European Environment Agency

European Topic Centre
Inland, coastal, marine waters

EEA Water 2012 Report

Thematic assessment on Ecological and chemical status and pressures

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Contents

Abbreviations <to be completed>
AWB – Artificial water body
EEA – European Environmental Agency
ETC / ICM – European Topic Centre on Inland Coastal and Marine Waters
EU – European Union
GEP – Good ecological potential
GES – Good ecological status
HMWB – Heavily modified water body
MS – Member States
PoM - Programme of Measures
RBD - River Basin District
RBMP - River Basin Management Plan
WBs - water bodies
WFD – Water Framework Directive
WFD-CIS – Water Framework Directives Common Implementation Strategy

0. Guidance to the reader

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 Water Framework Directive (WFD) and other water policies. Many European water bodies are at risk of failing to meet the aim of the WFD of achieving good status by 2015, due to problems in the management of water quality, water quantity, modifications of the structure of river banks and beds and the connectivity of rivers. Full implementation of the WFD throughout all sectors is needed to resolve these potential conflicts and to commit all users in a river basin to focus on the achievement of healthy water bodies with good ecological status.

0.1. EEA 2012 State of water assessments

2012 will be the European year of water in which The Commission will publish its “Blue-print to safeguard European waters” comprising reviews of the WFD, Water scarcity and drought and vulnerability and adaptation policies; In addition in March 2012 the 5th World Water Forum will be held in Marseille, France.

To accompany and inform these events and policy processes EEA plans for 2012 a set of reports on the “State of Europe’s water”. The reports will be based on information reported in 2010 via River Basin Management Plans and supplemented with assessments of information from other sources. It will be developed in close cooperation and coordination with the DG Environment’s assessment of the RBMPs and the development of the blueprint (impact assessment, reports; communication, staff working documents). The format of the EEA 2012 State of Europe’s water assessment is planned to consist of four thematic assessments and an overarching synthesis and integrated report. In terms of communication, the several assessments are planned to be published on several occasions throughout 2012. EEA are currently working on the following thematic assessments with indication of when they are to be published:

1. Efficient Use of Water Resources (World Water Forum, Marseilles, March 2012)
2. Vulnerability (Water scarcity and drought, floods, water quality) – Autumn 2012
3. WFD: Ecological and chemical status and pressures – Autumn 2012
4. WFD: Hydromorphology – Summer 2012

First reporting of the River Basin Management Plans (RBMPs) under the Water Framework Directive (WFD) was due end 2009. Most Member States (23 out of 27 Member States) have reported their RBMPs and delivered a huge amount of data on status, pressures and measures to the WISE-WFD database. According to Article 18 of the WFD 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;*

The current draft report on ecological and chemical status, pressures and impacts aims at providing an overview of the results on status and pressures from the River Basin Management Plans (RBMPs).

- Chapters 1 present general information on the WFD and the geographical settings including an overview of European river basin and sea regions.
- Chapter 2 present the current status of reported information and data by Member States in relation to RBMPs and a summary on information on River Basin Districts (RBDs) and water bodies (WBs).

- Chapter 3 provides an overview of the methodology used for data handling and describes different assumptions made.
- Chapters 4 to7 present results, information and assessment on status, pressures and impacts of European waters. The results are a compilation of results based on the data reported by Member States with their RBMPs and stored in the WISE-WFD database. All chapters present results for the four water categories: rivers, lakes, transitional and coastal waters. Chapter 6 on chemical status also presents information on groundwater bodies.
  - Chapter 4 provide an overview of the ecological status, significant pressures and impacts the four surface water categories by Member States). The chapter aims at comparing the ecological status in Member States and relate the observed ecological status to percentage of water bodies affected by significant pressures and impacts.
  - Chapter 5 presents overall European results on ecological status, pressures and impact and the status of River Basin Districts (RBDs) are presented in form of European maps. The chapter compares the status and pressures for different surface water categories. This chapter will be further developed when there are a better data set on common typologies is available (expected in the spring 2012).
  - Chapter 6 provide an overview of the chemical status of surface and groundwater bodies in Europe.
  - Chapter 7 presents information on ecological status and water quality. The chapter first present trend in pollution and water quality over the last 20 years and describe the status of implementing the Urban Waste Water Treatment and Nitrate Directive. Results on linking the on status, pressures and impacts to water quality (data reported to EEA by countries via WISE-SOE);

It is the intention to add some chapters on environmental objectives (status in 2015) and on measures. These chapters will be developed on basis of the analysis done by EU Commission DG ENV.

We hope that Member States and relevant stakeholders will contribute with case studies, text boxes expressing their views on the aspects raised in the respective chapters..

Comments and suggestions to the current draft are very much appreciated. Thanks in advance.

Disclaimer
The current draft is based on data delivered by the Member States via WISE up to February 2012 and in some cases information available in digital version of RBMPs. Where MS did not deliver data or the RBMPs are not yet available, information from the specific MS or RBDs are not presented.

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. *Comments and remarks on results are very much appreciated*.

The current draft is partly based on 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 in most cases been listed (to be improved in next draft).

1. Introduction to Water Framework Directive

1.1. The Water Framework Directive

The Water Framework Directive (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 European Union (EU). The WFD established new and better ways of protecting and improving our water environment with the overall objective of achieving co-ordinated and integrated water management across Europe.

The WFD calls for the creation of River Basin Districts. 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 then achievement of good status may be extended to 2021 or by 2027 at the latest. Good status means that certain standards have been met for the ecology, chemistry, morphology and quantity of waters. In general terms ‘good status’ means that water only shows slight change from what would normally be expected under undisturbed conditions. There is also a general ‘no deterioration’ provision to prevent deterioration in status.

Text box 1.1: Water Framework Directive - the backbone of EU Water Policy

- Introducing the river basin approach
- Protecting all water bodies, including transitional waters and coastal waters
- Covering all impacts on waters
- Achievement of good status in all water bodies and no deterioration of status

The Water Framework Directive establishes a legal framework to protect and restore clean water in sufficient quantity across Europe. It introduces a number of generally agreed principle and concepts into a binding regulatory instrument. In particular, it provides for:

- Sustainable approach to manage an essential resource: It not only considers water as a valuable ecosystem, it also recognises the economy and human health depending on it.
- Holistic ecosystem protection: It ensures that the fresh and coastal water environment is to be protected in its entirety, meaning all rivers, lakes, transitional (estuaries), coastal and ground waters are covered.
- Ambitious objectives, flexible means: The achievement of “good status” by 2015 will ensure satisfying human needs, ecosystem functioning and biodiversity protection. These objectives are concrete, comparable and ambitious. At the same time, the Directive provides flexibility in achieving them in the most cost effective way and introduces a possibility for priority setting in the planning.
- Integration of planning: The planning process for the establishment of river basin management plans needs to be coordinated to ultimately achieve the WFD objectives.

- The right geographical scale: The natural area for water management is the river basin (catchment area). Since it cuts across administrative boundaries, water management requires close cooperation between all administrations and institutions involved. This is particularly challenging for transboundary and international rivers.
- Polluter pays principle: The introduction of water pricing policies with the element of cost recovery and the cost-effectiveness provisions are milestones in application of economic instruments for the benefit of the environment.
- Participatory processes: WFD ensures the active participation of all businesses, farmers and other stakeholders, environment NGOs and local communities in river basin management activities.
- Better regulation and streamlining: The WFD and its related directives (Groundwater Daughter Directive (2006/118/EC); Floods Directive COM(2006)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 Directive is to be achieved through the river basin management (RBM) planning process which requires the preparation, implementation and review of a river basin management plan (RBMP) every six years for each river basin district (RBD) identified. This requires 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:

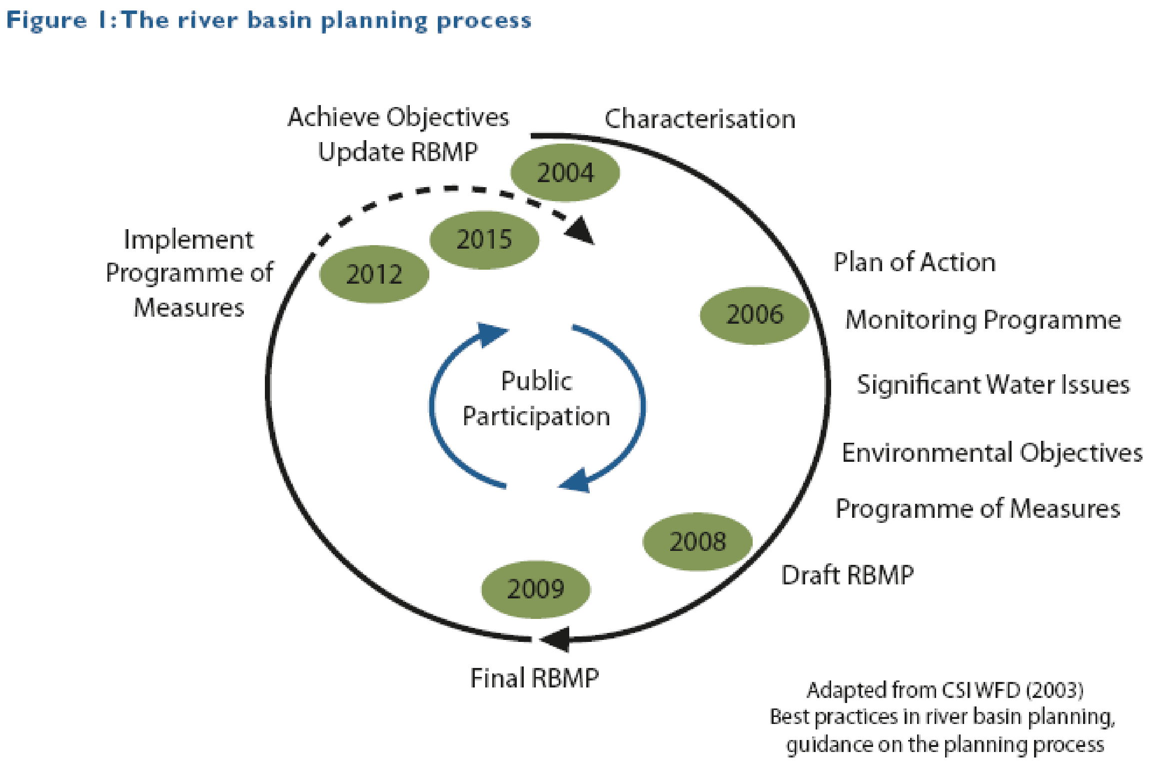
- Governance and public participation;
- Characterisation of the river basin district and the pressures and impacts on the water environment;
- Environmental monitoring based on river basin characterisation;
- Setting of environmental objectives; and
- Design and implementation of a programme of measures to achieve environmental objectives.

1.1.1. **River basin planning process**

River Basin Management Plans are plans for protecting and improving the water environment and have been developed in consultation with organisations and individuals. River basin planning is a strategic decision-making process that integrates the management of land and water within river basin districts. The river basin management planning process aims to improve and support sound and sustainable water management to deliver the requirements of the WFD while balancing the environmental, social and economic needs within the river basin district.

- The river basin planning process started more than ten years ago with implementation of the WFD in national legislation and establishing the administrative structures.
- The river basin planning process resulted in 2004 with an analysis of the pressures and impacts affecting the water environment in the river basin district. The findings were published in March 2005 in the characterisation report required by Article 5 of the WFD.
- River basin planning is a gradual cyclical process that involves public participation throughout. Characterisation is followed by a series of steps shown in Figure 2.1.

Figure 2.1 The WFD river basin planning process



Source: Adapted by CIS WFD (2003)

Monitoring and classification: In 2006 monitoring programs within the RBDs had to be established. The WFD monitoring network will enable us to identify problems and resolve them, thereby improving the water environment. It is a core concept of the WFD that the condition of biological communities is used to assess the ecological quality of surface waters, therefore the monitoring programs established is focused on monitoring specific biological element.

The ecological classification system covers all surface water bodies, and is based on a new ecological classification system with five quality classes. It has been devised following EU guidance and is underpinned by a range of biological quality elements, supported by measurements of chemistry, hydrology (changes to levels and flows) and morphology (changes to the shape and function of water bodies). Some of the quality elements used in the ecological classification system have only seldom been monitored in Member States before.

To define good chemical status, environmental quality standards have been established for 33 new and eight previously regulated chemical pollutants of high concern across the EU. The WFD is backed up by other EU legislation such as the REACH regulation on chemicals and the Directive for Integrated Pollution and Prevention Control (IPPC) for industrial installations.

The rules for groundwater are slightly different and good chemical and quantitative status is the objective. Member States must use geological data to identify distinct volumes of water in underground aquifers, and limits abstraction to a portion of the annual recharge. Groundwater should not be polluted at all – any pollution must be detected and stopped.

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.

Status and objective setting
Article 4.1 defines the WFD general objective to be achieved in all surface and groundwater bodies, i.e. good status by 2015, and introduces the principle of preventing any further deterioration of status. If a water body does not currently achieve "good status" measures should be established to reach good status by 2015. It may be possible to have exemptions to the general objectives that allow for less stringent objectives, extension of deadline beyond 2015.

The River Basin Management Plans (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 (PoM) 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.

1.2. Geographical settings

Several million kilometres of flowing waters and more than a million lakes cover the European continent. Each body of water has its own characteristics. Coastal waters represent the interface between land and ocean, and in the context of the Water Framework Directive coastal waters include water, that has not been designated as transitional water, extending one nautical mile from a baseline defined by the land points where territorial waters are measured. The European Union has a coastline of 68 000 km and several hundreds of transitional waters in the form of fjords, estuaries, lagoons, and deltas. The seas around Europe are extensively used and provide environmental services like fish, shipping and port development, tourism, oil and gas production, wind, and wave and tidal energy.

1.2.1. **Overview of River Basin Districts**

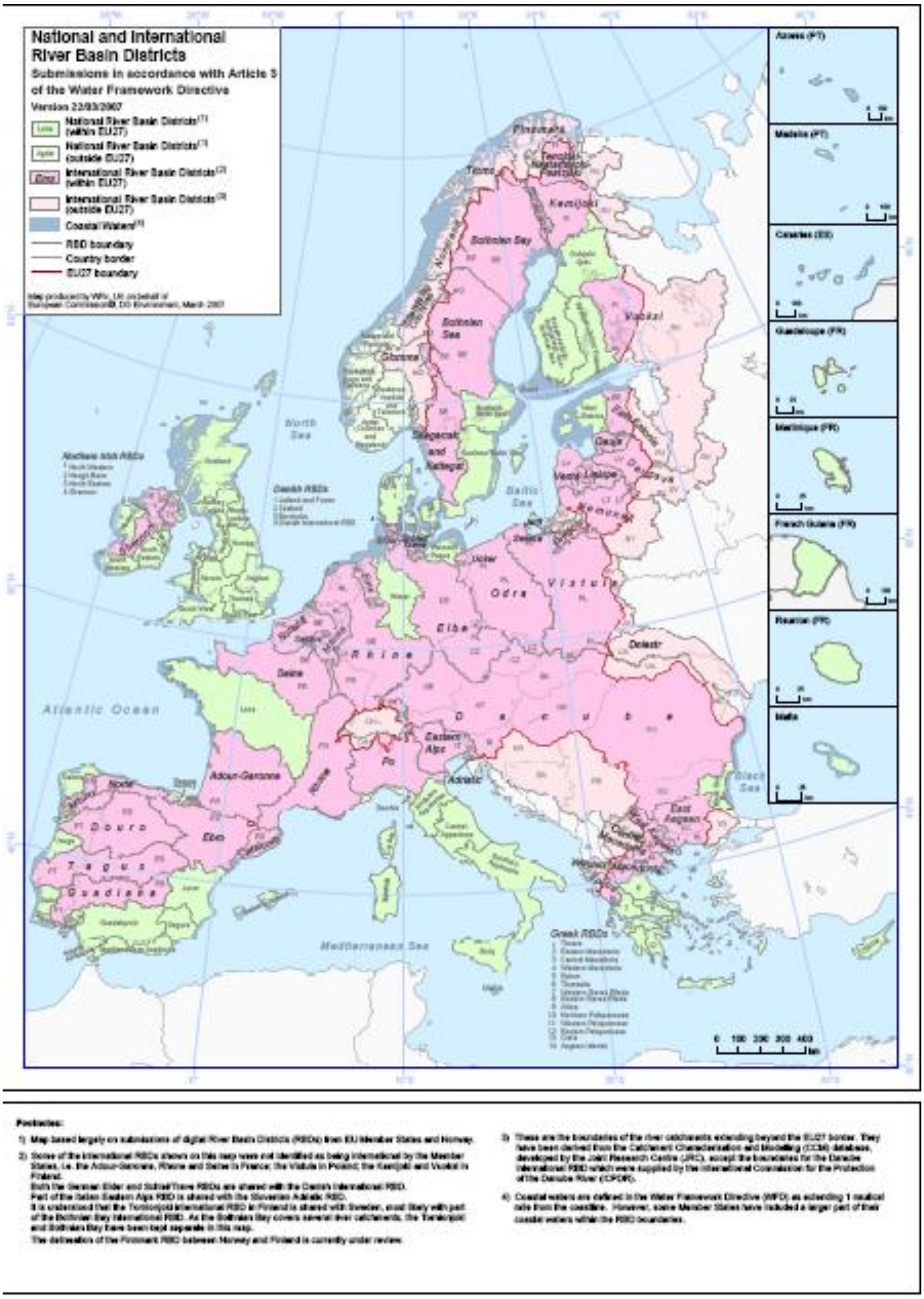
The implementation of the WFD has resulted in the establishment of 110 river basin districts (RBDs) across the EU (Map 1.1). Since 40 river basin districts are international, there are a total of more than 170 national or national parts of international river basin districts. The international river basin districts cover more than 60 % of the territory of the EU making the international coordination aspects one of the most significant and important issue and challenge for the WFD implementation.

Only rivers arising deep inside the continent are relatively large. Many central European countries are drained by only a few river catchments (Map 1.2). For example, the Vistula (Wisla) and Oder drain more than 95 % of Poland and the Danube drains most of Austria, Hungary, Romania, Serbia, Slovak Republic and Slovenia. France, Germany and Spain are drained by relative few large rivers and these countries have several large RBDs.

Countries with long coastlines, for example, the United Kingdom, Ireland, Norway, Sweden, Denmark, Italy and Greece, are usually characterised as having large numbers of relatively small river catchments and short rivers; the three to four largest of which drain only 15 % to 35 % of their area. In these countries a number of river catchments have been merged to form river basin districts.

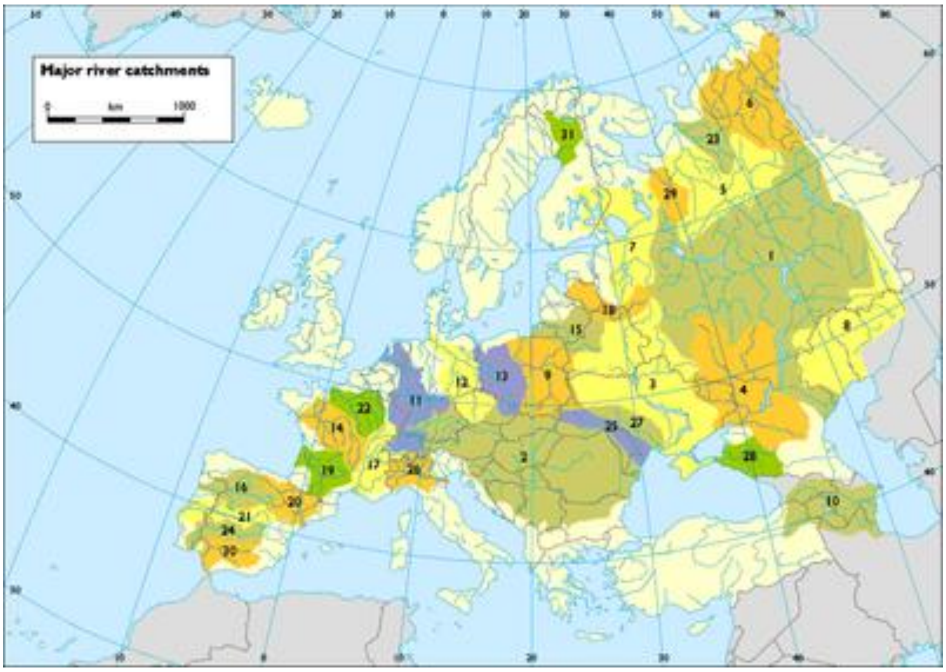
International river basins: Within the European Union there are many river basins which are shared between Member States. An important feature of the WFD is a planning mechanism, referred to as international river basin plans, by which Member States should co-operate to ensure that environmental objectives targets are met.

Map 1.1 Map of national and international river basin districts



Note: Map to be updated
Source: DG Environment http://ec.europa.eu/environment/water/water-framework/facts_figures/pdf/2007_03_22_rbd_a3.pdf

Map 1.2 Major European river basins



1: Volga
2: Danube River
7: Neva
9: Vistula
11: Rhine
12: Elbe
13: Oder
14: Loire
15: Nemunas
16: Douro
17: Rhône
19: Garonne
20: Ebro
21: Tajo
22: Seine
24: Guadiana
26: Po River
30: Guadalquivir
31: Torne River

Source: EEA 2005.

