Figure 7.2 Occurrence of hydromorphology measures in RBMPs (% of RBMPs)



Source: Based on EC, 2012a.

Natural water retention measures that restore natural water storage, for example through the inundation of flood plains and construction of retention basins were mentioned in less than a fifth of the RBMPs. Measures to improve the water flow regime for example by setting minimum flow requirements and mitigating hydropeaking were found in around half of the RBMPs.

Only in half of RBMPs assessed is there a clear indication that specific measures are being taken to achieve a natural flow regime and to ensure ecological flows. Ecological flows are an important element for achieving good hydromorphological status. Ecological flows reflect the volumes and flow regimes that are required for the ecosystem and all relevant functionalities. This is discussed in more detail in the EEA report 'Water resources in Europe in the context of vulnerability' (EEA, 2012d).

It is generally not clear how the proposed hydromorphological measures are expected to contribute to the improvement of ecological status or potential. Measures that can be taken under the jurisdiction of water authorities or funded by nature conservation programmes, like the removal of old structures (weirs, barriers and bank reinforcements), establishment of fish ladders, or habitat restoration are relatively easy to implement. Other measures, which still have to be developed with water authorities but need more coordination with one or the other economic stakeholders, are more difficult to establish. This is especially true if the measure implies restrictions on uses or financial costs, such as reduced hydropower production or restrictions on water uses.

Article 4.7 of the WFD requires that all practicable steps be taken to mitigate the adverse impacts of new infrastructure on the status of water bodies, and that the projects should have overriding public/societal interest and/or benefits to the environment and society (EC, 2006a). In relation to new projects (hydropower plants, navigation, etc.) most of the RBMPs (85 %) make no reference to Article 4.7 of the WFD, even if in some cases there are large projects in the pipeline that are likely to bring about new modifications of water bodies (EC, 2012a). This oversight seems to be due to a lack of integration of measures developed under other policies, in particular cohesion policy (EEA, 2012c). Where Article 4.7 WFD is applied, the justification according to the provisions of the WFD is often not provided in the RBMPs (EC, 2012a).

In the following sections, several hydromorphological measures are discussed in the context of the pressures and the economic sector in which they are felt.

7.5.1 Hydropower

Hydropower has been identified as one of the main drivers affecting hydromorphology, resulting in loss of connectivity, altered water flow and sediment transport (Figure 7.3). Pressures related to hydropower may be one of the reasons for many water bodies not achieving good ecological status by 2015 or for the subsequent RBMP cycles.

In 2008, hydropower provided 16 % of electricity in Europe; currently, it provides more than 70 % of all renewable electricity (Eurelectric, 2011), more than 85 % of which is produced by large hydropower plants. The share of hydropower in electricity production is generally high in the northern and Alpine countries.

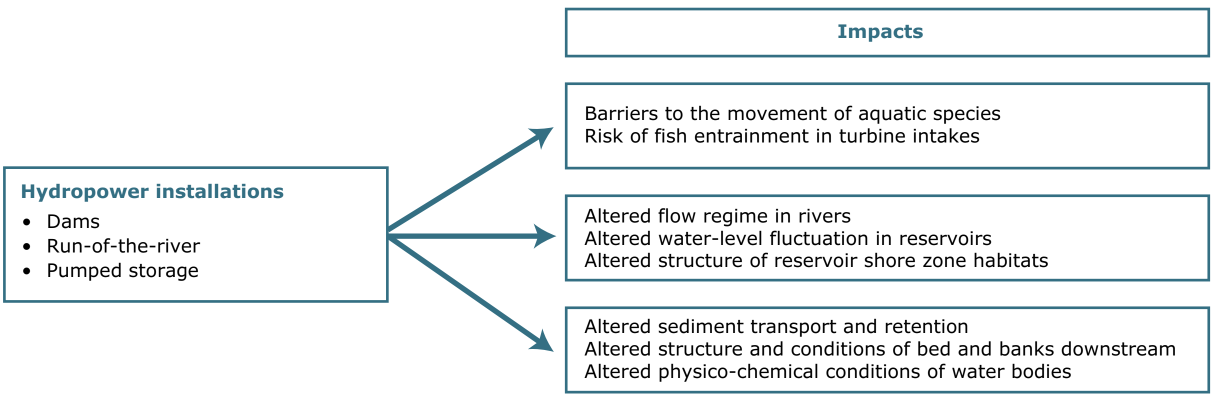
The total number of hydropower stations in the EU-27 amounts to about 23 000. Germany has the most hydropower plants, with more than 7 700. Austria, France, Italy and Sweden all have more than 2 000 hydropower plants (Kampa et al., 2011). There are about 10 times more small than large hydropower plants. However, the electricity generation of small hydropower stations only amounts to one tenth of the total generated by all hydropower stations.

The effects of hydropower production are considered in most of the RBMPs. The plans generally provide an overview of the plants and their location. River basins with hydropower schemes generally have several water bodies designated as heavily modified. Examples are lakes and reservoirs that have their water levels regulated due to the operation of hydropower schemes, e.g. storage of water during summer and hydropower production during winter, or river sections that are affected by dams and altered flow regimes.

Balancing WFD and Renewable Energy Directive requirements

It is important to ensure that existing and forthcoming EU policies to promote hydropower are compatible with the WFD and clearly consider the ecological impacts on the affected water bodies. At the same time, the Renewable Energy Directive (2009/28/EC) sets legally binding national targets for electricity and transport from renewable sources (not specifically for hydropower), adding up to a share of 20 % of gross final energy consumption in

Figure 7.3 Conceptual overview of different impacts of hydropower installations on biology, flow conditions and sediment transport



Box 7.2 State of small hydropower in the Alps

In 2010, several hundred applications for new small hydropower stations were reported across the whole Alpine area (with considerable difference in the numbers between countries), thus potentially adding to the high number of facilities already in place. This boom has been triggered in particular by financial incentives and support schemes in place in all the countries of the Alps. It presents a particular challenge for the competent authorities handling the huge amount of applications and granting authorisations for new facilities, due to a variety of aspects that have to be taken into account (energy generation, CO_2 emission reduction, ecological impact, etc.).

The decision on new facilities is still mostly determined for sites individually, although in some countries, projects within national parks and Natura 2000 sites are subject to specific rules. Environmental legislation has developed significantly in recent decades. Ensuring residual water (or ecological flows) as well as building fish passes are now seen as basic provisions of new hydropower plants.

Source: Alpine Convention, 2011.

the EU as a whole. By June 2010, each EU Member State had to adopt a national renewable energy action plan (NREAP). In several European Member States, an increase in hydropower generation is needed to achieve these targets. This increase in generation will be achieved by increasing efficiency in hydropower generation at existing sites but also by building new hydropower plants (EEA, 2010b). There are also many plans and studies for new dams, reservoirs and small hydropower projects (Box 7.2).

New hydropower projects may conflict with the WFD objectives of achieving good ecological status or potential. As most of the RBMPs make no reference to Article 4.7 of the WFD, even when large hydropower projects are planned, there seems to be a lack of integration of these policies.

Measures

Measures to alleviate the impacts of hydropower relate both to mitigation of pressures from existing plants and the impacts of any new plants. Some possible mitigation measures include:

- installing fish passes for upstream and downstream migration, including fish protection facilities, in particular for downstream fishways;
- setting minimum ecological flow requirements including mitigation of disruption of flow dynamics, and the attenuation of hydropeaking;
- sediment management to avoid flooding and degradation due to downstream erosion.

Many old hydropower plants do not meet modern environmental standards. For instance, older hydropower plants may not be equipped with fish-passes or provide sufficient residual water. In such cases, measures are required in order to meet environmental objectives. To mitigate the negative impact of migration barriers, many solutions are available (e.g. fish passes and fish ladders, but also fish lifts, fish stocking, and catch and carry programmes).

Box 7.3 Switzerland and certified hydropower plants by greenhydro standard

Switzerland has a long tradition of hydropower generation, which accounts for about 60 % of domestic electricity production. More than 10 years ago, a greenhydro standard was developed to address the trade-off between hydropower use and the protection and ecological enhancement of highly affected river ecosystems. The standard ensures that certified plants operate in an environmentally sound way.

Source: Ruef and Bratich, 2007.

When already established hydropower plants are due to renew their licences or authorisations, or when new ones are granted, the conditions for the water use should comply with — and be adjusted to — the objectives introduced by the RBMPs. To steer this process, national and European instruments (such as tradable certificates, feed-in tariffs, support schemes for renewables or eco-labelling) may be introduced (see Box 7.3). In some cases, existing hydropower licenses run for long periods (60 to 90 years) or do not have a time limit. This barrier may limit the effectiveness of new regulations on upgrading existing facilities. In order to allow for progress, some countries have set up promotion schemes and incentives to support operators or licensees in upgrading existing facilities with the aim of fulfilling environmental objectives (Alpine Convention, 2011).