Map to be updated with legend and the correct administrative boundaries.

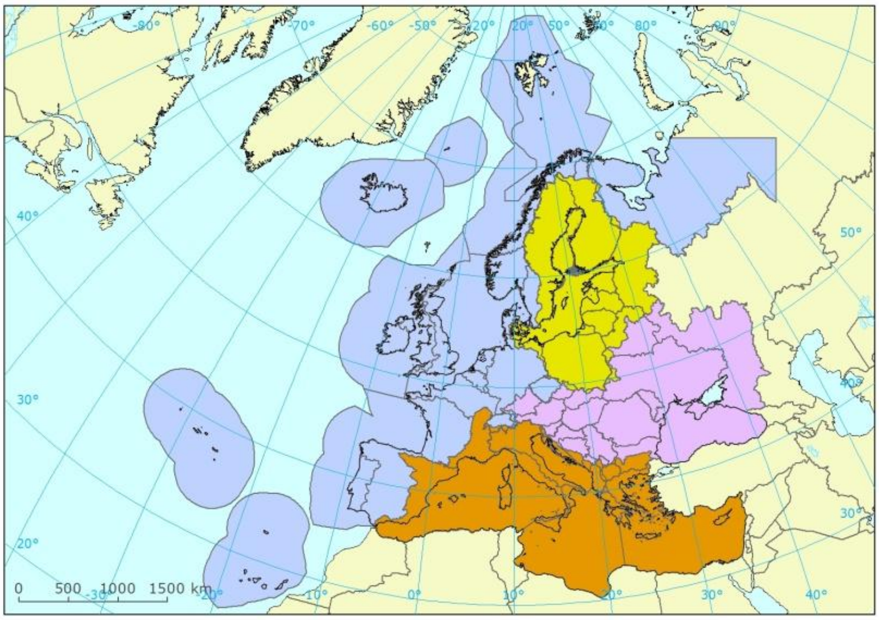
1.2.2. The European seas and coasts

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, and the Celtic Sea, Bay of Biscay and Iberian Coast (Map 1.3; EEA 2010; SOER2010 Marine and coastal).

- The Baltic Sea is semi enclosed with low salinity due to restricted water exchange with the North East Atlantic and large river run-off. These conditions make the sea particularly vulnerable to nutrient pollution.
- The Black Sea is also semi enclosed; it is the world's largest inland basin with restricted water exchange with the Mediterranean. Its waters are anoxic at depths below 150–200 meters. Surface water salinities of the Black Sea are within an intermediate range. Most of the Black Sea is believed to host oil and gas reserves, and oil and gas exploration is beginning in the area.
- The Mediterranean Sea is also a semi enclosed sea with high salinity due to high evaporation rates and low river run-off. It has restricted water exchange with the Atlantic and Black Sea. It is the most biologically diverse sea in Europe.
- The North East Atlantic covers a range of seas and a large climatic gradient. It is a highly productive area that hosts the most valuable fishing areas of Europe and many unique habitats and ecosystems. It is also home to Europe's largest oil and gas reserves.

In the current report the North-east Atlantic has been split into two regions The Greater North Sea and the Celtic Seas to the Iberian Coast.

Map 1.3 European Regional Seas and their catchments (draft).



North-East Atlantic Ocean split into

- The Greater North Sea and
- the Celtic Seas to the Iberian Coast.

Note that some parts of the catchments outside of the EU are missing.
Map to be updated with the five used sea regions.

References

EEA 2010; SOER2010 Marine and coastal. Available at http://www.eea.europa.eu/soer/europe/marine-and-coastal-environment

WFD and other EU Water Directives See http://ec.europa.eu/environment/water/index_en.htm

2. Data overview

2.1. River Basin Management Plans (RBMPs)

According to the WFD River Basin Management Plans should since 22.12.2009 be available in all River Basin Districts across the EU. There are however serious delays in some parts of the EU, and in some countries consultations are still on-going.

Ultimo 2011 23 EU Member States have had their RBMPs adopted. Four countries Portugal, Spain, Greece and the Walloon and Brussels part of Belgium had not yet finalised the consultation of the RBMPs and therefore no adopted RBMPs.

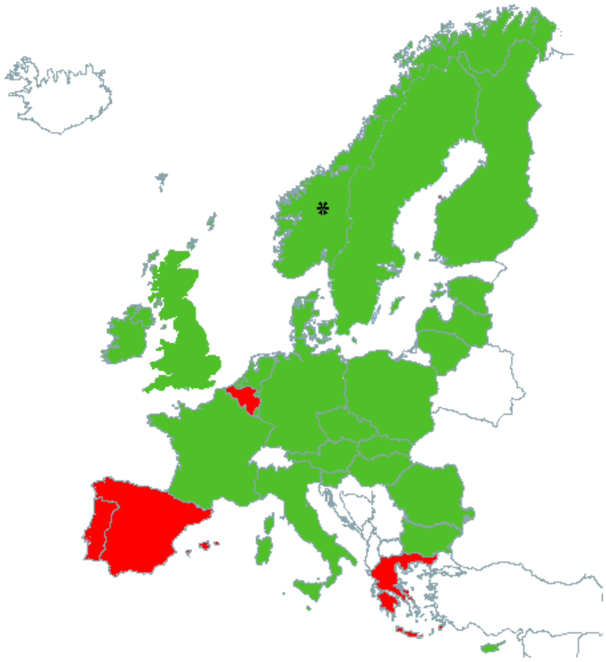


Figure 2.1: Overview of the status of reporting of RBMPs

Source: DG Environment (Status 22/12/2011).
http://ec.europa.eu/environment/water/participation/map_mc/map.htm
GREEN - River Basin Management Plans adopted.
YELLOW - consultations finalised, but awaiting adoption.
RED - consultation have not started or on-going.
* Norway is implementing the Water Framework Directive as part of the European Economic Area Agreement, with specific timetable agreed.

2.2. WISE-WFD data reporting and database

Member States have in addition to the digital version of the River Basin Management Plans (RBMPs) 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. The WFD-CIS Guidance Document No. 21 "Guidance for reporting under the Water Framework Directive" provides the specification of the data that have to be reported by MS in relation RBMPs.

2.2.1. Status of WISE-WFD database

Most of the Member States with adopted RBMPs have reported data from the RBMPs to the WISE-WFD database. However, Denmark and Slovenia that have adopted RBMPs have yet not reported data WISE-WFD database. Spain and Greece have reported data from their RBMPs to the WISE-WFD database., but not yet adopted RBMPs *All data reported to the WISE-WFD database by primo February have been included into the analysis presented on ecological and chemical status and pressures.*

The data reported by Member States have had a first quality assurance and quality control (QA/QC) and have then been transferred into WISE-WFD database. EEA has been using the WISE-WFD database version February 2012. This database contained information from 24 Member States and it is covering more than 100 000 surface water bodies and 12 600 groundwater bodies.

2.2.2. Reported RBDs

Ultimo 2011 data from 144 river basin districts (RBDs) have been reported by Member States and incorporated into the WFD-WISE database (Table 2.1). There are still missing reporting from some countries and RBDs. The smaller and medium size Member States generally have 1-5 RBDs, while

Spain, the United Kingdom, France, Greece, Sweden, Finland, Germany, Poland and Portugal have 8 to 15 RBDs.

Table 2.1 Overview of reported RBDs per Member State and missing Member States

Member States	**RBDs**	**Member States**	**RBDs**		***Missing countries and RBDs***	**RBDs**
Austria	3	Italy	8		Belgium (Wallonia & Brussels)	(6)
Belgium Flanders	2	Latvia	4			
Bulgaria	4	Lithuania	4		Denmark	(4)
Cyprus	1	Luxembourg	2		Portugal	(8)
Czech Rep.	3	Malta	1		Slovenia	(2)
Estonia	3	Netherlands	4		Spain – Segura RBD	(1)
Finland	8	Poland	9		Norway	(9)
France	13	Romania	1		**Missing RBDs**	**30**
Germany	10	Slovak Rep.	2			
Greece	14	Spain	15			
Hungary	1	Sweden	10			
Ireland	7	United Kingdom	15			
Total reported RBDS			**144**			

Note: Spain and Greece have reported data but do not yet have provided RBMPs. Denmark and Slovenia have provided RBMPs, but not yet reported data.
Source: Extract from WISE-WFD (version February 2012).

Size of RBDs
The size of the RBDs varies considerably from very small ones below 1,000 km^2 to the largest one, the Danube with over 800 000 km^2 (Table 2.2). Obviously, the international RBDs are generally larger. The average size of current reported (national) RBDs is about 30 000 km^2. There are 42 and 29 RBDs with an area greater than 15 000 and 50 000 km^2, respective. These two size categories cover 25 % and 65 % of the reported area. More than half of the population are found in the RBDs larger than 50 000 km^2.

Table 2.2 Reported RBD divided by size of the RBD.

Size of RBD (km2)	Number of RBDs	Sum of area (1000 km^2)	Sum of population (million)
< 5000	31	56	11,3
5-15000	38	383	36,0
15-50000	42	1043	120,9
> 50000	29	2750	205,1
Total	**140**	**4232**	**373,3**
RBDs that are missing area information on area	4		

Source: Extract from WISE-WFD database

There are 14 international RBDs with an area of the RBDs greater than 40 000 km^2 (Table 2.3). The international Danube RBD is by far the largest RBD and consists of eight national RBDs. The Rhine and Elbe internal RBDs consist of six and four national RBDs. Most of the other international RBDs are composed of two national RBDs.

Table 2.3 International River Basin Districts greater than 40 000 km^2

International River Basin District	IRBD Area	RBDs	Country (Area in km^2 of national RBD)
Danube	585675	8	RO (239100); HU (93011); AT (80565); DE (56295); BG (47235); SK (47084); CZ (22000); PL (385)
Elbe	199427	4	DE (148268); CZ (50000); AT (921); PL (238)
Vistula	185126	2	PL (183176); SK (1950)
Rhine	159617	6	DE (102100); NL (28500); FR (23359); LU (2526); AT (2365); BE (767)
Oder	134615	3	PL (118015); DE (9600); CZ (7000)
Douro	98075	2	ES (78856); PT (19219)
Seine	96607	2	FR (96527); BE (80)
Tajo	81310	2	ES (55645); PT (25665)
Guadiana	67139	2	ES (55528); PT (11611)
Nemunas	50959	2	LT (48444); PL (2515)
East Aegean/Thrace	47040	2	BG (35237); GR (11803)
Torne river	40168	3	SE (25400); FI (14587); NO (181)

There are 26 national RBDs (plus 18 being part of international RBDs) greater than 40 000 km^2, with six of them being larger than 100 000 km^2 (Table 2.4). Some of the large districts consist mainly of one large river (e.g. the Loire, Rhône, and Ebro river basin), while other districts are composed of several river system such as the Swedish Bothnian Bay and Bothnian Sea RBDs or the Scottish RBD.

Table 2.4 National River Basin Districts greater than 40 000 km^2

Country	River Basin District	Area		Country	River Basin District	Area
FRG	Loire Bretagne	169204		FIVHA4	Oulujoki-Iijoki	68084
SE1	Bothnian Bay	147000		NO1105	Finnmark	64382
SE2	Bothnian Sea	140000		FIVHA1	Vuoksi	58158
FRD	Rhône Mediterranée	123491		ES050	Guadalquivir	57228
FRF	Adour Garonne	118897		FIVHA2	Kymijoki-Gulf of Finland	57074
UK01	Scotland	113920		FIVHA5	Kemijoki	54850
ES091	Ebro	85570		SE4	South Baltic Sea	54000
FRK	Guyane	83846		DE4000	Weser	49000
FIVHA3	Kokemäenjoki	83357		NO5101	Glomma	47683
ITB	Padan (Po river)	74000		NO1102	Troendelag	47229
SE5	Skagerrak and Kattegat	69500		EE1	West-Estonian	45375
NO1103	Nordland	68291		ES080	Jucar	42851
ITF	South Appennines	68200		ITA	Eastern Alps	40851

2.3. EEA WISE-SoE data collection

EEA base its water quality data on a representative sub-sample of national monitoring results, which EEA member countries report voluntarily each year to the EEA. EEA has mainly collected annual values (e.g. average, median, minimum and maximum) but in some cases EEA also have collected seasonal (summer and winter) values. 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). With this it remains one of the EIONET Priority Data Flows, but gains full integration into the reporting under WISE and complementarily with data collected under the WFD.

Data are transferred on an annual basis from the countries to the EEA and stored in Waterbase. At the end of 2011, Waterbase contained water quality information on

- more than 10 000 river stations in 37 countries,
- more than 3500 lake stations in 35 countries,
- more than xx coastal stations, and
- quality data from around 1500 groundwater bodies.

Some of the water quality data are from countries not reporting on the WFD. The different Waterbase are available through the following Website http://www.eea.europa.eu//themes/water/dc.

The data reported in the WISE-WFD and the WISE-SoE databases should make it possible for comparing the water quality data with the data on ecological and chemical status and pressure information for the individual water bodies. The have been several obstacles for making this match between the two database including Member States reporting different water body identifications in the two reporting streams. Selected results on comparing the information in the two databases are presented in the chapter 7. However, these analyses will be further improved and more detailed results will be presented during the spring 2012.

2.4. Water bodies

The WFD requires that waters within each river basin district be differentiated into water categories: groundwater, rivers, lakes, transitional waters and coastal waters. These waters are then further sub-divided depending on their type, based on natural factors (such as altitude, longitude, geology and size) that might influence ecological communities. This division forms the basis of water bodies. Water bodies are the basic management units for reporting and assessing compliance with the WFDs environmental objectives.

The EU Member States now has reported 12 600 groundwater bodies and more than 100 000 surface water bodies: 80% of them rivers, 15% lakes and 5% coastal and transitional waters (Table 2.5). All Member States have reported groundwater bodies; 23 Member States, all reporting Member States except Malta have reported river water bodies, 21 Member States have reported lake water bodies, and 15 and 19 Member States have reported transitional and coastal water bodies, respectively.

Table 2.5: Number of Member States, RBDs, water bodies, and length or area, per water category.

Category	Member States	RBDs	Number of water bodies	Length or area	Average length/area
Groundwater	24	133	12635	3500 000 km^2	282 km^2
Rivers	23	143	85687	1015 000 km	11.8 km
Lakes	21	128	17957	90 800 km^2	5.1 km^2
Transitional	15	77	953	17 300 km^2	18 km^2
Coastal waters	19	99	2742	265 000 km^2	97 km^2
Total	24	144	116650		

Source: Extract from WISE-WFD http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_RIVER_DENSITY
Notes: Based on 142 RBDs available in WISE-WFD database (version ultimo August 2011). Wrong river length for Italy, and coastal area for Spain not included in average calculation and sum.

In total there are reported more than one million kilometres of rivers and more than 90 000 km² lakes and 290 000 km² transitional and coastal waters. The total area of reported groundwater bodies is 3.5 million km2. Groundwater bodies have been for different horizon and groundwater bodies may overlay other groundwater bodies.

Table 2.6 lists for the Member States that have reported the number of RBDs, surface water bodies per category; and total and average river lengths and area of lakes, transitional and coastal waters.

Table 2.6: Number of RBDs, water bodies, and river lengths, area of lakes, transitional and coastal waters per country.

		Rivers			Lakes			Transitional			Coastal			Total
Country	RBDs	Nb	Avg L	L 1000 km	Nb	Avg A	Total A	Nb	Avg A	Total A	Nb	Avg A	Total A	Nb
Austria	3	7339	5	31392	62	26	934	0			0			7401
Belgium Flanders	2	177	15	2472	18	2	40	6	7	42	1	1	1	202
Bulgaria	4	689	43	25568	42	2	73	15	7	109	13	110	1428	759
Cyprus	1	216	15	2579	14	2	22	0			25	35	837	255
Czech Rep.	3	1069	18	18596	71	4	249	0			0			1140
Estonia	3	645	19	12106	89	17	1966	0			16	851	14501	750
Finland	8	1602	18	28875	4261	6	28161	0			215	123	24778	6078
France	13	10824	22	229790	439	13	1964	96	33	2840	164	258	26652	11523
Germany	10	9074	21	126159	712	8	2399	5	179	814	74	357	22843	9865
Greece	14	1033	11	11480	29	24	889	29	33	1129	233	225	38390	1324
Hungary	1	869	19	18802	213	17	1267	0			0			1082
Ireland	7	4566	5	21039	806	3	2628	190	6	1068	111	100	13183	5673
Italy	8	7644	1552	9445045	300	5	2238	181	8	1137	489	59	6609	8614
Latvia	4	205	39	7751	259	4	825	1			5	221	1107	470
Lithuania	4	832	18	14251	344	23	4391	0			0			1176
Luxembourg	2	102			0			0			0			102
Malta	1	0			0			0			9	395	3555	9
Netherlands	4	254	27	4756	450	4	3046	5	154	684	15	611	11889	724
Poland	9	4586	23	111483	1038	2	2293	9	205	1936	10	70	666	5643
Romania	1	3262	26	74473	131	3	993	2	391	781	4	143	572	3399
Slovak Rep.	2	1760	12	18944	0			0			0			1760
Spain	15	4296	19	74808	328	14	5281	201	14	2840	186	4120	1612158	5011
Sweden	10	15563	6	79466	7232	4	29192	21	18	180	602	55	34623	23418
United Kingdom	15	9080	12	99749	1119	4	1933	192	25	3716	570	135	63399	10961
EU	144	85687	12	1014539	17957	5,1	90783	953	18	17275	2742	97	265036	107339

Source: Extract from WISE-WFD http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_RIVER_DENSITY
Notes: Based on 142 RBDs available in WISE-WFD database (version February 2012). Wrong river length for Italy, and coastal area for Spain not included in average calculation and sum.

2.4.1. **River water bodies**

Category	Member States	RBDs	Number of water bodies	Length or area	Average length
Rivers	23	143	85687	1015 000 km	11.8 km

Europe has an extensive network of rivers and streams. In total more than 85 000 river water bodies with a length greater than one million kilometre has been reported by Member States. Four countries, Sweden, France, UK and Germany, reported more than half of the river water bodies, while three countries, France, Germany and the UK accounted for nearly half of the river length (Table 2.6).

The average size of the more than 85 000 reported river water bodies is 11.8 km long. Four Member States had river water bodies more than the double size the EU average and Latvia and Bulgaria had river water bodies longer than 30 km, and The Netherlands and Romania had river water bodies longer than 25 km. Austria, Ireland and Sweden had relative small river water bodies average length less than 5 km and less than half the EU average. If a Member State report relative large river water bodies for example it may have several river water bodies longer than 50 km, it may be difficult to characterize the status (e.g. sections may have different status).

The same river can contain different water bodies, since the status of the water may change. The diagram below applies to a river with high-quality water at its source, which gradually becomes more polluted downstream.

Member States like Ireland and Austria have a three to four times higher density of river water bodies than the EU average of around 23 river water bodies per 1000 km^2 of the Member State territory. Five countries have a relative higher river length (length per 1000 km^2) than the EU average. Some countries like Latvia, Finland, The Netherlands, Greece and Spain have a lower density of river water bodies (rWBs per km^2) and river length (river length per km^2) than the EU average. If a Member State has a low coverage of the rivers in a country, the characterization of status and pressures may not be fully representative for the rivers in the Member State.

2.4.2. **Lake water bodies**

There are more than 500 000 natural lakes larger than 0.01 km^2 (1 ha) in Europe (EEA 1995). About 80 % to 90 % of these are small with a surface area of between 0.01 and 0.1 km^2, whereas around 16 000 have a surface area exceeding 1 km^2. Twenty four European lakes have a surface area larger than 400 km^2.

Many natural European lakes appeared 10 000 to 15 000 years ago; when the ice sheet covered all of northern Europe. In central and southern Europe ice sheets only stretched as far as mountain ranges. As a rule, the regions comprising many natural lakes were affected by the Weichsel ice. For example, countries like Norway, Sweden, and Finland have numerous lakes that account for approximately 5% to 10% of their national surface area. In central Europe, most natural lakes lie in mountain regions. Lakes at high altitude are relatively small whereas those in valleys are larger, for example Lac Léman, Bodensee, and Lago Maggiore in the Alps. European countries which were only partially affected by the glaciation period (Portugal, Spain, France, Belgium, southern England, central Germany, the

Czech Republic, and the Slovak Republic) have few natural lakes. In these areas man-made lakes such as reservoirs and ponds are often more common than natural lakes.

Lakes are often split into two main types (shallow and deep lakes) as they tend to have different sensitivities to pressures such as water pollution. High quality shallow lakes are characterised by healthy submerged plant communities and associated diverse communities of invertebrates, fish and wetland birds. Phytoplankton is also present but typically in low levels. Naturally characterised by clear water, these systems have frequently shifted into turbid, phytoplankton-dominated states lacking macrophytes, primarily caused by nutrient pollution (eutrophication). Deep lakes are mainly found in mountainous regions and under natural conditions they are characterised by very low nutrient loads. Macrophytes are restricted to a narrow belt along the shores and phytoplankton abundance is low. Eutrophication in deep lakes causes enhanced primary production by phytoplankton, in severe cases algal blooms and oxygen depletion (particularly in the deep zones) may affect all processes and species

Twenty-one Member States have reported lakes. In total around 18 000 lake water bodies with an area greater than 90 000 km^2 has been reported by Member States. Two countries, Sweden, and Finland, reported more than two thirds of the lake water bodies and lake area.

Category	Member States	RBDs	Number of water bodies	Length or area	Average area
Lakes	21	128	17957	90 800 km^2	5.1 km^2

The average area of the more than 18 000 reported lake water bodies is 5.1 km^2 – the average size is markedly influenced by the very large lakes. Seven Member States (Austria, Estonia, France, Greece, Hungary, Lithuania, and Spain) had average size of lake water bodies greater than 10 km^2.

Half of the reported lakes are less than 1 km^2 in area and more than 87 % of the reported lake water bodies have an area less than 5 km^2 (Table 2.7) Only 78 of the reported lake water bodies have an area greater than 150 km^2; Finland and Sweden have reported 28 and 16 lake water bodies greater than 150 km^2, and Lithuania and Spain reported 9 and 8 large lake water bodies.

Table 2.7: Number of lake water bodies according to size of WBs

	Area of lakes in km^2					
	<0.5	0.5-1	1-5	5-25	25-150	> 150
Number of lWBs	4249	4300	6693	1745	388	78
Percentage	24 %	25 %	38 %	10 %	2.2%	0.4%

Some Member States (e.g. Sweden and Finland) have divided their large lakes into several water bodies, while other Member States (e.g. Austria) only have one water body for each of their lakes.

2.4.3. **Transitional water bodies**

Transitional waters are those waters between the land and the sea and include fjords, estuaries, lagoons, deltas and rias. They often encompass river mouths and show the transition from freshwater to marine conditions. Depending on the tidal influence from coastal waters, but also on the freshwater influence from upstream, transitional waters are often characterised by frequently changing salinity.

Transitional waters are the sites of major cities and harbours (ports) and these waters historically have been degraded by port activities, by pollution from urban, industrial and agricultural areas, and by land claim for sea defences, building and agriculture.

Fifteen Member States reported from 77 RBDs transitional water bodies. In total 953 transitional water bodies with an area greater than 17 300 km^2 has been reported by Member States. Five countries; United Kingdom, Spain, France. Italy and Ireland; reported more than 90 % of the transitional water bodies and more than 70 % of transitional area.

Category	Member States	RBDs	Number of water bodies	Length or area	Average length/area
Transitional	15	77	953	17 300 km^2	18 km^2

The average size/area of the reported transitional WBs is 18 km^2. Five Member States had average size of transitional water bodies greater than 100 km^2.

2.4.4. **Coastal waters**

Coastal waters represent the interface between land and ocean, and in the context of the Water Framework Directive coastal waters include water, that has not been designated as transitional water, extending one nautical mile from a baseline defined by the land points where territorial waters are measured.

All European coastal waters have, to a varying degree, been affected by eutrophication and this has led to nuisance and toxic algal blooms, loss of benthic habitats by shading out benthic vegetation and eradication of benthic fauna due to oxygen depletion as well as fish kills.

The EU has a coastline of 68 000 km. When EEA member countries Turkey, Iceland and Norway are also included, the coastline length is 185 000 km (EEA 2010). Almost half of the EU's population lives less than 50 km from the sea, the majority concentrated in urban areas along the coast. In 2001, 70 million people or 14 % of the entire EU population lived within 500 meters of the coast. The sea is Europe's most popular holiday destination: 63 % European holiday makers choose the seaside as their holiday destination.

Eighteen Member States reported more than 2770 coastal water bodies from 97 RBDs. The total area of the reported coastal waters is more than 265 000 km^2. The average area of the reported coastalwater bodies is 97 km^2 (Table 2.6)Two Member States: Estonia and the Netherlands; had average size of coastal water bodies greater than 700 km^2.

Category	Member States	RBDs	Number of water bodies	Area
Coastal waters	18	97	2774	267 600 km^2

2.5. Groundwater bodies

All 24 Member States have reported groundwater bodies. In total 12 600 groundwater bodies from 133 River Basin Districts have been reported. Sweden and Finland reported 3021 and 3804 groundwater bodies and thus accounted for more half of the groundwater bodies. Compared to the other Member States the average size of groundwater bodies Sweden and Finland is 7 km^2 while the average size the groundwater bodies for the other Member States is 600 km^2.

Category	Member States	RBDs	Number of water bodies	Length or area	Average area
Groundwater	24	133	12635	3560 000 km^2	282 km^2
GWBs Sweden and Finland	2		6825	49 742 km^2	7 km^2
GWBs except SE & FI	22		5810	3510 000 km^2	604 km^2

Source: Extract from WISE-WFD http://wfd.atkins.dk/report/WFD_aggregation_reports/GWB_status
Notes: .

The total area of reported groundwater bodies is 3.5 million km^2. Groundwater bodies have been for different horizon and groundwater bodies may overlay other groundwater bodies.

2.6. Heavily modified and artificial water bodies

See draft chapter 2 of draft thematic assessment on hydromorphology < *the main results are included below*>
The Water Framework Directive (WFD) allows Member States (MS) to designate some of their surface waters as heavily modified water bodies (HMWB) or artificial water bodies (AWB), whereby they will not need to meet the same quality criteria required for other surface waters, which are considered as natural types. A surface water body is a section of a river, lake, or transitional or coastal water.

A heavily modified water body refers to a body of surface water that as a result of physical alteration by human activity is substantially changed in character (WFD Article 2 (9)). A surface water body is considered as artificial when it was created by human activity (WFD Article 2 (8)). There is a wide range of differences in the number of designated surface water bodies among the countries.

Overall, 17.8% of European river water bodies and 16.0% of lake water bodies are designated by the MS as either heavily modified water bodies or artificial water bodies. In the Netherlands majority of the river water bodies are heavily modified while in Sweden almost all river water bodies are in natural condition. The Netherlands, Czech Republic and Belgium, Flanders designated nearly all of their lake water bodies as being either heavily modified or artificial.

A total of 18 EU Member States have on average identified around 6.1 % of their coastal water bodies as heavily modified (6.1 %) and artificial (0.5 %) . The share of transitional water bodies identified as heavily modified and artificial in 15 EU Member States is much larger (25 %), of which 2 % are artificial.

Two sea regions of Europe (Greater North Sea and Black Sea) and six Member States (the UK, Spain, Malta, the Netherlands, Romania and Poland) have more than 10 % of their coastal water bodies identified as heavily modified or artificial. About 60 % of transitional water bodies are identified as heavily modified or artificial in the Greater North Sea and Black Sea regions. In other sea regions this percentage is 25 % or less. Six Member States (the UK, Bulgaria, Poland, Belgium, Germany and the Netherlands) have more than 25 % of their transitional water bodies identified as heavily modified or artificial.

Heavily modified and artificial water bodies are clearly associated with densely populated, urbanised areas with industrial areas and ports as well as low-lying or mountainous regions.

References

WFD-CIS Guidance Document No. 21 "Guidance for reporting under the Water Framework Directive"
http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents/guidance_guidance_report/_EN_1.0_&a=d

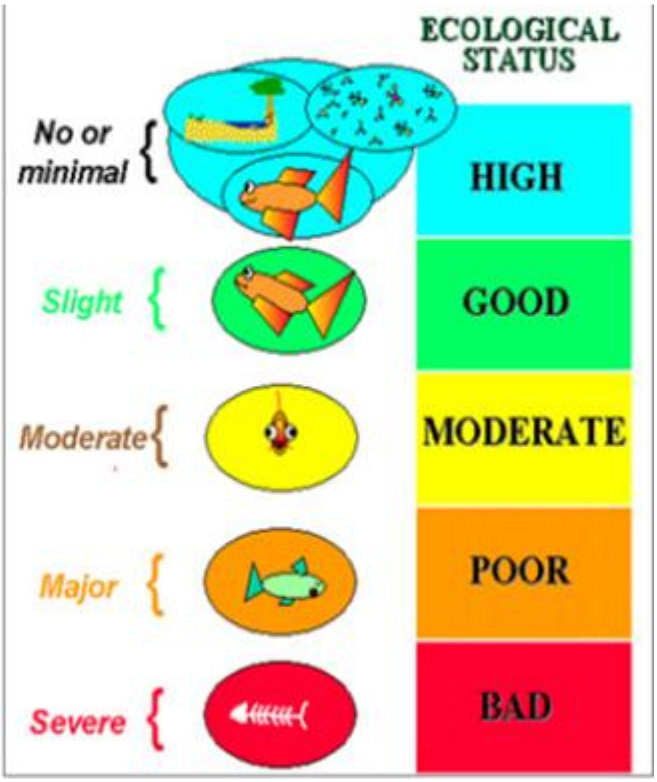
3. Methodology

3.1. Basis for classification of ecological status

3.1.1. **Principles on classification of ecological status or potential**

The WFD defines "good ecological status" in terms a healthy ecosystem based upon classification of the biological elements (phytoplankton, phytobenthos, benthic fauna and fish) and supporting hydromorphological, physico-chemical quality elements and non-priority pollutants. Biological elements are especially important, since they reflect the quality of water and disturbance of environment over longer period of time. The ecological status is reported for each water body. 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..

WFD has different requirements for natural waters and for artificial or heavily modified waters. 'Artificial water bodies' are those, created by human activity (e.g. an artificial lagoon in the area where there was naturally no water before). 'Heavily modified water bodies' (HMWB) are waters, where significant human induced physical alterations have changed of their hydro-geomorphological character to the extent that habitats are negatively affected (e.g. large harbours, hydropower reservoirs, major reductions of natural river flow, etc.). For natural water bodes the ecological status is standard for classification, while for heavily modified and artificial water bodies the ecological potential should be determined. Member States will need to meet the good ecological potential (GEP) criterion for ecosystems of HMWBs and AWBs rather than good ecological status as for natural water bodies. The objective of GEP is similar to good status but takes into account the constraints imposed by social and/or economic uses.



The ecological status classification scheme includes five status classes: high, good, moderate, poor and bad. 'High status' is defined as the biological, chemical and morphological conditions associated with no or very low human pressure. This is also called the 'reference condition' as it is the best status achievable - the benchmark. These reference conditions are type-specific, so they are different for different types of rivers, lakes or coastal waters in order to take into account the broad variation of ecological conditions in Europe.

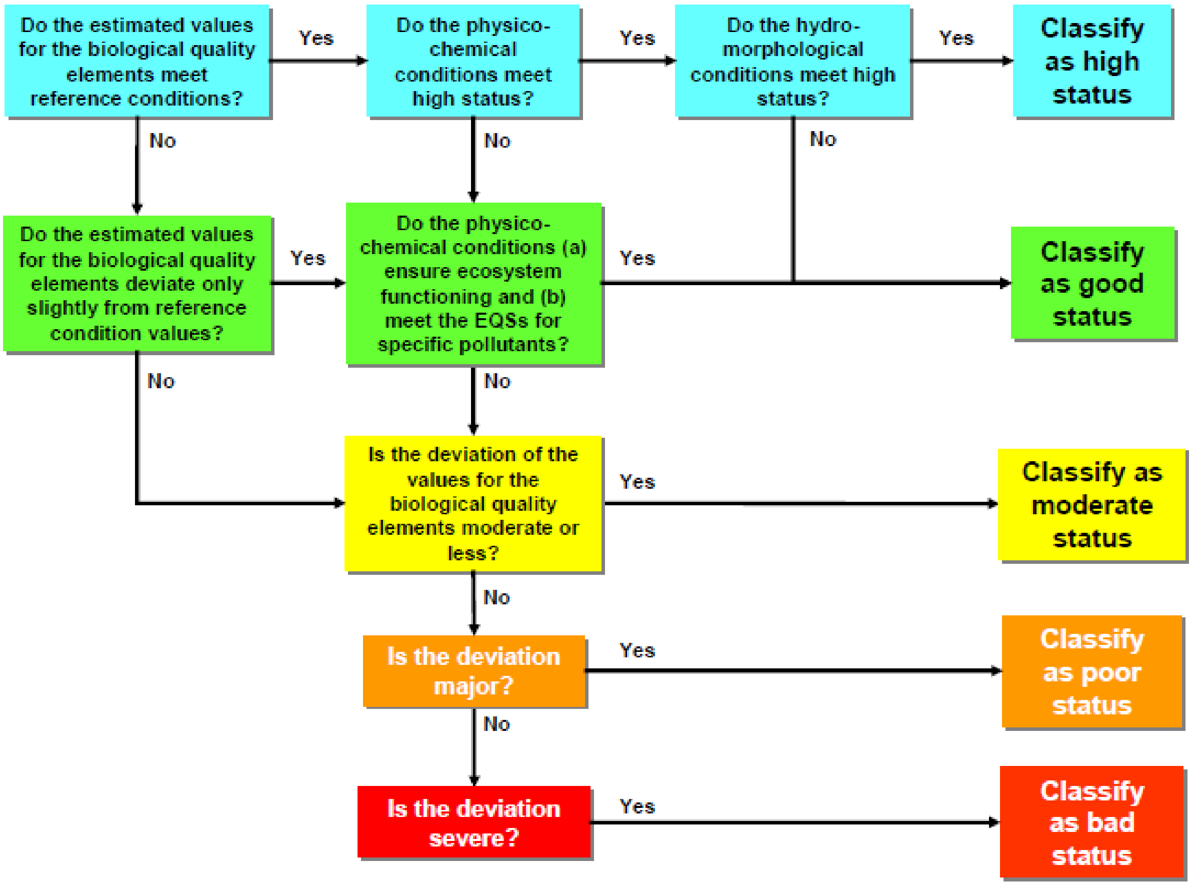
The Directive requires that the overall ecological status of a water body be determined by the results for the biological or physicochemical quality element with the worst class determined by any of the biological quality elements. This is called the "one out - all out" principle.

At "good" ecological status, none of the biological quality elements can be more than slightly altered from their reference conditions. At "moderate" status, one or more of the biological elements may be moderately altered. At poor status, the alterations to one or more biological quality elements are major and, at bad status, there are severe alterations such that a large proportion of the reference biological community is absent.

The class boundaries for the biological classification tools are expressed as ecological quality ratios (EQRs). EQRs are a means of expressing class boundaries on a common scale from zero to one. The boundary EQR values represent particular degrees of deviation from the corresponding reference values. High status is represented by values relatively close to one (i.e. little or no deviation) and bad status by values relatively close to zero (i.e. substantial deviation).

The process of ecological classifications is described in Figure 3.1.

Figure 3.1: Classification of ecological status (from WFD CIS Guidance on classification)



WFD requires that standard 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. Further information on the intercalibration process and results are given in the text box below.

Text box: Inter-calibration of national classification systems for assessment of ecological status or potential

The national classification systems for assessing ecological status for all the required biological quality elements (BQEs) have been intercalibrated according to WFD requirements. Through the

intercalibration process, the national classification systems has been adjusted to ensure that the good status boundaries are set at the same distance from reference conditions for each biological quality element in all member states sharing the same type of water bodies. The first phase of intercalibration was completed by the end of 2007. Due to delays in the development of the national systems in many member states the results from this first phase do not cover all the biological classification tools required and provide only partial results for others. The delays were most severe for transitional waters, which were not even included in the first phase of the intercalibration process, but there were also major gaps for coastal waters, as well as for lakes. For rivers, most member states had developed assessment systems for at least two BQEs (macroinvertebrates and diatom phytobenthos) in time for the first phase of the intercalibration. This means that the comparability across member states of the ecological status reported in these first RBMPs are best for rivers, less good for lakes and coastal waters and not known for transitional waters. For more information on the first Official Decision of the Intercalibration exercise and the Technical Annexes to this Decision for Rivers, Lakes and Coastal Waters, see:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:332:0020:0044:EN:PDF.

The 2nd phase of Intercalibration ended in December 2011 with finalisation of the updated intercalibration technical report and with formal adoption of the new results in 2012. These last results are not incorporated in the first River Basin Management Plans, but are to be included in the second cycle of reporting in 2015.

Chemical and physicochemical quality elements
The general chemical and physicochemical quality elements describe water quality and are considered as supporting elements to biological community. General chemical and physicochemical quality elements relevant for rivers and lakes are transitional and coastal waters are (i) transparency (not for rivers), (ii) thermal conditions, (iii) oxygenation conditions, (iv) nutrient conditions and (v) acidifying substances (for rivers and lakes only). At high ecological status, the condition of each element must be within the range of conditions normally associated with undisturbed conditions. At good ecological status, the Directive requires that the general physicochemical quality elements comply with standards established by the Member State to protect the functioning of the ecosystem and the achievement of the values specified for the biological quality elements at good status.

Specific pollutants
Member States are required to identify 'specific pollutants' (i.e. those pollutants being discharged in significant quantities) from the Directive's general list of the main types of pollutants. For good ecological status, the environmental quality standards established for specific pollutants must not be exceeded. Environmental quality standards for the specific pollutants have been set in such a way that, where the standards are met, no adverse effects on aquatic plants and animals should occur.

Hydromorphological quality elements
For high status to be achieved, the Directive requires that there are no more than very minor human alterations to the hydromorphological quality elements. At good, moderate, poor and bad status, the required values for the hydromorphological quality elements must be such as to support the required biological quality element values for the relevant class. Each of the four surface water categories is ascribed specific hydromorphological quality elements (Table 3.1).

Table 3.1: Hydromorphological quality elements to be used for the assessment of ecological status or potential based on the list in WFD Annex V. 1.1.

Morphological conditions	
Rivers • river depth and width variation • structure and substrate of the river bed • structure of the riparian zone Lakes • lake depth variation • quantity, structure and substrate of the lake bed • structure of the lake shore	Transitional waters • depth variation • quantity, structure and substrate of the bed • structure of the intertidal zone Coastal waters • depth variation • structure and substrate of the coastal bed • structure of the intertidal zone
Hydrological regime	
Rivers • quantify and dynamics of water flow • connection to ground water bodies Lakes • quantify and dynamics of water flow • residence time • connection to the groundwater body	Transitional waters • freshwater flow • wave exposure Coastal waters • direction of dominant currents • wave exposure

3.1.2. Results of classification of status and Biological Quality Elements, confidence and data quality

European overview

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 river basin management plans. The assessment systems available at the time of delivering the RBMPs were mainly for benthic invertebrates in rivers and coastal waters, for diatoms in rivers and for phytoplankton chlorophyll a in lakes. Most of the assessment systems are relevant mainly to assess impacts of pollution pressures causing nutrient and organic enrichment, whereas hydromorphological pressures causing altered habitats have mainly been assessed in rivers using fish as indicator of ecological status. For transitional waters there were almost no assessment systems available in time to be used in the first RBMPs. There were also large differences in the level of development of assessment methods across Europe, with the most serious gaps found in the Mediterranean and Eastern Continental / Black Sea regions. For more information, see: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:332:0020:0044:EN:PDF .

An additional weakness in the national systems used for ecological status assessment of water bodies in the first RBMPs is that the class boundaries for the supporting quality elements (e.g. nutrients, organic matter etc.) in many cases are not well linked to the class boundaries for the biological quality elements, and in some cases are quite relaxed compared to the responses of the biological quality elements (ref. to Ulli Claussen and Jens Arle's comparison of nutrient standards).

For ecological potential of heavily modified and artificial water bodies, the assessment systems applied have either been the same as those for ecological status (for example in terms of phytoplankton chlorophyll in Mediterranean reservoirs or fish in Alpine rivers), or been based on expert judgement considering possible measures that could be used to improve the ecological potential.

The overview of quality elements used for assessing the ecological status or potential of water bodies (Figure 3.2), reflects the level of development of the national assessment systems described above, and also shows that the proportion of water bodies monitored are less than the proportion classified for most quality elements in most of the water categories. The latter is explained by grouping of water bodies, using a few representative monitored water bodies to classify a larger group of non-monitored water bodies. If this grouping is applied for water bodies of the same type exposed to the same type and level of pressures, the classification of non-monitored water bodies would still be WDF compliant, according to the WFD CIS guidance on monitoring.

However, also expert judgement based on the information compiled in the pressure and impact analyses (WFD article 5) has probably also been used for classification of water bodies in this first cycle of RBMPs.

For rivers, the most commonly used quality elements are macroinvertebrates and fish, as well as the supporting quality elements for hydromorphology, for general physico-chemical and for non-priority specific pollutants. The proportion of classified water bodies is much larger than the proportion of monitored water bodies illustrating the practice of grouping and/or expert judgement for classifying non-monitored water bodies. This grouping is justified by the very large number of river water bodies. The phytobenthos (mainly diatoms) are monitored in less than 10% of all water bodies and used for classification of less than 20%, while macroinvertebrates are monitored in more than 20% and classified in more than 40% of all river water bodies. This is surprising, considering the high sensitivity of phytobenthos to nutrient enrichment, but propably reflects the traditional use of macroinvertebrates to assess organic enrichment (saprobic indices) in rivers.