7.5.2 *Navigation*

European countries depend on maritime and inland waterway transport. Nearly 90 % of the EU's external trade and more than 40 % of its internal trade goes by sea. The more than 1 200 EU ports handle almost 2 billion tonnes of freight each year. Around 40 000 km of inland waterways connect the seas and the inland cities and industrial regions. Some 18 out of 27 Member States have inland waterways.

Navigation activities and/or navigation infrastructure works are typically associated with hydromorphological pressures and pollution, with potentially adverse ecological consequences. Deepening including channel maintenance, dredging, and removal or replacement of material is a major activity. Dredging is of vital importance to many of the EU's ports, harbours and waterways, providing and maintaining adequate water depths and hence safe navigational access. Channelisation and straightening, bank reinforcement and fixation are often needed. Pollution may be related to oil spills and anti-fouling substances like TBT.

Potential impacts associated with these pressures can include the physical removal of habitats or species, changes to physical processes (erosion, accretion and sediment transport) and changes in hydrology. The extensive networks of inland waterways and marine transport including ballast water have allowed species from different biogeographical regions to mix. This has altered communities, affecting the food webs and introducing new constraints to the recovery of native biodiversity (Box 7.4).

WFD and navigation

The environmental objectives set by the WFD/RBMPs and the introduced measures have potential implications for navigation, both for ongoing port activities such as dredging and disposal of sediment, and for new development proposals. For example, measures could require the modification of existing

Box 7.4 Invasive species in large European rivers

The extensive networks of inland waterways in parts of Europe have allowed species from different biogeographical regions to mix. This has altered communities, affecting the food webs and introducing new constraints to the recovery of the native biodiversity.

Invasive species have become a major concern in the Danube. The Joint Danube Survey in 2007 found killer shrimps, *Dikerogammarus villosus*, at 93 % of the sites sampled along the river, Asian clams at 90 % of the sites and carpets of weeds at 69 % of the sites. Killer shrimps can adapt to a wide range of habitats and cause significant ecological disruption such as species reduction. The water hyacinth (*Eichhornia crassipes*) is considered one of the worst aquatic weeds in the world.

Over the past two centuries, the connection of the Rhine with other river catchments through an extensive network of inland waterways has allowed macro-invertebrate species from different biogeographical regions to invade the river. A total of 45 such species have been recorded. Transport by shipping and dispersal by man-made waterways are the most important dispersal vectors.

Source: ICPDR, 2008; Bernauer and Jansen, 2006; Leuven et al., 2009.

structures or introduce constraints on dredging and disposal activities.

Article 4(3) of the WFD states that water bodies designated as HMWBs may be accepted due to use-related navigation, including port facilities. In case a water body is designated as a HMWB, the objective is still to achieve good ecological potential by accepting the use but adjusting it so as to achieve good ecological potential.

According to the Danube Regional Strategy (EC, 2010c), cargo transport on the Danube River should be increased by 20 % by 2020. However, the World Wide Fund for Nature (WWF) is concerned that this would require a deepening and widening of the river, which could destroy valuable biodiversity and associated ecosystem services (WWF, 2010). Such plans for the development of inland navigation should, through Strategic Environmental Assessments (SEAs) (EC, 2012f), look into which waterways could carry more navigation with minimal environmental impacts compared to other transport modes.

The potential impacts on future navigation activities mentioned above, and the objectives and measures introduced by WFD require close cooperation between the navigation sector and water and nature managers. In October 2012 the Commission issued a new guideline on inland navigation and nature protection to assist the sector in applying EU environmental legislation (EC, 2012h). Other good examples of moving towards sustainable navigation and such cooperation are the World Association for Waterborne Transport Infrastructure (PIANC) activities on sustainable waterways. These include the 2003 'Guidelines for Sustainable Inland Waterways and Navigation' (PIANC, 2003) and the International Commission for the Protection of the Danube River's (ICPDR's) 'Sustainable waterway planning manual' for the Danube river basin (ICPDR, 2010b).