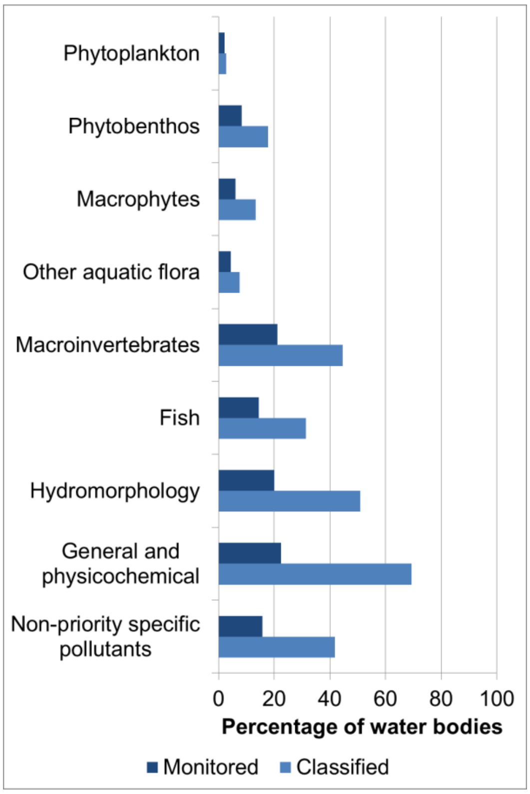
For lakes, phytoplankton is the most commonly used biological quality element. In many cases the phytoplankton classification is based only on chlorophyll a, which was the only part of this quality element that was fully developed for classification by most member states for the first RBMPs. Also for lakes, the supporting quality elements, especially the general physico-chemical ones, are most commonly monitored and used for classification. As for rivers, the classification of lakes is based on grouping and/or expert judgement for the majority of the classified water bodies; less than 20% of the water bodies are monitored for one or more quality elements, while close to 80% is classified for general physico-chemical quality elements.

For transitional waters, the picture is quite different from that of rivers and lakes. Almost the same proportion of water bodies is monitored as that classified. For angiosperms, as well as for hydromorphological and non-priority specific pollutants, the proportion monitored is even higher than the proportion of classified water bodies. The explanation may be that some member states did not have their assessment systems in place at the time of the first RBMPs, and thus collected monitoring data to be able to develop their assessment systems. The total number of transitional water bodies reported is also much lower than for rivers and lakes, and they may be less comparable in terms of types and pressures, thus grouping and expert judgement is less needed and also less easy to apply for classifying the transitional waters. The biological quality elements most commonly used for monitoring and classification of transitional waters are phytoplankton, macroinvertebrates and fish, as well as the supporting quality elements.

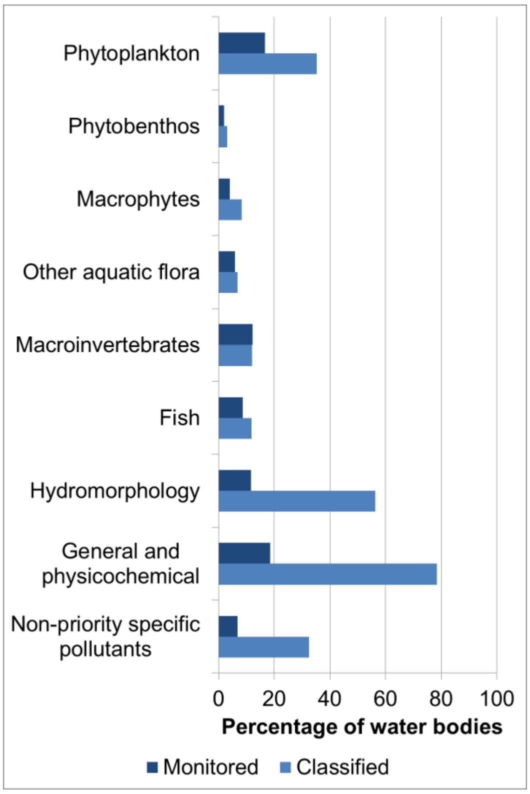
For coastal waters, phytoplankton and macroinvertebrates are the most commonly used biological quality elements and is monitored in ca. 30% of all water bodies, and classified in more than half of all coastal water bodies. The supporting quality elements are also monitored and classified in almost the same proportions as the biological quality elements. As for lakes, the use of phytoplankton is probably dominated by chlorophyll a measurements, while the use of macroinvertebrates reflects the traditional use of this biological quality element to assess organic enrichment (and secondary impacts of nutrient enrichment) in soft-bottom sediments.

Figure 3.2. European overview of the different quality elements reported by Member States to be used for monitoring and classification of water bodies in the different water categories.

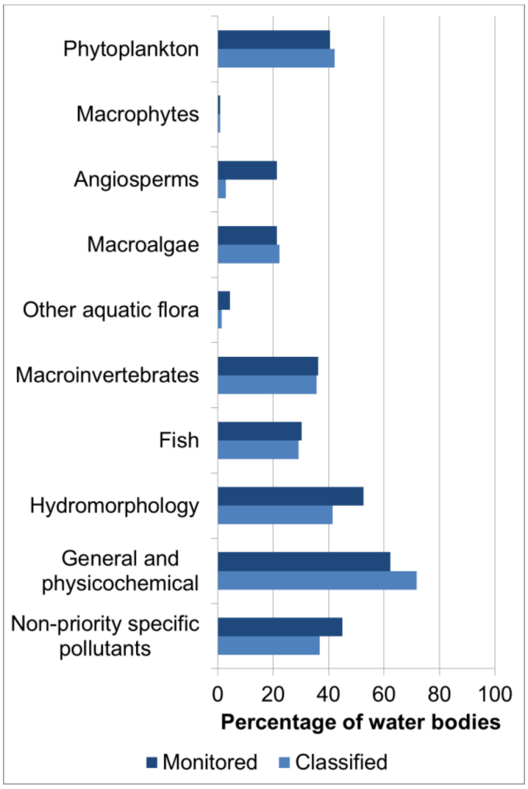
Rivers



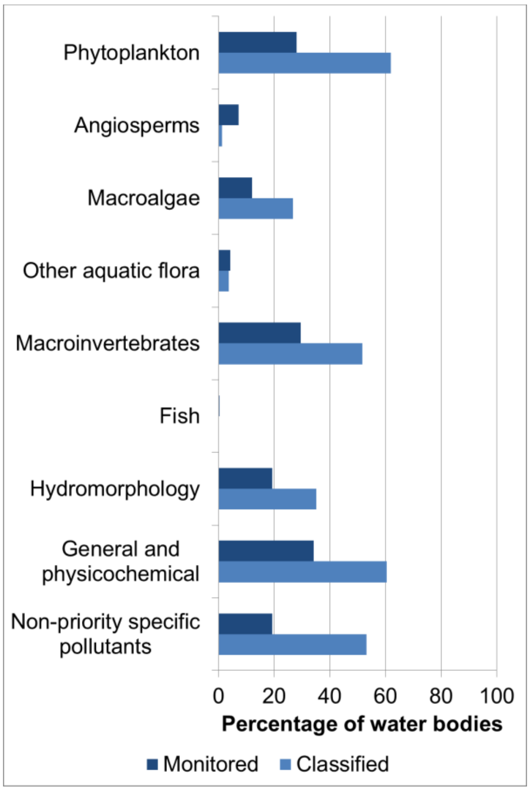
Lakes



Transitional waters



Coastal waters



Notes: The percentage is calculated against the total number of classified water bodies, i.e. total number of water bodies reported where quality elements were identified are for rivers: 75763, for lakes: 13849, for transitional waters: 629, for coastal waters: 2225. “Monitored” means WBs with at least one monitoring station for that particular QE. This percentage is most likely underestimated, because a) some member states have not reported monitoring stations (Poland, Hungary, Ireland, Latvia, Lithuania, Slovakia and Estonia (transitional and coastal only)) and b) it seems to be an underreporting of monitoring stations where only non-BQEs are monitored. “Classified” means WBs with status information for that particular QE. Here too this may be an incorrect estimate, as the member states have interpreted this reporting differently. The member states were asked only to report status class for WBs were the QE was monitored. Status can also be set based on grouping or expert judgement (see text). In practice, some member states have reported status class also when the QE has not been monitored, others have not. Hence, if regarding “Classified” as all WBs with status information on a particular QE, regardless of method for setting that status, the results shown are likely to be underestimated. If possible, the Member States should help clarifying how they have reported monitoring stations and classification of single QEs.

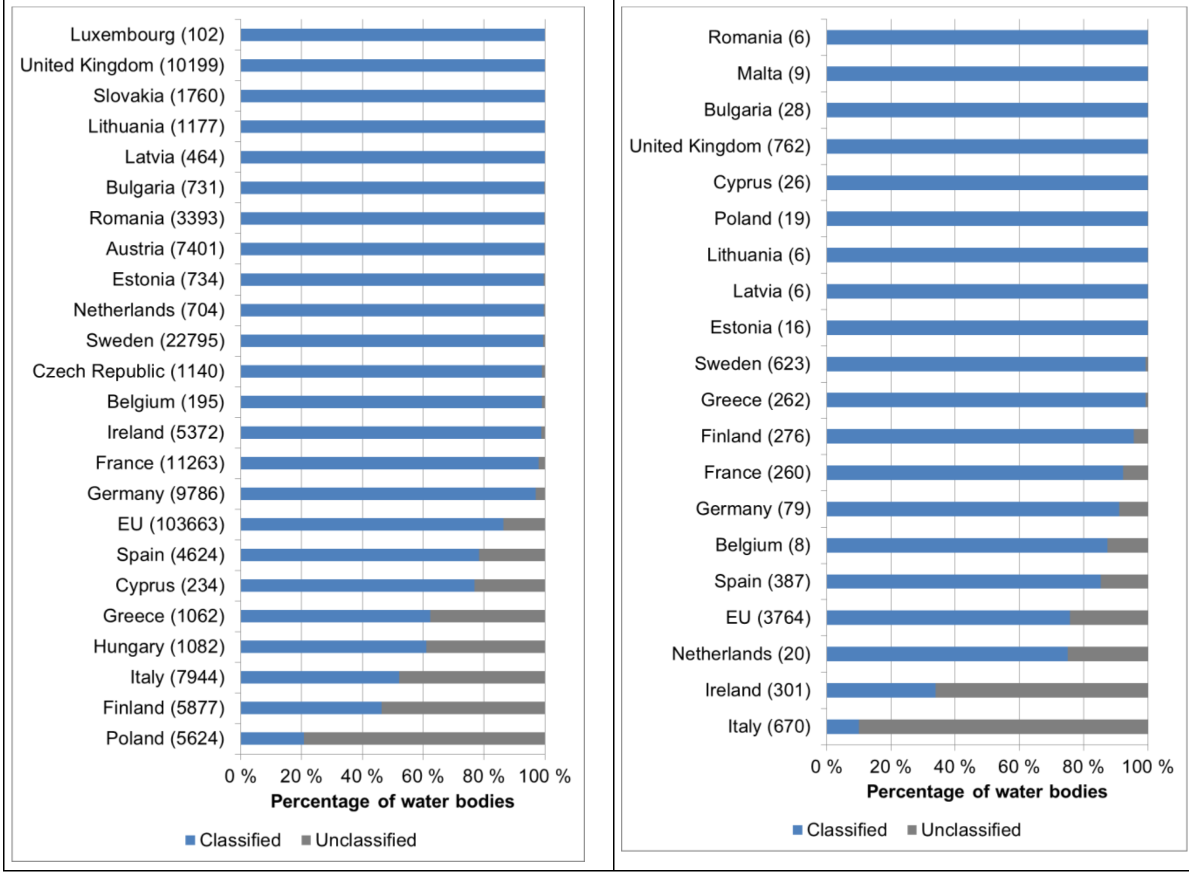
3.1.3. Confidence in classification of ecological status or potential in different countries

Most member states have classified all their water bodies (figure 3.3), although a few countries have a substantial proportion of water bodies that are delineated, but not classified. At the EU level 86% of a total of 103663 river and lake water bodies are classified, while 76% of a total of 3764 transitional and coastal water bodies are classified. The member states with a substantial proportion of unclassified water bodies for rivers and lakes are Poland (79%), Finland (54%), Italy (48%), Hungary (39%), Greece (38%), Cyprus (23%) and Spain (22%), while for transitional and coastal waters only three countries have a substantial proportion of unclassified water bodies: Italy (90%), Ireland (66%) and the Netherlands (25%).

The reasons for not classifying all water bodies are unclear, but may be related to low confidence or gaps in assessment systems for certain quality elements or certain types of water bodies.

Figure 3.3. Proportion of classified water bodies of the total number of water bodies for rivers and lakes (left) and for transitional and coastal waters (right). The member states are ranked by the percentage of classified water bodies.

Rivers and lakes	Transitional and coastal waters



Notes: The total number of water bodies is given in brackets for each member state. The total number of water bodies does not include water bodies in countries/RBDs for which there is no reporting (see table 2.1). “Classified” means WBs with status class bad to poor. “Unclassified” means WBs with status class “Unknown” or “Not applicable”.

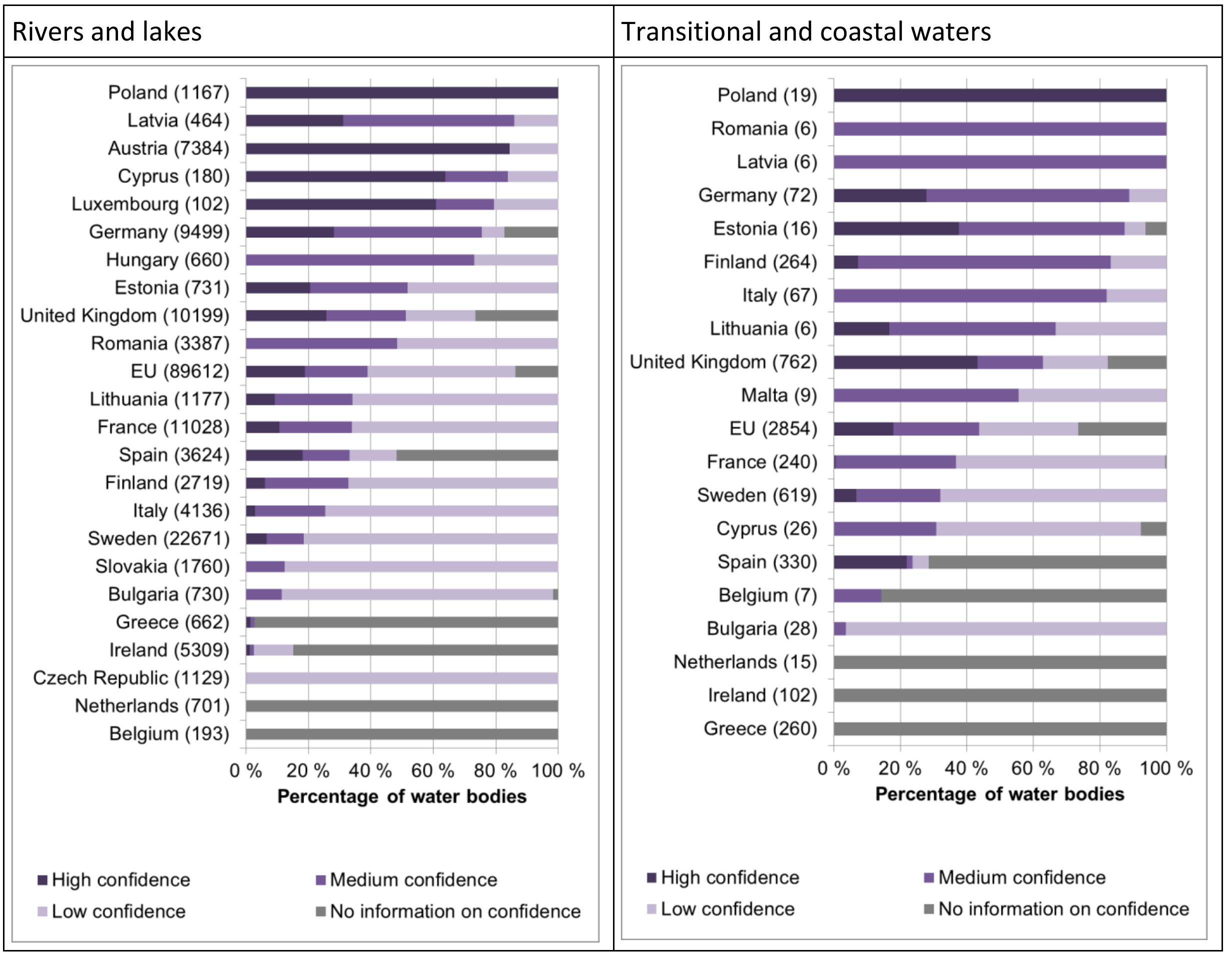
Due to inconsistencies of reporting the RBMP data in WISE in terms of which quality elements have been used for classification, it has not been possible to obtain reliable results across member states for comparison of the proportion of water bodies classified with at least one BQE and those classified with only supporting QEs or without any monitoring data (see also notes for figure 3.2).

Member states have reported the confidence of classification as high, medium or low, but the basis for choosing these confidence categories is not harmonised across the EU. However, from the descriptions reported by the member states on how these categories have been used, there are some general principles applied by many member states:

- high confidence: classification based on monitoring of at least one biological quality element and some supporting quality elements
- medium confidence: classification based on monitoring of at least one supporting quality element
- low confidence: classification is done without monitoring data, based on expert judgement

For some water bodies no information of confidence is reported.

Figure 3.4. Member states own assessment of confidence in classification of ecological status or potential of classified rivers and lakes (left) and classified transitional and coastal waters (right). The Member States are ranked by the proportion of water bodies classified with high or medium confidence.



Notes: The number of classified water bodies is given in brackets for each member state.

Poland has reported high confidence for all their classified water bodies, whereas they have only classified 21 % of their water bodies in rivers and lakes. This indicates that Poland has only classified a water body if they have high confidence in the classification. Some member states have a majority of water bodies classified with high or medium confidence both for rivers and lakes, as well as for transitional and coastal waters, e.g. Latvia, Estonia, Germany, UK, and some land-locked member states like Austria, Hungary and Luxembourg report high and medium confidence for most of their classified river and lake water bodies.

On the other hand, some member states have not provided information on confidence for all or almost all of their classified water bodies, e.g. the Netherlands, Belgium, Ireland and Greece.

The reasons for reporting low confidence may be related to gaps in assessment systems for certain quality elements or certain types of water bodies, or lack of monitoring data.

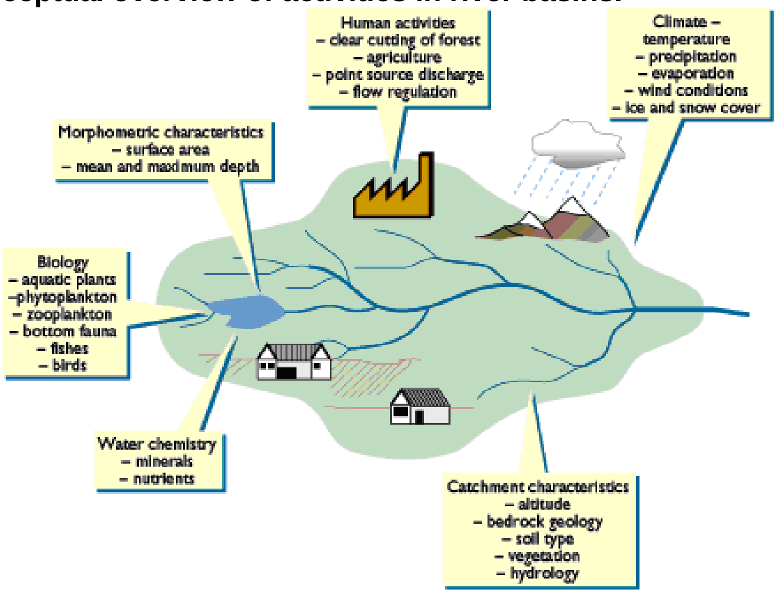
At the EU level, only 39% of the classified river and lake water bodies and 44% of the classified transitional and coastal water bodies are reported to be classified with medium or high confidence. This suggests that the classification results are quite uncertain for the majority of water bodies in these first RBMPs. In many cases the classification is probably based merely on expert judgement and/or on results of the pressure and impact analyses (article 5) rather than on biological monitoring data and WFD-compliant classification systems.

3.2. Pressures and impact analysis

The WFD defines "good ecological and chemical status" in terms of low levels of chemical pollution as well as a healthy ecosystem. To achieve good ecological status, Member States will have to address the factors affecting water eco-systems. Pollution is one, so are morphological changes such as dams built on rivers. The extraction of water for irrigation or industrial uses can also harm ecosystems if it reduces water levels in rivers or lakes below a critical point.

The status of a water body is greatly influenced by the characteristics of its catchment area (Figure 3.5). The climatic conditions, for example rain, bedrock geology and soil type, all influence the water flow. In addition, soil type impacts on the mineral content of the water. Similarly, human activity affects surface water and groundwater through afforestation, urbanisation, land drainage, pollutant discharge, morphological changes and flow regulation.

Figure 3.5: Conceptual overview of activities in river basins.



Identifying significant pressures: The WFD requires that Member States collect and maintain information on the type and magnitude of significant pressures to which water bodies are liable to be subject. 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 achieving good status. Annex II of the Directive provides lists of some of the different types of pressures that may be significant.

Published in 2005, the WFD Article 5: Characterisation and impacts analyses reports were the first step in identifying pressures and impacts in the river basin management planning process. This pressure and impact analysis reviewed the impact of human activity on surface waters and on groundwater and identified those water bodies that are at risk of failing to meet the WFDs environmental objectives.

> *'at risk' means that: the pressure and impact assessment shows that there is a likelihood that a water body will fail to meet the WFD´s environmental objectives by 2015 unless appropriate management action is taken.*

“At risk” does not necessarily mean that the water bodies are already suffering poor status, but it does highlight areas where appropriate management measures should be applied to ensure that good status is maintained or to ensure it is achieved in the future.

The first identification of pressures and impact (Article 5) was the basis for the overview of Significant Water Management Issues (SWMI) that was reported in 2007 and was the basis for establishing the first RBMPs. The identification of significant pressure and impact were further developed in the RBMPs.

3.2.1. **Significant pressures and impacts**

Several factors contribute to surface water bodies being at risk. These include point sources - for example pollution from urban areas and industries as well as diffuse sources such as agriculture. In addition, the influence of water extraction and of morphological changes are important pressures. Changes in habitats can result from the physical disturbance through damming, channelisation and dredging of rivers, construction of reservoirs, sand and gravel extraction in coastal waters, bottom trawling by fishing vessels etc. Below is described the main pressures and impacts affecting Europe’s surface waters.

One major pressure is **pollution.** Pollution is harmful to aquatic plants and animals, and may threaten drinking water and water supplies. Pollution can be anything from hazardous substances to a nutrient which can result in excessive plant growth or even silt that can smother fish spawning beds. Pollution comes from one of two types of source:

- **point sources**, e.g. pipes discharging effluents from urban wastewater treatment plants, industrial sites, or mines; and
- **diffuse sources**, e.g. land use activities such as farming, forestry and urban areas.

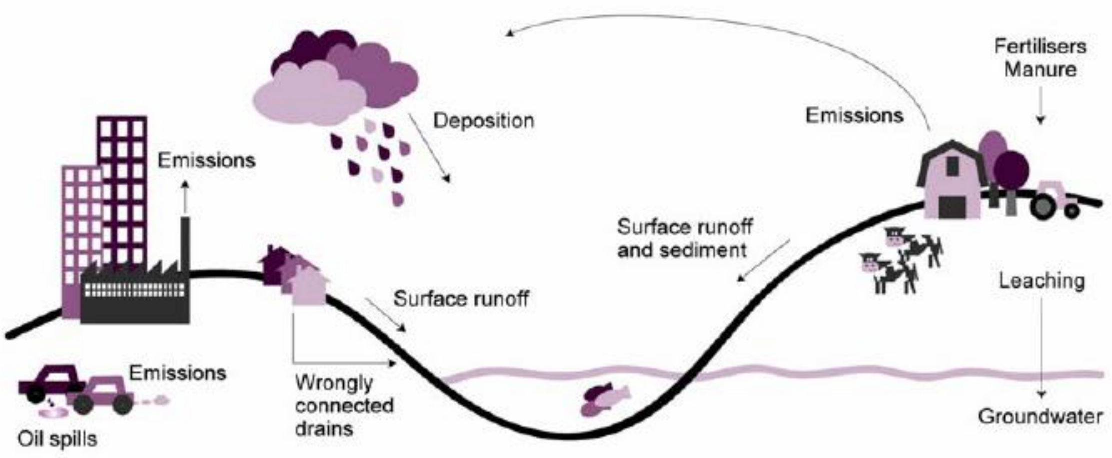
During the last decades, significant progress has been made in reducing the point source pollution: improved wastewater treatment, reduced volume of industrial effluents, and reduced or banned phosphate content in detergents as well as reduced atmospheric emissions. Over the last 30 years the urban and industrial wastewater treatment has progressively improved and in many parts of Europe a large proportion of the pollutants are today removed (see chapter 7). However, pollution caused by inadequately treated wastewater is still in some areas an important source of river pollution and an important source for transitional and coastal waters. Main impacts related to point source pollution are organic pollution, nutrient enrichment and contamination by hazardous substances. Severe organic pollution may lead to rapid de-oxygenation of water, a high concentration of ammonia and the disappearance of fish and aquatic invertebrates.

Diffuse water pollution is a serious problem in many parts of Europe (see chapter 7). Diffuse sources of pollution include run-off from farmland, run-off from roads or scattered dwellings. Diffuse pollution is closely linked to land use (e.g. the application of fertiliser or pesticides to farmland; livestock manure; use of chemicals and leakage from old waste storage and polluted industrial sites). Diffuse pollution is also linked to air emissions, for example acid rain or deposition of nitrogen, impacts of traffic emissions or other air transported pollutants.

Some of the main impacts related to diffuse pollution are high levels of nutrients in rivers, lakes, estuaries and coastal waters, which can cause eutrophication; nitrate and pesticide contamination of groundwater; hazardous chemicals leaking into rivers, lakes and groundwater from industrial sites; and air pollution causing acid rain, deposition of nitrogen on sensitive waters and deposition of hazardous chemicals (e.g. mercury and PAHs).

Figure 3.6: Overview of different diffuse sources

Figure 1
Common sources of diffuse pollution



Source: Environment Agency 2007
http://www.environment-agency.gov.uk/static/documents/Research/geho0207bzlvee_1773088.pdf

During the last centuries European mining for coal, metal ores, and other minerals have affected water bodies. Many thousands of mines have been abandoned and now discharge mine-water containing acid water, heavy metals and other pollutants into water bodies. Other mines are still filling up with groundwater or have heavy regulation of water level affecting the surrounding groundwater aquifers or surface waters. Abandoned mines in several areas of Europe are today a significant pollution pressure. For example, eight of the twelve River Basin Districts in the UK have identified abandoned mines as a significant problem (Johnson and Rolley, 2008). Nine per cent of rivers in England and Wales, and 2% in Scotland are at risk of failing to meet their WFD targets of good chemical and ecological status because of abandoned mines. These rivers cause some of the biggest discharges of metals such as cadmium, iron, copper, and zinc to rivers and the seas around Britain.

Aquaculture has grown substantially in a number of European countries over recent years such as Atlantic salmon in Scotland, Norway and Ireland, seabass and seabream in the Mediterranean and mussel farming in Ireland, Spain and France. In particular, marine aquaculture of finfish has become more intensive over the last 25 years resulting and can generate considerable amounts of effluent, such as waste feed and faeces, medications and pesticides, which can have undesirable impacts on the environment.

The **abstraction** of too much water from rivers, lakes or groundwater is harmful to the environment and can compromise the water resources needed by other water users. Water abstraction may reduce the amount of water available to dilute discharges and therefore makes pollution worse. In extreme cases, rivers and reservoirs can dry up or salt water can be drawn into groundwater. Transfers of water from one catchment to another and flow-controlling structures, such as dams may also have major influences on water flows.

Hydrological alterations refer to pressures resulting from water abstraction and water storage affecting the flow regime such as change in daily flow (hydropeaking) and seasonal flow. In addition, river stretches may dry up and water levels of lakes and reservoirs may be heavily regulated. The flow regime of a water body may be significantly altered downstream of an impoundment or an abstraction, and the biology may impacted. Alterations to the flow regime degrade aquatic ecosystems through modification of physical habitat and of erosion and sediment supply rates.

Morphology is the physical structure of a river, lakes, estuary or coast including, for example, the banks and bed of a river and the shore of lakes or coastal waters. Engineering or the way the land is managed can change the morphology of these waters. This has a direct impact on animals and plants and can lead to increased flooding or erosion.

Land reclamation, shoreline reinforcement or physical barriers (such as flood defences, barrages and sluices) can affect all categories of surface waters. Weirs, dams and barrages can alter water and sediment movements, and may impede the passage of migratory fish such as salmon. Using water for transport and recreation often requires physical alteration to habitats and affects the flow of water. Activities such as maintenance and aggregate dredging and commercial fishing using towed bottom-fishing gear can also damage physical habitats.

Biological pressures related to **Invasive Alien Species (IAS)** have been identified as a significant pressure in several of the RBMPs. IAS are non-native plants or animals which compete with, and may even over-run, our natural aquatic plants and animals. Introduction of IAS may alter both species composition and the numbers of different species in surface waters. Escaped farmed salmon for instance, represents a serious risk to wild salmon stocks.

It is increasingly being recognised that **climate change** will have a significant impact on the aquatic environment in Europe (EEA 2008; CEC 2009; IPCC, 2007, 2008). Climate change is projected to lead to major changes in yearly and seasonal precipitation and water flow, flooding and coastal erosion risks, water quality, and the distribution of species and ecosystems. Models indicate that at a general level the south of Europe will show a significant drying trend and the north of Europe one of wetting. There are many indications that water bodies, which are 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. Although climate change is not explicitly included in the text of the WFD, the step-wise and cyclical approach of the river basin management planning process makes it well suited to adaptively manage climate change impacts.

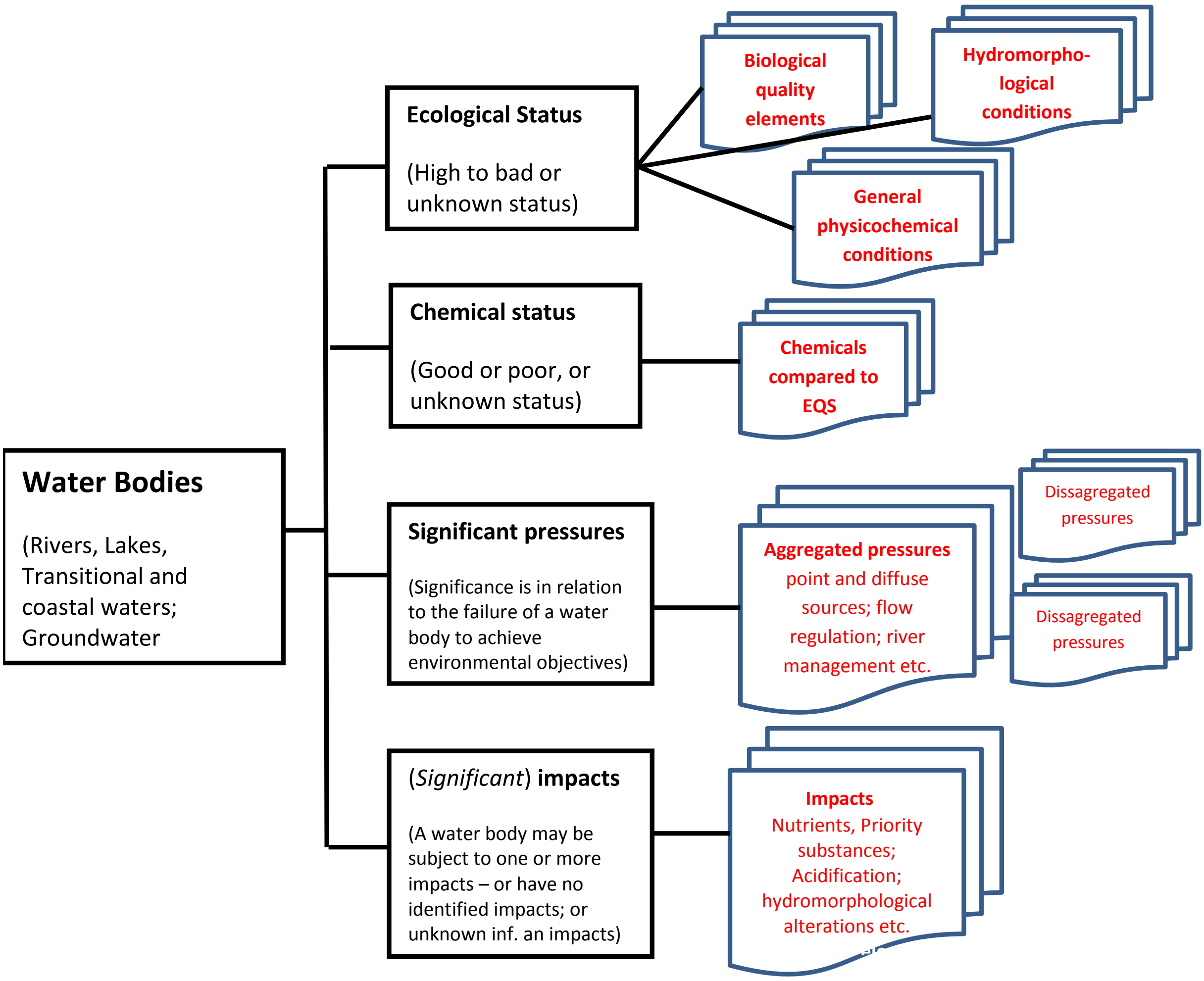
3.3. Methodology issues in relation to data handling

In the following is described some of the methodology issues, quality issues and shortcomings in relation to analysing the data in the WISE-WFD database. A set of information is reported for each water body (Figure 3.7). A surface water body have information on:

- the *ecological status/potential* and *chemical status*. This information is based on more detailed information on biological quality elements (e.g. macroinvertebrates; phytoplankton); general physiochemical conditions (general water quality information e.g. nitrate and phosphorus); and hydromorphological conditions.
- *Significant pressures* such as pressures related to diffuse sources or water flow regulation. More than one pressure may apply to a water body. Significance is in relation to the failure of a water body to achieve environmental objectives.
- Significant impacts such as nutrient enrichment; contamination by priority substances; acidification; and alteration of habitats etc. A water body may be subject to more than one impact.

A water body may have no significant pressure or impact because it is in good (or high) status. However, no reported pressures or impacts may also mean that pressures and impacts have not been reported or identified.

Figure 3.7: Conceptual overview of reported information in relation to a water body



Notes

Significant pressures: Member States are required to report on the significant pressures on surface and groundwater water bodies. Significance is in relation to the failure of a water body to achieve environmental objectives. More than one pressure may apply to a water body.

Significant pressures have been reported at different levels of aggregation. For example, point source discharges might be reported at three levels of aggregation: 1 Point Source, 1.1 Point - UWWT_General and 1.1.1 Point - UWWT_2000.

Significant impacts: Number and percentage of water bodies that are reported as being subject to the indicated significant impacts. A water body may be subject to more than one impact.

3.3.1. Assumption made in relation to data handling

Unclassified water bodies – unknown status, pressure and impact

Some water bodies have been reported with unknown or not applicable ecological status/potential (unclassified water bodies), or no information on significant pressures (no pressures) or impacts (no impacts). In most cases unclassified water bodies do not have information on pressure and impacts. All analyses done in the following chapters are based on water bodies which are classified with respect to ecological status or potential only.

No differentiation between ecological status and potential

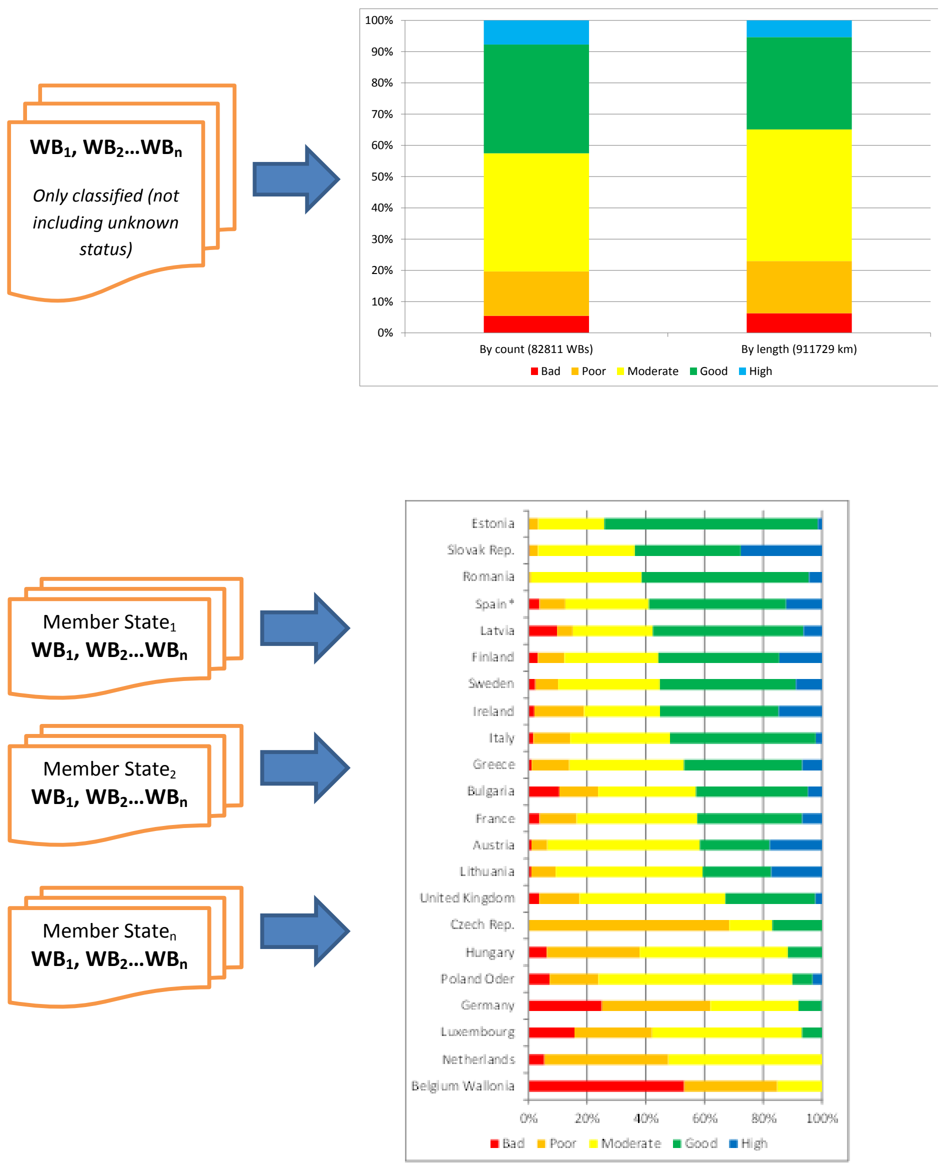
In the analysis, no distinction has been made between ecological status and potential. The criteria for classification of natural (status) and artificial or heavily modified water bodies (potential) vary, but the ecological conditions they reflect are assumed to be comparable.

3.3.2. **How to read the diagrams**

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

- Percentage, number or length/area of water bodies in the different classes of ecological and chemical status.
- Percentage, number of water bodies affected by different significant pressures and impacts.

Figure 3.8: Aggregation of status to European overviews (upper panel) and for country comparison.



- The diagrams are based on only water bodies with classified ecological status or potential.
- The percentage high and good status (blue or green colour) or water bodies without pressures or impacts (blue colour) are always presented to the right of the bar charts.
- Diagrams with country comparison are always ranked by the percentage of water bodies not achieving good status (red, orange and yellow colour).
- This ranking by percentage of water bodies not achieving good status are kept when presenting percentage of water bodies affected by different pressures or impacts.
- Pressure information has been aggregated to main pressure groups (see the notes to the diagrams).

References

CEC 2009;
EEA 2008;
IPCC, 2007, 2008
Johnston D. and Rolley S. 2008: Abandoned Mines and the Water Framework Directive in the United Kingdom. Paper available at http://www.imwa.info/docs/imwa_2008/IMWA2008_128_Johnston.pdf
Environment Agency 200x: Abandoned mines and the water environment. Science report from the Environment Agency. Available at http://publications.environment-agency.gov.uk/PDF/SCHO0508BNZS-E-E.pdf

4. Ecological status, pressures and impacts in different countries

4.1. Introduction

This chapter provides information at the member state level on ecological status, pressures and impacts with sub-chapters for each water category: Rivers, Lakes, Transitional and Coastal waters. The information is based on data that has been reported by Member States along with their first River Basin Management Plans (WFD Article 13 reports).

Each water category is presented in the same way, showing two sets of figures using all classified water bodies in each country:

1. Three separate bar plots with one bar per country showing
   a. Ecological status class distribution, countries are ranked from top to bottom with those with the highest proportion of good and high ecological status on top and those with the lowest proportion of good and high on the bottom
   b. Proportion of water bodies with any pressure reported (red colour) and with no pressures reported (blue colour). Countries with no pressures reported for any water body have no bar in the figure.
   c. Proportion of water bodies with any impact reported (red colour) and with no impact reported (blue colour). Countries with no impacts reported for any water body have no bar in the figure.
2. Four separate bar plots with one or two bars per country showing the pressures and impacts that are most often reported.
   a. Point source and diffuse source pressures
   b. Organic enrichment and nutrient enrichment impacts
   c. Contamination impacts, including priority substances and contaminated sediments
   d. Hydromorphological pressures, including water flow regulation, river/transitional/coastal management, other morphological alterations, and water abstraction, and altered habitats (impacts)

For each water category the ranking of the countries is the same in all these plots and follows that given by the ecological status plot (1a above).

For each water category there are also some case studies included.