Sediment causes many problems for authorities managing waterways and port. In the future, RBMPs together with other authorities should aim at improving the knowledge base on sediment quality and quantity. When authorities have a good view of the major sources of sediment ending up in waterways and ports, preventive measures can be taken in a more targeted and therefore more effective way (Carette, 2011).

7.5.3 Agriculture and hydromorphological pressures

Agricultural activities are in many places affecting the hydromorphological status of European water bodies. Water storage and abstraction for irrigated agriculture have changed the hydrological flow regime of many river basins, particularly in southern Europe. In northern Europe, many lowland agricultural streams were straightened, deepened and widened to facilitate land drainage and to prevent local flooding. Intensification of agriculture included many land reclamation projects affecting flood plains, transitional waters, and coastal waters.

Hydromorphological restoration measures are related to technical actions or activities that aim to restore or improve the impaired morphology and changed hydrology of water bodies. Some of the measures related to agricultural pressures and/or agri-environmental schemes in the RBMPs are listed below. However, as hydromorphological measures often respond to more than one pressure at the same time, there is not always a clear link between the hydromorphological measures and the specific pressures they address.

Measures are divided into the following groups.

- 'Re-naturation of aquatic habitats' include the reinstatement of some degree of meandering, opening covered (culverted) streams and remediation schemes for channelised sections; habitat remediation, i.e. improving physical habitats of rivers and lakes; removal of migration barriers, like removing obstacles to fish migration or introduce fish passes; and re-establishing drained wetlands.

- Natural water retention measures (NWRMs) (see Chapter 6) aim to restore natural water storage capacities by increasing soil and landscape water retention and groundwater recharge. The water flow regime can be changed to a more natural flow regime. NWRMs can be implemented in agriculture by stopping drainage; restoring and maintaining meadows and pastures; soil conservation crop practices; reducing or eliminating tillage; green cover; early sowing; and traditional terracing.

- Maintenance, sediment and land use strategies. Soil erosion of cultivated land is in some regions a widespread problem, and together with hard maintenance of channel morphology (dredging and weed cutting) can increase sediment transport. Therefore strategies that reduce sediment load are important. Measures to address such impacts involve maintaining soil organic matter levels, changing crop patterns, enhanced use of buffer strips, improved irrigation practices, wetland restoration, restoration of riparian areas, etc.

- Re-establishing wetlands, reconnecting rivers to former floodplains, and stopping the drainage and pumping of reclaimed land are also important measures to restore ecological status.

Precise information on how the hydromorphological pressures from agriculture will be addressed and to what extent the selected measures will contribute to the achievement of the environmental objectives is limited in the RBMPs (EC, 2012a).

7.5.4 Towards sustainable flood risk management

For centuries, 'hard' infrastructure including bank enforcements and dykes, water storage reservoirs, and drainage through straightening rivers and pumping canals, has been used for flood defences. Aside from their use for flood safety, hard flood defence infrastructures often have negative effects on ecological status. More information on flood risks and their sustainable management is included into the EEA report on vulnerability (EEA, 2012d).

The WFD requires Member States to take measures for flood management and land-drainage schemes to ensure compatibility with the WFD objectives. In many cases, the WFD will require the restoration of river and coastal hydromorphology adversely impacted by flood management and land drainage schemes, unless these impacts can be justified through derogation.

Sustainable flood risk management is a shift away from our predominantly 'hard-engineering' flood defences to a river basin approach. This river basin approach uses natural processes and natural systems to slow and store water in addition to measures such as flood warning, spatial planning and emergency response. Natural floodplains are allowed to flood, and wetlands are allowed to act as giant sponges to soak up excess water, which they can then release slowly back into the river, providing additional benefits in retaining nutrients from diffuse pollution sources. In general, measures for managing flood risk and mitigating hydromorphological pressures that work with nature rather than against it should be promoted, such as making more room for rivers. Also, natural water retention measures as investigated and described by the Commission are very important, not only in the context of water resource management, but also for flood prevention and the development of wetlands (Chapter 6) (Stella Consultants, 2012).

For many European rivers, restoring former floodplains and wetlands and increasing retention measures would reduce flood risk, reduce pollution, and improve the ecological and quantitative status of freshwater, as well as lower the risk for water scarcity. Opportunities to enhance the natural environment and improve its capacity to perform ecosystem services should be identified.

In many Member States, activities in relation to the WFD and flood risk planning have been an impetus for changing the way we manage flooding to enhance the environment and protect people.

There are many national activities in Europe aimed at more sustainable flood management and restoring rivers. Examples include the Dutch 'Room for the river' (Ruimtevoorderivier, 2010), the British programme 'Making space for water' (DEFRA, 2008), the Swiss 'Guiding principles for sustainable water management' (FOEN, 2010 and EEA, 2010a), the Austrian Stream Care Scheme (Lebensministerium, 2010) and the Spanish National River Restoration Strategy (MARM, 2012).

7.5.5 Restoration of rivers in urban areas

Urban rivers have become increasingly important in the planning of urban ecology, green infrastructure and green areas in European cities in recent years. Today, river restoration, in connection with other projects for city development and urban planning, are offering win–win situations: improving flood control and ecological functions (meeting WFD objectives), while offering recreational value and raising the quality of life in urban areas.

Box 7.5 Urban development and river regulation

The River Liesing is Vienna's third largest river after the Danube and Wienfluss. Its catchment basin is 115 km²; the whole river length is 30 km, with 52 km² of the catchment area and 18 km of the river's length in Vienna. The Liesing is famous for its fast rising, heavy floods. Heavy flood events in the past led to a regulation system involving lowering and widening of the riverbed. Meanders were cut off and refilled, and high weirs interrupted the flow. Loss of wildlife, disturbance of the ecosystem and bad water quality in the new channel were not concerns at that time.

A pilot project was funded by LIFE-Environment with the objective of achieving 'maximum ecological potential' for the Liesing River. For a length of 5.5 km, a concrete channel located in an urban area was redesigned into a semi-natural type-specific river, which also meets the relevant flood protection requirements.

Heavy flood events in 1954 © Wiener Gewässer

After the flood in 1954 the Liesing was pressed into a u-shaped concrete bed © Wiener Gewässer

Revitalisation activities include construction measures to restore river continuity by removing barriers; restoration of semi-natural morphological conditions by integrating bays and shallow water zones; restoration of former meanders; construction of a semi-natural riverbed with a gravel substrate; and the restoration of the river's natural transport capacity.

Source: Based on Goldschmid and Schmid, 2006.

7.6 Further considerations for the next phase of RBM planning

As outlined above, there are ample possibilities for improving water management so as to achieve the objectives of the WFD, through stringent and well-integrated implementation. However, the next cycle of RBM planning needs to also take into account a wider consideration of water resource management and aspects of climate change.

7.6.1 Climate change and the WFD

Preparing for climate change is a major challenge for water management in Europe. In the years to come, climate change will increase water temperature and the likelihood of flooding and droughts. In the report 'Climate change, impacts and vulnerability in Europe 2012 — An indicator-based report' (EEA, 2012f), the EEA presents a more detailed assessment of the different water-related impacts of climate change, the results of which are summarised below. In addition, the EEA is working on a report on adaptation actions for coping with the impacts of climate chance (EEA, 2013a).

Climate change is not explicitly included in the text of the WFD. However, water management under the WFD will have to deal with the challenges posed by climate change (EEA, 2007). The challenges can be broadly classified into three categories: an increase in the risk of floods along rivers and coastal zones, a decrease in the availability of water, and a deterioration of water quality and ecological status.

Climate change has and will impose additional pressures on water ecosystems by accelerating the rise in sea levels and increasing water temperatures, storms, erosion and flooding (EEA, 2012f; IPCC, 2007, 2008).

Climate change is projected to lead to significant changes in yearly and seasonal water availability across Europe (EEA, 2012d and 2012f). Water availability will generally increase in northern regions, although summer flows may decrease. Southern and south-eastern regions, which already suffer most from water stress, will be particularly exposed to reductions in water availability and see an increase in the frequency and intensity of droughts. Seasonal changes in river flows are also projected. Earlier snowmelt and a general decrease in summer precipitation may result from the declining snow reservoir, and longer periods of reduced river flow may be observed in late summer and early autumn in many parts of Europe. In areas where river flow and groundwater recharge will decrease, water quality may also decrease due to reduced dilution of pollutants.

Water quantity and water quality are closely interrelated. Climate change can result in significant changes in the variables that affect the quality of water. These include:

- physical changes such as water temperature, river and lake ice-cover, stratification of water masses in lakes, and water discharge;
- chemical changes, in particular oxygen content, nutrient loading and water colour;
- biological changes and species composition, affecting the structure and functioning of freshwater ecosystems;
- ecological changes due to altered flow regimes following changes in discharge volumes.