4.2. Rivers

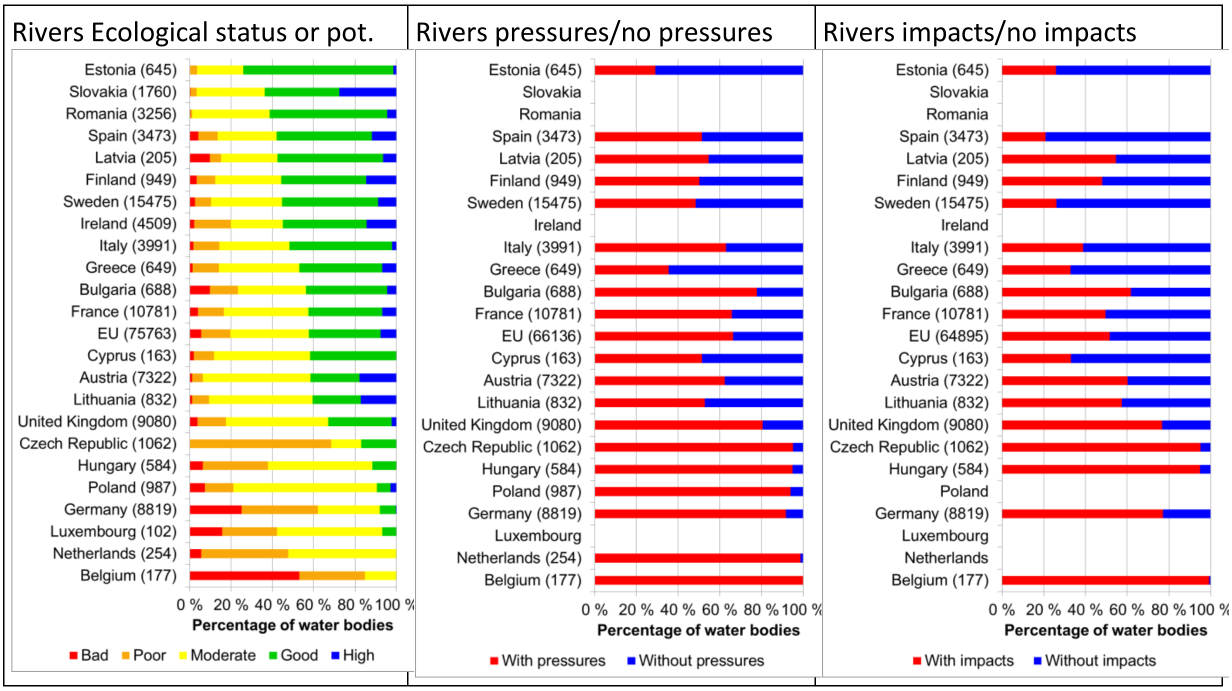
4.2.1. **Main assessment of status and main pressures and impacts**

Europe has an extensive network of rivers and streams. In total more than 80 000 river water bodies with a length greater than 900 000 km has been reported by Member States. Four countries, Sweden, France, UK and Germany, reported more than half of the river water bodies, while three countries, France, Germany and the UK accounted for nearly half of the river length.

The average length of the more than 80 000 reported river WBs is 12 km. Four Member States have reported river WBs that are twice as long as the EU20 average, and Latvia, Bulgaria and Poland have river WBs longer than 30 km. Austria, Ireland and Sweden have relatively short river water bodies with average length less than 5 km, which is less than half the EU20 average.

For rivers, there are 44 000 water bodies (58% of the total number), or 606 000 km (65% of total river length) reported to be in less than good ecological status or potential. The main causes for the poor ecological status/potential are emissions from diffuse and point sources coming from agricultural pollution, from urban waste water and industrial emissions, causing nutrient and organic enrichment, as well as hydromorphological changes causing altered habitats.

Figure 4.1 Ecological status or potential, pressures and impacts of classified river water bodies in different member states sorted by proportion of good or better ecological status or potential. The figure shows the percentage of total number of river classified water bodies in different status classes (left panel), with and without pressures reported (middle panel), with and without impacts (right panel).



Notes: The number of classified river water bodies is given in brackets for each member state. Empty rows in the pressures and impacts plots mean that no data on pressures and/or impacts are reported from those member states. These member states are also excluded from the overall EU results. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.
Source: Based on data available in WISE-WFD database primo February 2012, - country results on ecological status, pressures and impacts are available here
http://wfd.atkins.dk/report/WFD_aggregation_reports/swb_status &
http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_pressure_status &
http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_impact_status

Many of the Central-European Member States with high population density and intensive agriculture, generally have only a small proportion of their river water bodies in good or better ecological status or potential (lower part of figure 4.1). A high proportion of river WBs with good ecological status or potential is mainly reported in Northern Europe (Sweden, Finland, Ireland), in two of the Baltic countries (Estonia and Latvia) and in some southern and eastern European member states (Spain, Romania, Slovakia). The large differences reported between some neighbouring member states, e.g. Latvia and Lithuania, the Czech Republic and Slovakia, as well as between Hungary, Romania and Bulgaria may partly be caused by different assessment approaches (see section 3.1.2), and need further analyses of population density and % arable land to be fully understood.

The proportion of river WBs with no significant pressure or no impacts generally followed the ranking of Member States based on at least good ecological status, i.e. Member States having a more than 50 % of the river WBs in good ecological status generally also had the a high proportion of river WBs without pressures and with no identified impacts. Conversely, the Member States with a large proportion of WBs in less than good ecological status generally have the majority of river WBs with significant pressures and impacts.

Figure 4.2 shows the major categories of pressures and impacts affecting ecological status in European rivers. The proportion of river WBs affected by diffuse pollution (Fig. 4.2.a), nutrient enrichment (Fig. 4.2.b), as well as hydromorphological pressures and altered habitats (Fig. 4.2.d) generally corresponds to the proportion in good ecological status as shown in Figure 4.1 above.

The most important pollution pressure comes from diffuse sources, causing nutrient enrichment impacts in the majority of rivers in most of the member states having the worst ecological status (lower part of figure 4.1), with the notable exception of Poland who reported very low diffuse pressures. Most member states with better ecological status report a lower proportion than the EU average of 35% to be affected by diffuse pressures and nutrient enrichment, with the exception of Finland who reported more than 40% of their classified river water bodies to be affected by diffuse pollution causing nutrient enrichment.

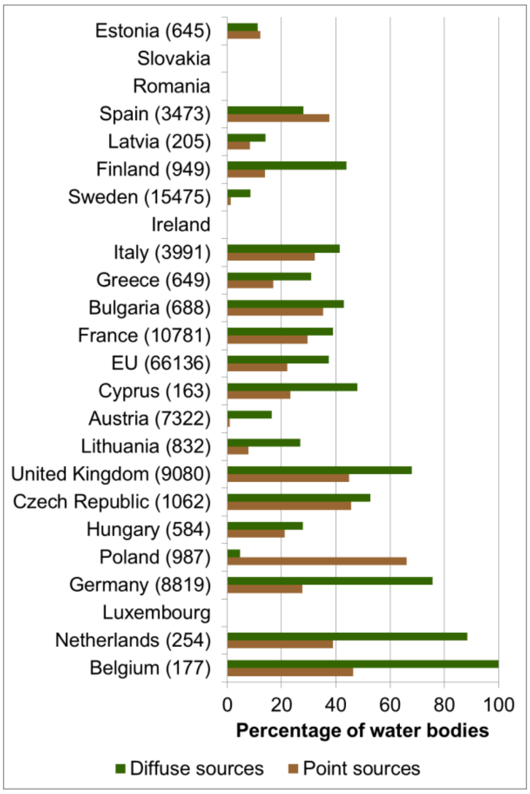
Some member states still have important point source pollution, e.g. Poland and Belgium (Flanders), which is due to inefficient urban waste water treatment. This pollution are causing quite massive organic enrichment impacts in their rivers, explaining the poor ecological status. Most member states, however, have much less point source pollution due to substantial urban waste water treatment over the past decade(s), thereby causing organic enrichment in only a minority of rivers.

Contamination by priority substances coming from both point and diffuse source pollution is affecting less than 25% of rivers in most member states, except in two member states (UK and Belgium) (Fig. 4.2.c). This impact is not well reflected in the ecological status, as the assessment systems are not developed to measure this impact. It will however be important for the chemical status. In Sweden, all the water bodies are subject to the impact contamination by priority substances. This is also reflected in the reporting of diffuse pressures, and is mainly due to mercury in biota. This has little impact on ecological status, although it affects chemical status. See more on this in section 5.3.2.

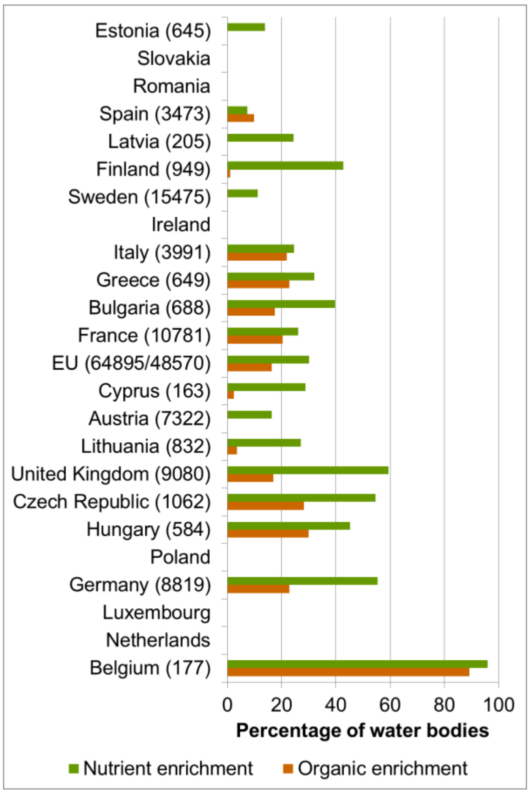
Hydromorphological pressures causing altered habitats is the other major pressure in European rivers, affecting the majority of water bodies in Member States with a large proportion of rivers in moderate or worse ecological status or potential (Fig. 4.2.d). [A large share of these rivers are heavily modified or artificial rivers.] In the Member States with better ecological status or potential this pressure and impact affect less than 50% of the classified rivers, but is still an important problem in many rivers.

Figure 4.2. Proportion of classified rivers exposed to different main pressures and impacts in different member states ranked by proportion of good or better ecological status/potential (fig 4.1)

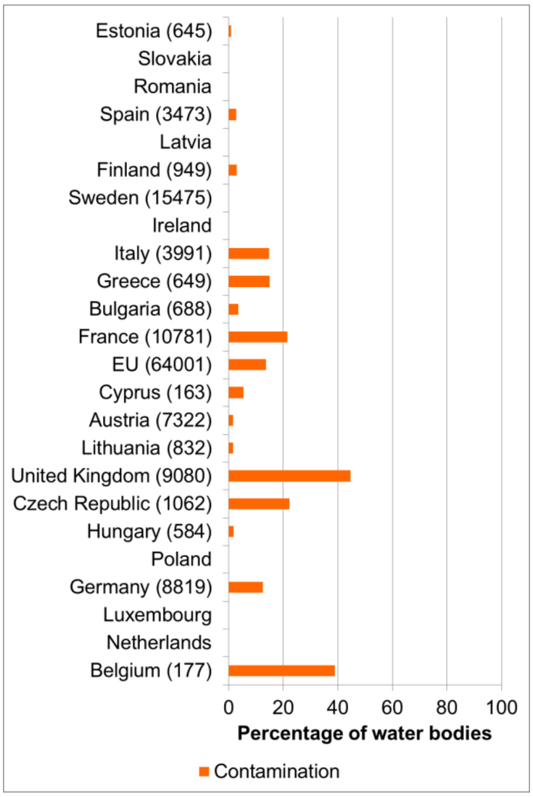
a) Diffuse and point source pollution



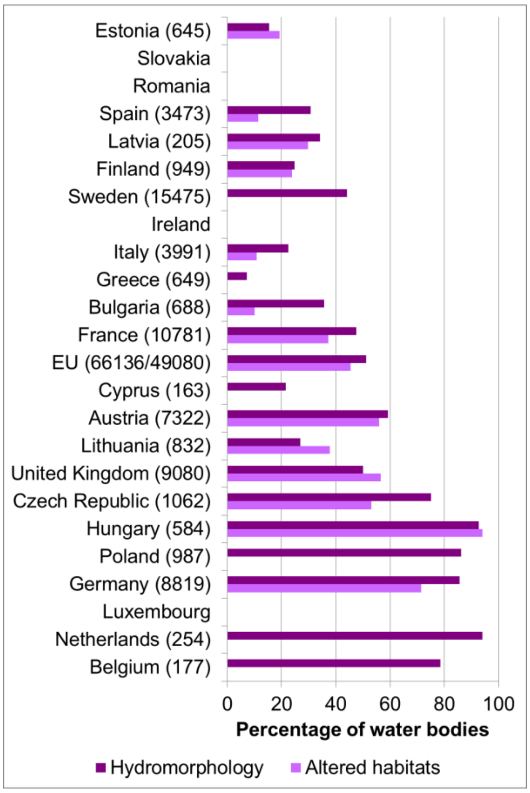
b) Nutrient and organic enrichment



c) Contamination



d) Hydromorphology / altered habitats



Notes: The number of classified river water bodies is given in brackets for each member state. Empty rows mean that no data on the specific pressure and/or impact are reported from those member states. These member states are also excluded from the overall EU results. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.
Source: http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_pressure_status & http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_impact_status

4.2.2. Case study: Rhine and Danube river basins on status and impacts

The river Rhine connects the Alps to the North Sea. The river has a length of 1300 km, and its catchment area covers approximately 200000 km2 spread over nine states (7 EU member states). The catchment area has 58 million inhabitants, with about half of the surface area used for agricultural purposes, about one third is forest and protected areas and almost 10% is urbanized. The catchment area also contains extensive industrial and chemical parks.

Important tributaries of the Rhine are Neckar, Main and Moselle. The Lower Rhine splits in several braches that enter the coastal waters of the North Sea and the Wadden Sea.

The Rhine river basin is divided into nine subunits, the Alpine Rhine/Lake Constance, the High Rhine, Upper Rhine and Middle Rhine, the tributaries Neckar, Main and Moselle/Saar, and then the Lower Rhine and Delta Rhine. The latter subunit also includes the transitional and coastal water bodies of the North Sea and the Wadden Sea. Some of these subunits (Alpine Rhine: AT, DE; Moselle/Saar: DE, FR, LU; and Delta Rhine: DE, NL) cover more than one national state (Figure 2.4.1).

The analysis of the ecological status or potential in the freshwater part of the Rhine river transect (figure 4.3) shows that the ecological conditions decline following the main stream of the river downstream from the Alps to the river mouth in the Netherlands. In the three uppermost sub-units (Alpine Rhine/Lake Constance and High Rhine) altered habitats is the main, or the only, impact (figure 4.3). There are numerous reservoirs and barrages for hydropower generation. These structures disrupt river continuity. The impact by altered habitats increases downstream, where it to a larger extent is related to flood protection, maintenance of the navigation channel, water level regulation measures and hydropower.

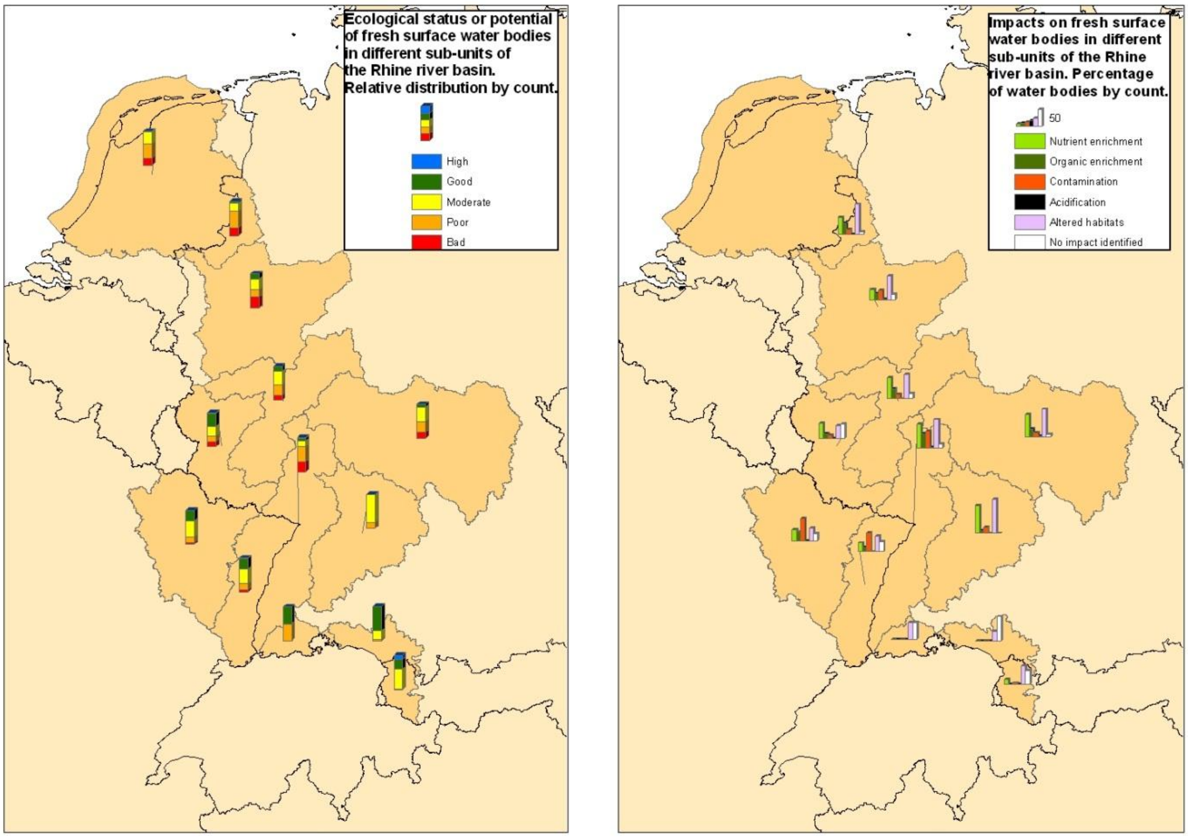
The hydromorphological modifications have impacted the ecological function of the Rhine, by restricting river dynamics, loss of alluvial areas, impoverishment of biological diversity and creating obstacles to fish migration. Restoring biological river continuity and increasing habitat diversity are major objectives of restoration measures. Measures aim to improve fish migration, from the North Sea up to the Basel area, with the salmon and other species.

The proportion of water bodies affected by nutrient enrichment and (to a lesser extent) organic enrichment also increases markedly downstream, following the main stream. Excessive concentrations of phosphorus and nitrogen have an impact on ecological status through eutrophication. While phosphorus concentrations have decreased to a certain extent, further reduction is still necessary to restore ecological conditions for some parts of the Rhine district. The coastal water bodies at the downstream end of the Rhine are sensitive to elevated nitrogen concentrations, and targets have been set to further reduce nitrogen pollution and achieve good status in the coastal waters (North Sea and Wadden Sea).

Some substances still cause contamination problems in the Rhine district. Nowadays, 96% of the people living in the catchment area and many industrial plants are connected to wastewater treatment plants. Point sources contribute less to classical pollution than in the past. Nutrient enrichment and contamination is thus largely caused by diffuse sources.

Together these impacts can explain the decline in ecological conditions from upstream to downstream areas. In the downstream subunits (Lower Rhine and Delta Rhine) only a small proportion of the water bodies are in good status, mainly as a consequence of the altered habitats and nutrient enrichment.

Figure 4.3 Relative distribution of ecological status or potential of classified fresh surface water bodies in sub-units of the Rhine RBD given as percentage of total number of water bodies in different ecological status classes (left panel). The percentage of total number of classified fresh surface water bodies affected by various impacts in sub-units of the Rhine RBD (right panel).