There are many indications that water bodies already under stress from human activities are highly susceptible to climate change impacts, and that climate change may hinder attempts to prevent deterioration and/or restore some water bodies to good status. Here the establishment of good ecological and healthy ecosystem conditions are extremely important. As outlined earlier, good ecological status is also an indicator of increased resilience of the ecosystem, i.e. its capability to absorb additional adverse effects (see more on ecosystem resilience and vulnerability in EEA (2012d).

The step-by-step and cyclical approach of the WFD RBMP process makes it well suited to adaptively manage climate change impacts. In particular, the review of RBMPs every six years establishes a mechanism to prepare for and adapt to climate change. Planning for droughts and floods will also be an integral part of this system. The WFD CIS Guidance document *River basin management in a changing climate* (EC, 2009d) describes guiding principles for adaptation, and relates each to steps in the RBMP. The guidance is conveyed in five blocks that explain:

- how to handle available scientific knowledge and uncertainties about climate change;
- how to develop strategies that build adaptive capacity for managing climate risks;
- how to integrate adaptive management within the key steps of the RBMP and how to address the specific challenges of managing future climate impacts;
- flood risk;
- water scarcity.

This guidance is a good basis for taking up the aspects of the impact of climate change on water management in the following RBMP cycles.

7.6.2 More focus on water resource management

Considerations of water resource management are directly related to the aspects of climate change, adaptation and vulnerability. The WFD relates to the quantitative aspects explicitly through the good quantitative status of groundwater. Related information is also reviewed by the EEA/ETC-ICM and published in a parallel report focusing on water quantitative aspects of water scarcity, droughts and floods, in the context of ecosystem vulnerability (EEA, 2012d).

Water quantity and water quality are closely linked, and good ecological status also depends on the quantitative water resource aspects as on its quality. Water resource management needs to be an integrated part of the RBMP. In more arid river basins, e.g. in the Mediterranean, drought management plans are already partly integrated into RBM planning. However, the recent assessment of both the water scarcity and drought policy and the climate change adaptation and vulnerability policy show that there are considerable improvements needed in future water resource management in Europe. In 2012, the EEA dedicated a whole report to these aspects, with additional results assessing the water exploitation in Europe (EEA, 2012d). The 'Blueprint to safeguard Europe's waters' puts particular emphasis on the better implementation of existing policies in order to improve this aspect of water management. In particular, it emphasises, the stringent implementation of the WFD with regard to resource aspects, and the harmonised establishment of ecological flows, and drought management plans.

One of the challenges for the next round of RBM planning is certainly the full integration of water resource aspects as put forward in the Blueprint. This will need to be implemented together with the enforcement of water resource management aspects and water savings in sectoral policies like agriculture and the energy sector, that further support the achievement of the good status under the WFD.

7.6.3 The need for sectoral integration and strengthening of the participatory approach

From the assessment of ecological and chemical status, and in particular from the assessment of pressures and impacts, it is evident that the driving forces behind achievement or non-achievement of good status are activities in sectoral areas like agriculture, energy or transport.

The objective of good status of water ecosystems is an ecosystem-oriented target, which can only be achieved and maintained when the sum of the environmental impacts of all combined relevant sectoral activities are low enough to respect the limits of sustainability.

As a logical consequence, the reduction of pressures in any of the relevant sectoral areas should be discussed in dialogue with all stakeholders having an impact in a particular river basin, as it may transpire that the most cost-effective and efficient set of measures involves a 'trade-off' between sectors.

Also, the case analysis provided above in Sections 7.3 to 7.5 suggests that nearly all measures related to both reducing diffuse pollution and hydromorphological pressures need to be implemented in the areas of urban water services, agriculture, energy or navigation.

The WFD with public participation as set out under Article 14 provides an important tool to set up a strong stakeholder dialogue that can organise implementation of the sectoral policies. The late consultation and participation processes in the first round of RBMPs up to 2009, which partly are still ongoing, clearly show that there are lessons to be learned in implementing this dialogue for future planning. Looking into feedback from Member States on their planning processes (EC, 2012a), it is clear that one of the successes in the implementation of the WFD lies in the mere fact that the dialogue between relevant stakeholders and sectoral actors was moved on a new level of intensity.

However, further development of the stakeholder dialogue is vitally needed to develop and implement not only the current plans of measures to deliver good status in 2015, but also the second round of plans up to 2021.

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