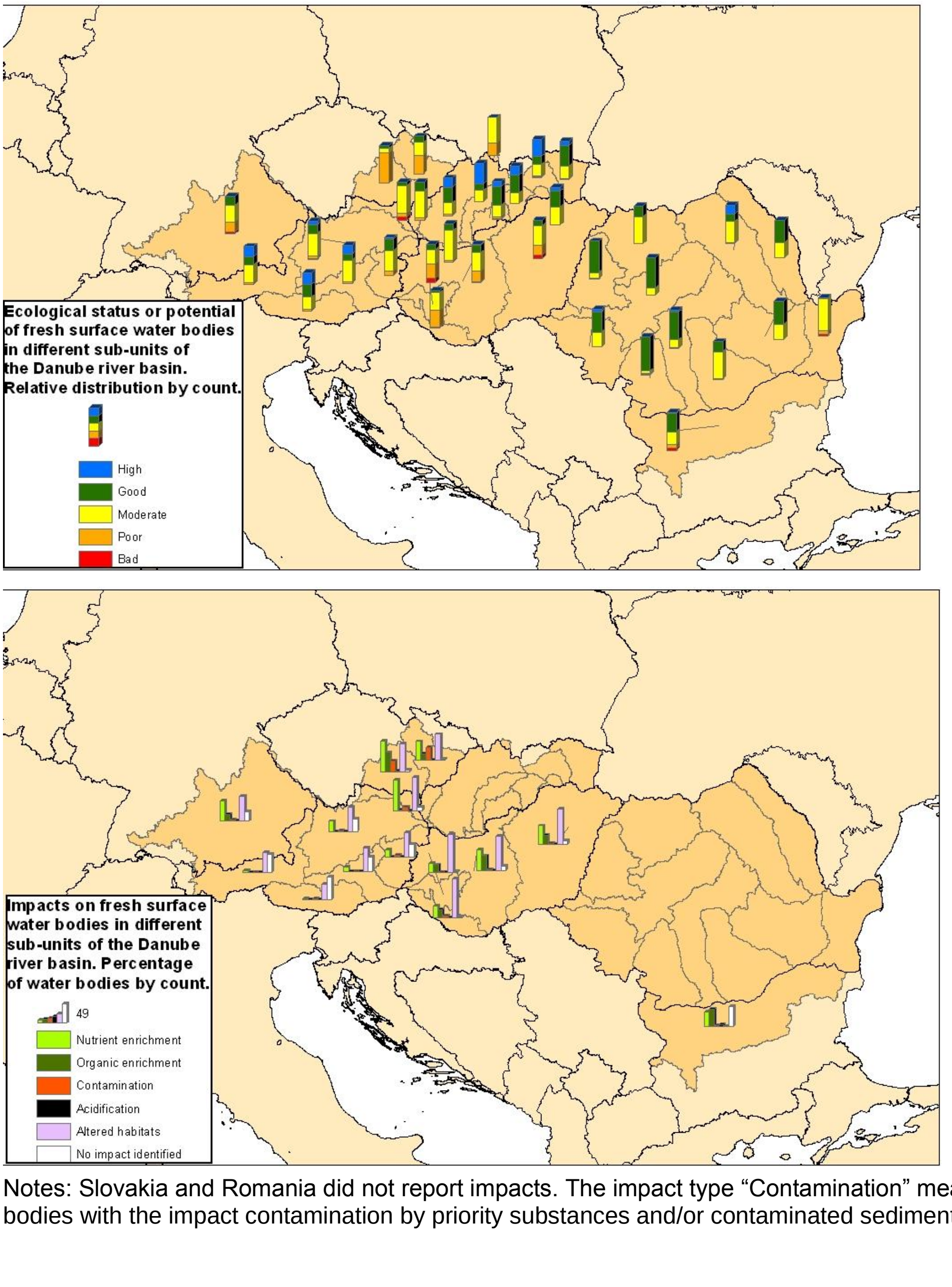


Notes: The Netherlands did not report impacts. The impact type "Contamination" means surface water bodies with the impact contamination by priority substances and/or contaminated sediment.

The map of ecological status or potential of Danube sub-units (figure 4.4, upper panel) does not to such a large extent as the Rhine map reflect an upstream-downstream decline in ecological conditions. Rather, it shows the difference between higher altitude, less densely populated areas (western Austria, northern Slovakia, mid-Romania) and lower altitude, more densely populated areas with more intensive agriculture (south Germany, eastern Austria eastern Czech Republic, Hungary, eastern Romania). The main stem of the Danube is largely flowing through the sub-units with the worst ecological conditions, while the conditions are better in the tributary sub-units.

The differences between the higher and lower lying areas are less evident from the impacts map of the Danube sub-units (figure 4.4. lower panel), due to the lack of reporting impacts from Slovakia and Romania. However, it does show nutrient enrichment in the lower lying areas of south Germany, eastern Austria, the Czech Republic and mid-Hungary. It also shows the strong impact of altered habitats many places.

Figure 4.4. Relative distribution of ecological status or potential of classified fresh surface water bodies in sub-units of the Danube RBDs given as percentage of total number of water bodies in different ecological status classes (upper panel). Percentage of total number of classified fresh surface water bodies affected by various impacts in sub-units of the Danube RBDs (lower panel).



Notes: Slovakia and Romania did not report impacts. The impact type “Contamination” means surface water bodies with the impact contamination by priority substances and/or contaminated sediment.

4.2.3. **Case studies, Ecological status of rivers in Germany and Sweden**

Germany – Ecological status of different river types

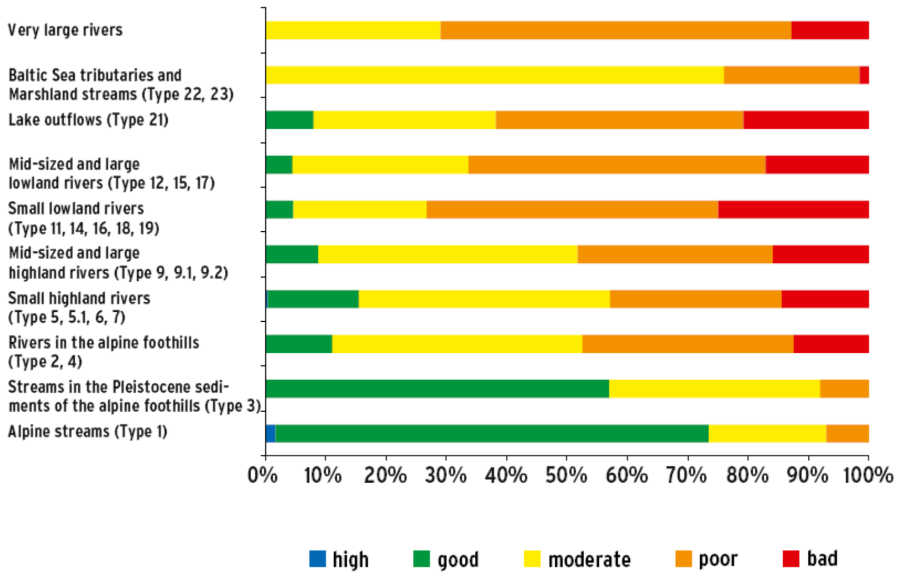
Source: BMU/UBA 2010: Water Resource Management in Germany, Part 2 - Water Quality

Germany has identified 9070 river water bodies with a total length of around 127 000 kilometres. The length of all natural watercourses totals 74 506 km, corresponding to 59 % of the total river length. The proportion of heavily modified water bodies (HMWB) is 31 %, while artificial water bodies (AWB) account for 10 %. The natural river water bodies have been divided into 25 river types characterized by their location in the different eco-regions and the geological, morphological and hydrological characteristics of the river and the catchment.

An assessment of natural river water bodies reveals that by river length 14 % of the length is high or good ecological status, while 37 %, 33.5 % and 15.5 % are in moderate, poor or bad status, respectively. The most common reason for failing to achieve a "good ecological status" are changes in hydromorphology in natural river water bodies, and the high levels of nutrient pollution.

There are significant differences in the ecological status of the different German river types (Figure 5.x). More than 60 % of the natural river water bodies of the Alps and of the Pleistocene sediments in the Alpine foothills have at least "good" ecological status. Of the other watercourse types of the alpine foothills and Central German Highlands, 20 % are classed as having a "good" status, while 30 to 50 % are classed as "moderate". Among North German lowland streams and rivers, the proportion of good status is generally well below 10 %. Generally speaking, more than 70 % of the river length in many lowland watercourse types has an ecological status worse than "moderate". None of the large rivers have high or good ecological status.

Figure 4.5 Percentage distribution of ecological status classes in natural German river water bodies per common groups of river types.



Source: Federal Environment Agency (UBA), data supplied by LAWA, data source: Berichtsportal WasserBLIcK/BfG, as at 22 march 2010

The Po River, Italy

The longest river in Italy, the river Po, flows eastward across northern Italy from the Cottian Alps to the Adriatic Sea near Venice. The 652 km long river has a 74 000 km^2 drainage area of which 41 000 km^2 is mountainous and the remaining 29 000 km^2 is located in the Po valley encompassing the lowland plain of rich soil. There are 450 lakes in the drainage basin, and 141 tributaries add to the river that discharges an average 1540 m^3/s into the Adriatic Sea through a wide delta. The amount of water discharged by Po is approx. 50% of the total freshwater input to the northern Adriatic Sea.

On the North side the flux of water is regulated by five large lakes. These lakes are directly connected to the main tributaries of the Po River. The retention of water, nutrient and particulate material in the lakes reduce the discharge of pollutants to the river. The landscape has changed due to increased urbanisation and intensified agriculture production over the past century. In recent years a large proportion of the natural vegetation (nearly 25%) in the riparian zone of the Po river has been replaced with plantations of poplars harvested for cellulose.

Due to an uneven precipitation pattern, the river is subject to periodic heavy flooding which is intensified by the fast runoff from the increasing urban areas. More than half the river length is controlled with a system of dikes to prevent flood damage.

Driving forces and Pressures

The Po River basin is a strategic region for the Italian economy, with significant agriculture, industry and tourism sectors. The lakes in the northern part are important for tourism, but are affected by eutrophication, especially lake Garda, where nutrient reduction measures are still not sufficient to meet the WFD requirement of good ecological status.

The river passes a number of larger Italian cities and Turin is the industrial center of the region. Milan is indirectly connected to the river by a channel system.

More than 40% of the Italian workforce is employed in this region and produces nearly 40% of the national GDP. 55% of Italian livestock is found here and 35% of the agricultural production takes place in this region.

The principal farming areas are localised in the Po valley, covering 45% of the basin’s total area. Most of the agricultural land in the Po valley is arable land, drained by artificial ditches, and 50% of agricultural land is irrigated during summer. The major crops that are grown are wheat, maize, fodder, barley, sugar beets and rice – with the latter being especially water demanding.

The United Nations World Water Development Report 3 (World Water Assessment Programme, 2009) summarises the water challenges in the Po River basin, concluding that the high level of regional development has put heavy pressure on water resources and led to degradation of surface and groundwater quality.

Averaged year flow rate is presently lower than water use permits, both for surface waters and for groundwater. Irrigation is by far the largest consumer of water, four times the consumption of industrial water and public water supply combined.

State

Surface and groundwater quality is affected by discharges and losses of pollutants from industrial, agricultural and household. Excessive nutrients and organics in surface water causes eutrophication in rivers and in lakes. Although a network of wastewater treatment facilities has stopped further degradation of water quality, it has not been sufficient to reverse the process. Groundwater resources continue to contain high concentrations of nitrates due to fertilizer use in agriculture, while excessive exploitation has caused salt intrusion into coastal aquifers and, in some places, ground subsidence.

More than half of the nitrogen and phosphorus loads in the river Po originate from diffuse sources – and the role of the intensive agriculture activities on the plain is obvious. The results of scenario analyses by the turn of the century indicated that the measures imposed by the EU Nitrates Directive and the EU Wastewater Treatment Directive may not be stringent enough to achieve a large reduction in the N and P loads in the river Po (de Wit M.1 and Bendoricchio G., 2001).

The nutrient enriched water has a negative impact on the ecological status of the main river and its tributaries (Figure 4.6), showing that the whole river basin, except a few minor tributaries, fails the WFD objective of good ecological status. Moreover, when the water discharges into the Adriatic Sea the high nutrient load leads to eutrophication of the coastal waters. Paleo analyses of marine sediments covering the period 1830–1990 have revealed that a progressive increase in eutrophication took place in the beginning in the 20th century - particularly marked between 1930 and 1978. After 1978, the situation has improved, but still not recovered (Sangiorgi and Donders, 2004).

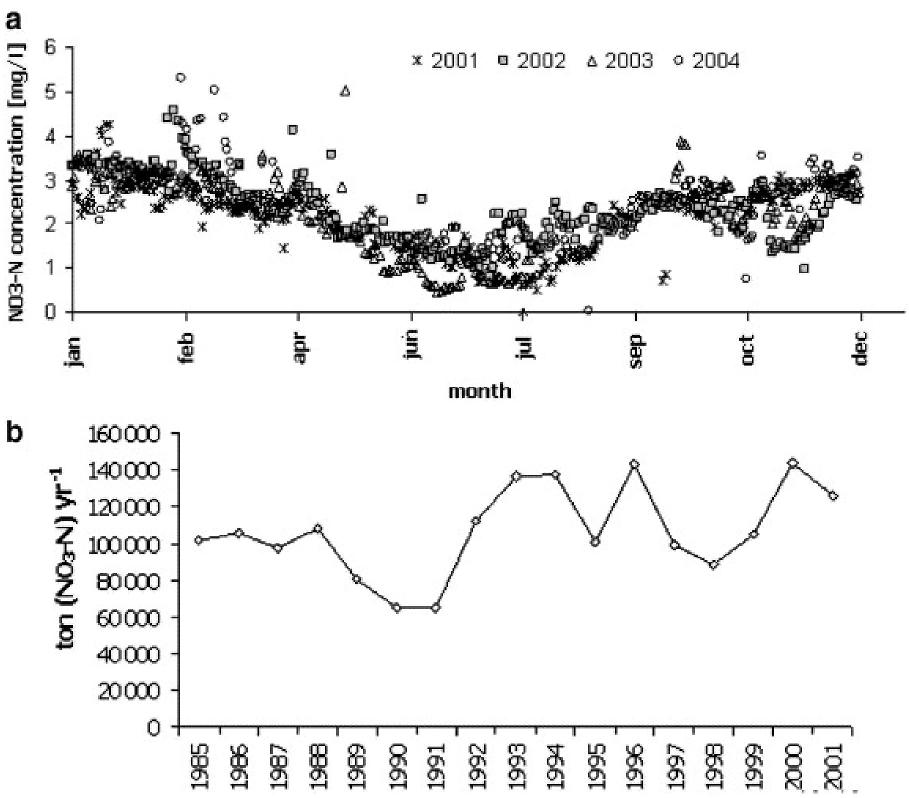
Response

Although policy tools for managing and safeguarding water resources have been implemented at national level for some time, there have been long lasting problems with the implementation and enforcement of rules and regulations at a regional level.

A set of integrated water management plans as well as flood risk management plans are adopted in all regions of the Po river basin. In 2009 all these plans were homogenised into the integrated river basin management plan at District level according to the WFD.

The Po Valley Project is a new integrated project that aims to integrate actions and measures for water quality, flood risk control, cultural and tourism requirements over a 6 year period from 2009 - 2015.

Figure 4.6 - Time serie (1985-2001) of nitrate concentration from the monitoring station at Pontelagoscuro (near the river mouth).



Copied from Salvetti et al. (2006).

Figure 4.7 - Mean phosphate concentration for the Po river basin taken from WISE SoE.

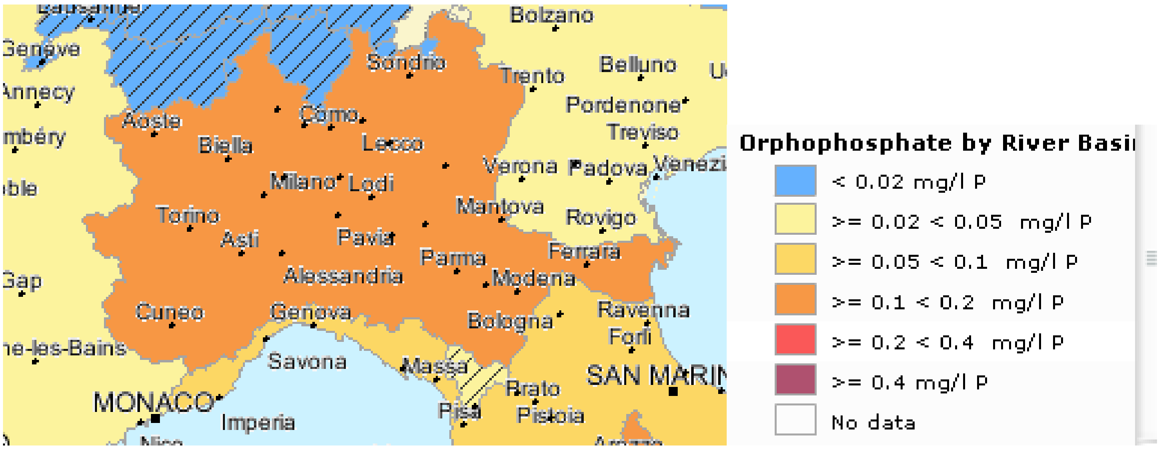
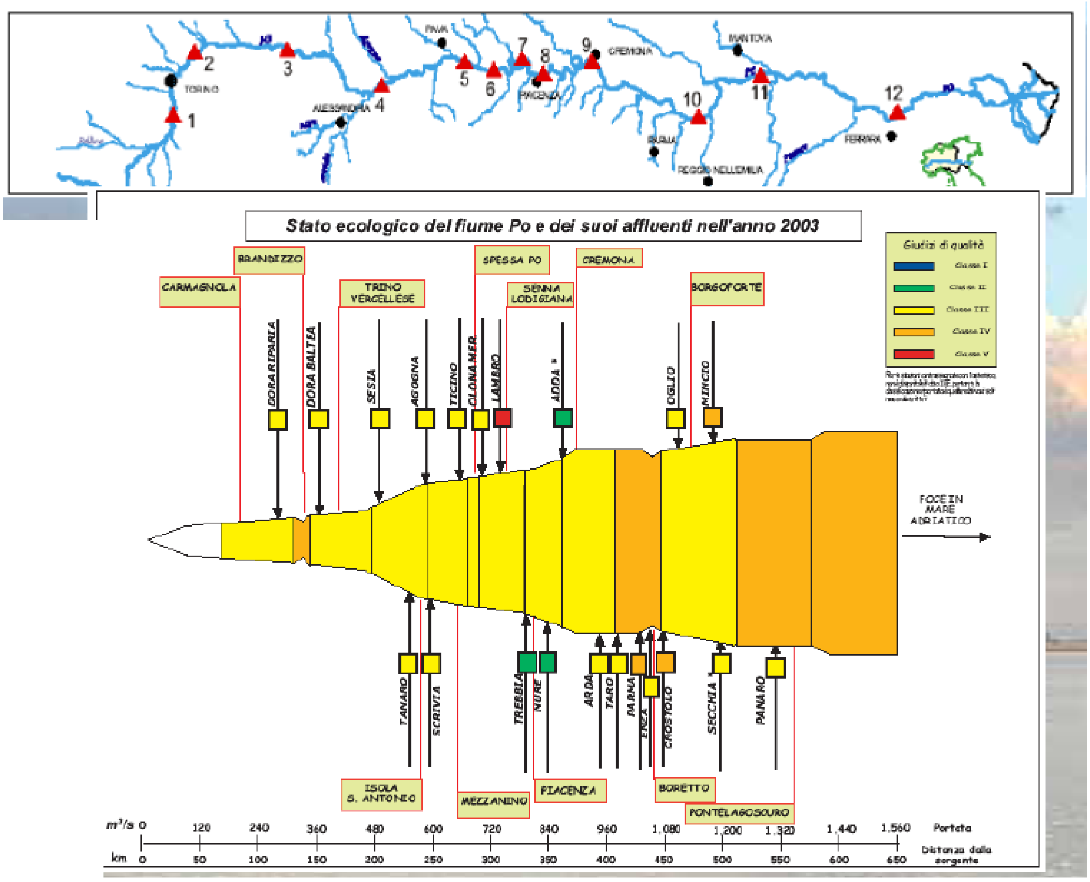


Figure 4.8 - Ecological status of the Po river and its tributaries from the source (left side) to the mouth (right side) (Bortone, 2009).



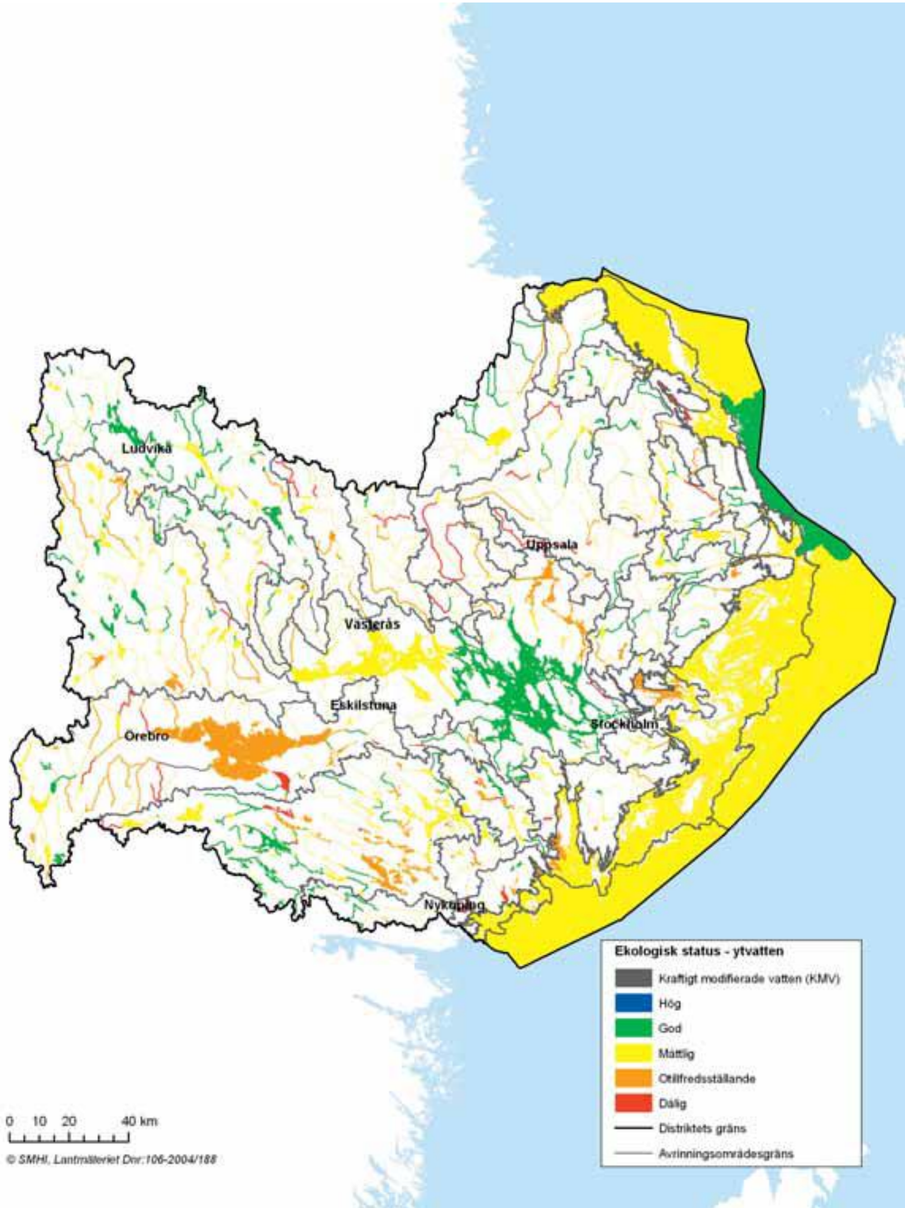
Sweden: Ecological status of surface waters in the North Baltic RBD

Source: North Baltic River Basin Authority 2009: River Basin Management Plan for the North Baltic River Basin District, 2009-2015. (185 pp). Chapter 7: Status 2009.

The North Baltic River Basin District is the part of Sweden with highest pressures and impacts due to many large cities (e.g. Stockholm, Uppsala and Örebro) and large areas with intensive agriculture. According to the first river basin management plan as much as 75% of the 1111 natural surface water bodies (excluding 19 heavily modified or artifical water bodies) have been reported to be in moderate or worse ecological status, including the large lake Hjälmaren (Figure 4.9). Only one water body (a lake) is classified as having high ecological status, whereas 42 water bodies are in bad status.

Nutrient enrichment mainly from diffuse source pollution is the main pressure and impact in lakes, transitional and coastal waters, while hydromorphological pressures, in particular migration barriers for fish, is an important additional pressure and impact in the rivers.

Figure 4.9. Ecological status for surface water bodies in the North Baltic RBD, Sweden.



4.3. Lakes

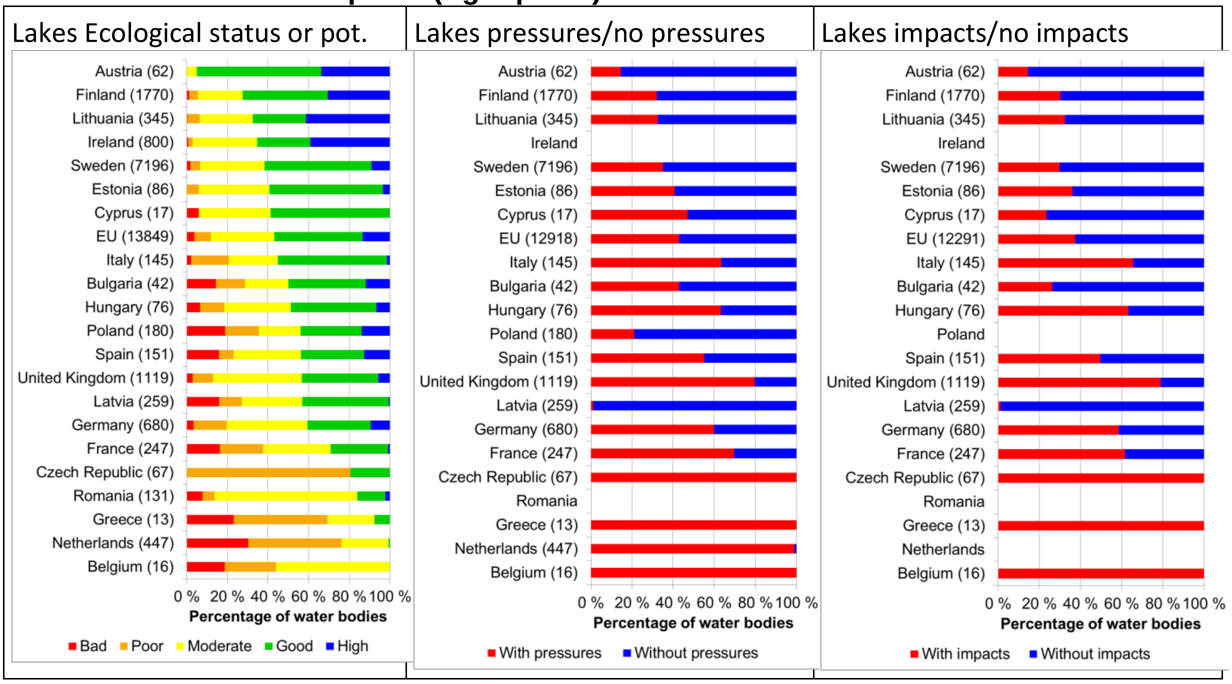
4.3.1. **Main assessment status and main pressures and impacts**

In total around 18 000 lake water bodies with an area greater than 90 000 km^2 has been reported by 21 Member states. Two countries, Sweden, and Finland, reported more than two thirds of the lake water bodies and lake area.

The average area of the more than 18 000 reported lake water bodies is 5.1 km^2. Seven Member States (Austria, Estonia, France, Greece, Hungary, Lithuania, and Spain) had average size of lake water bodies greater than 10 km^2. Half of the reported lakes are less than 1 km^2 in area and more than 87% of the reported lake water bodies have an area less than 5 km^2. Only 78 of the reported lake water bodies have an area greater than 150 km2; more than half of these are found in Finland and Sweden.

For lakes, there are close to 6000 water bodies (43% of the total number), or close to 31 000 km^2 (39% of total lakes surface area) reported to be in less than good ecological status or potential. The main causes for the poor ecological status or potential in these lake WBs are emissions from diffuse sources coming from agricultural pollution, causing nutrient enrichment, as well as hydromorphological changes causing altered habitats.

Figure 4.10 Ecological status or potential, pressures and impacts of classified lake water bodies in different member states sorted by proportion of good or better ecological status or potential. The figure shows the percentage of total number of lake water bodies in different status classes (left panel), with and without pressures reported (middle panel), with and without impacts (right panel).



Notes: The number of classified lake water bodies is given in brackets for each member state. Empty rows in the pressures and impacts plots mean that no data on pressures and/or impacts are reported from those member states. These member states are also excluded from the overall EU results. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.Source: Based on data available in WISE-WFD database primo February 2012, - country results on ecological status, pressures and impacts are available here http://wfd.atkins.dk/report/WFD_aggregation_reports/swb_status & http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_pressure_status & http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_impact_status

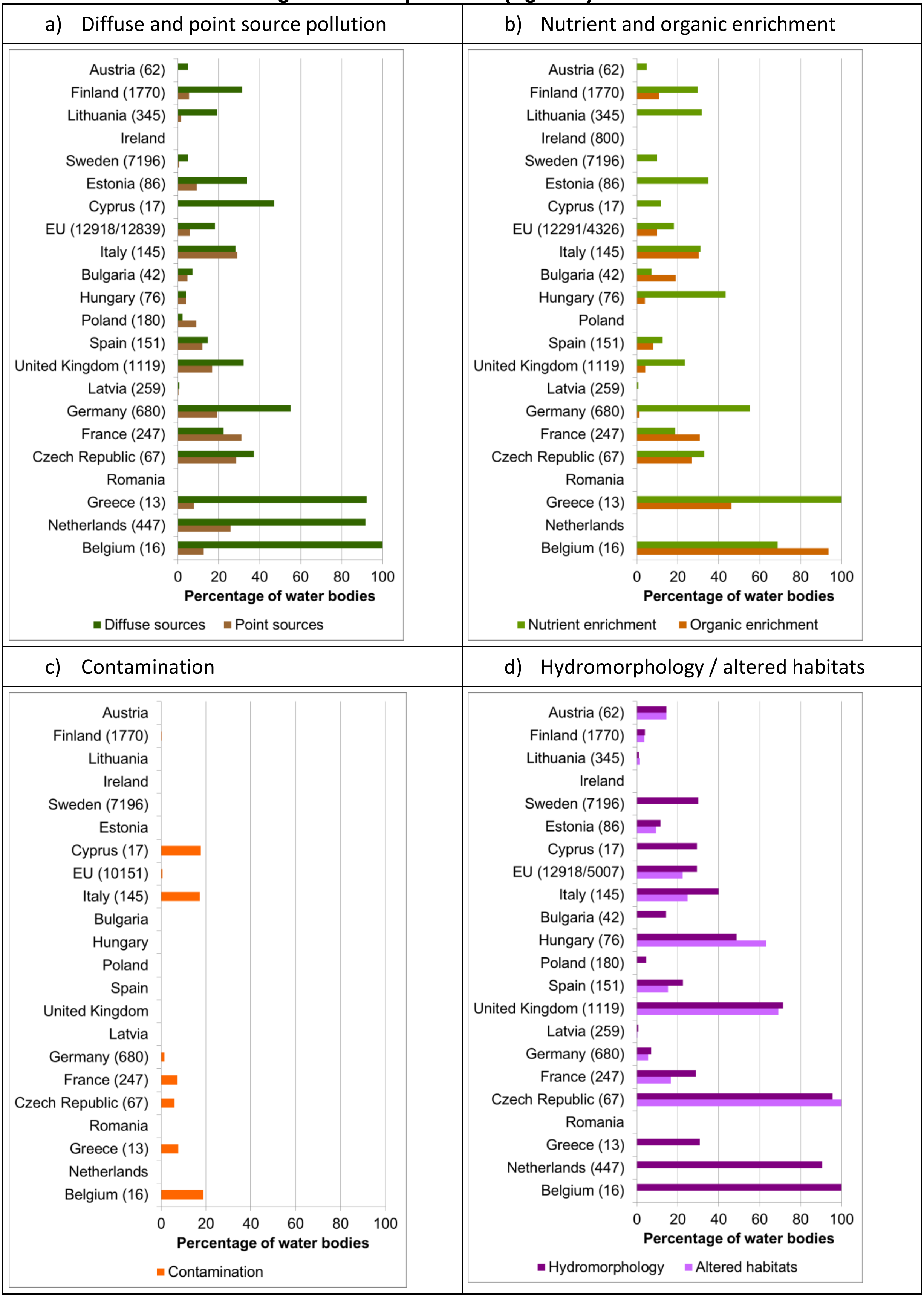
Many of the Central-European Member States with high population density and intensive agriculture, generally have less than half of their lake water bodies in good or better ecological status or potential (lower part of figure 4.10). The highest proportion of lake WBs with good ecological status or potential is reported in Austria, where close to all lake water bodies are reported to be in good or better status. Also in Northern Europe (Sweden, Finland, Ireland), and in two of the Baltic countries (Estonia and Lithuania), as well as in Cyprus the majority of lake water bodies are reported to be in good or better ecological status or potential. The large differences reported between some neighbouring member states, e.g. Lithuania and Latvia, or Hungary and Romania may partly be caused by different assessment approaches (see section 3.1.2), and need further analyses of population density and % arable land to be fully understood.

In some member states there are large differences between the proportion of lake and river water bodies in good or better ecological status or potential, e.g. in Romania, where less than 20% of the lake water bodies (Fig. 4.10), but more than 60% of the river water bodies (Fig. 4.1) are reported to be in good or better ecological status or potential. In Lithuania, the situation is opposite with better status in the lakes than in the rivers: close to 70% of the lakes water bodies, but only 40% of the river water bodies are reported to be in good ecological status or potential. Also in Austria a much better status has been reported for the lake water bodies than for river water bodies. These differences can partly be caused by incomplete and more or less stringent class boundaries for assessment systems in lakes versus those for rivers, but can also be real differences caused by the location of lakes (lowland or upland) relative to rivers, or different pressures and restoration efforts done over the past years in lakes versus rivers.

The proportion of lake WBs with no significant pressure or no impacts generally followed the ranking of Member States based on at least good ecological status, i.e. Member States having a more than 50 % of the lake WBs in good ecological status generally also have a high proportion of lake WBs without pressures and with no identified impacts. Conversely, the Member States with a large proportion of WBs in less than good ecological status generally have the majority of lake WBs with significant pressures and impacts. The exception is Latvia who has not reported any significant pressures nor impacts for close to 100% of their lake water bodies, in spite of having more than half of their lake water bodies in less than good ecological status or potential. Also Poland reports lower pressures on their lake water bodies (less than 20% with pressures) than the ecological status reporting would suggest (less than 50% in good or better status). These inconsistencies may be caused by reporting mistakes, or lack of pressure information.

Figure 4.11 shows the major categories of pressures and impacts affecting ecological status in European lakes. The proportion of lake WBs affected by diffuse pollution (Fig. 4.11.a), nutrient enrichment (Fig. 4.11.b), as well as hydromorphological pressures and altered habitats (Fig. 4.11.d) generally corresponds to the proportion in good ecological status as shown in Figure 4.10 above.

Figure 4.11. Proportion of classified lakes exposed to different main pressures and impacts in different member states ranked by proportion of good or better ecological status/potential (fig 4.10)



Notes: The number of classified river water bodies is given in brackets for each member state. Empty rows mean that no data on the specific pressure and/or impact are reported from those member states. These member states are also excluded from the overall EU results. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.
Source: http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_pressure_status & http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_impact_status

The most important pollution pressure comes from diffuse sources, causing nutrient enrichment impacts in the majority of lakes in most of the member states having the worst ecological status (lower part of figure 4.10). Exceptions are France and the Czech republic who reported quite low diffuse pressures relative to the large proportion of lakes reported to be in less than good ecological status or potential. For the Czech republic this can be explained by the high proportion of lakes or reservoirs affected by hydromorphological pressures and altered habitats (fig. 4.11.d), while this is not the case for France, who has reported also quite low proportion of lakes affected by hydromorphological pressures and altered habitats.

Contamination by priority substances coming from both point and diffuse source pollution is affecting less than 20% of classified lakes in most member states (Fig. 4.11.c). This impact is not well reflected in the ecological status, as the assessment systems are not developed to measure this impact. It will however be important for the chemical status. In Sweden, all the water bodies are subject to diffuse pressures of priority substances and contamination impact, mainly due to mercury in biota, but this has little impact on ecological status, although it affects chemical status. Therefore these data has been excluded from the analyses of pressures and impacts affecting ecological status.

Point source pollution of lakes is generally reported to affect less than 25% of lake water bodies. This low proportion of lakes being affected by point source pollution is due to substantial urban waste water treatment over the past decade(s), thereby causing organic enrichment in only a minority of lakes in most countries. The exception here is Greece and in particular Belgium where most of the lake water bodies are affected by organic enrichment in spite of low proportions reported to receive point source pollution.

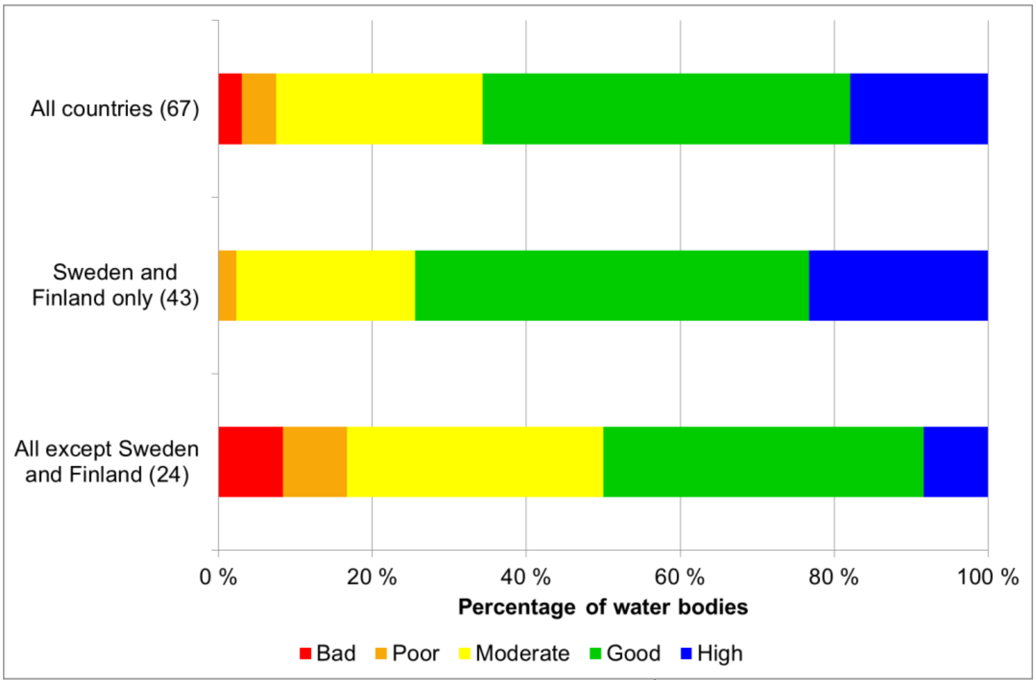
Hydromorphological pressures causing altered habitats is the other major pressure in European lakes, affecting the majority of water bodies in Member States with a large proportion of lakes in moderate or worse ecological status or potential (Fig. 4.11.d). [A large share of these lakes is heavily modified or artificial reservoirs.] In Member States with better ecological status or potential this pressure and impact affect less than 50% of the classified lakes. Some of these pressures may also affect only a part of the lake shore, and thus may in some cases not be sufficient to degrade the ecological status of the whole lake water body.

4.3.2. **Ecological status, pressures and impacts of Europe's largest lakes**

General overview
The largest lakes of Europe are the lakes Ladoga and Onega in Russia, the lakes Vänern, Vättern and Mälaren in Sweden, Lake Saimaa in Finland, Lake Peipsi in Estonia/Russia, and Lake Ijsselmeer in the Netherlands. All these lakes have a surface area more than 1000 km^2.
Based on the member states reporting of lake water bodies in the river basin management plans, there are 67 lake water bodies with a surface area larger than 150 km^2. One third of these are in less than good ecological status or potential (Figure 4.12).
Most of the large lake water bodies are found in Sweden and Finland, and the large majority of these (74%) are in good or better ecological status or potential. The only large lake water body reported to be in poor status in these Nordic member states is the Swedish lake Hjälmaren. Lake Hjälmaren is a shallow, lowland lake situated in a region with lime-rich clays and large agricultural areas surrounding the lake contributing to the nutrient loading of the water. The lake is used as a freshwater reservoir, as a recipient of sewage water-mainly from the town Örebro in the westernmost part - and

for recreational purposes. The accelerated eutrophication during the last thirty years has especially affected the two basins closest to the town Örebro due to the increased population of the town (http://www.ilec.or.jp/database/eur/eur-14.html).

Figure 4.12. Ecological status or potential of classified lake water bodies with surface area more than 150 km^2.

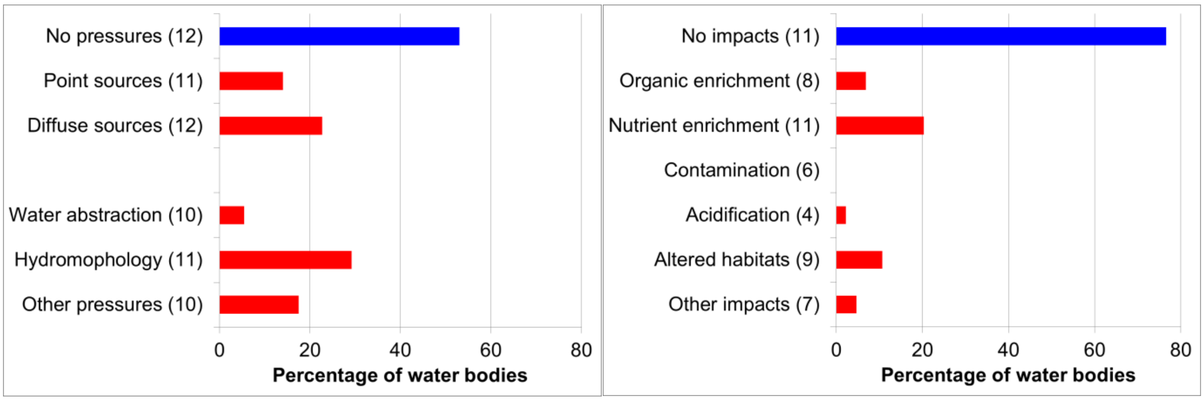


Notes: Total number of classified large lake water bodies > 150 km^2 is given in brackets.
Source: Based on data available in WISE-WFD database primo February 2012, - country results on ecological status is available here http://wfd.atkins.dk/report/WFD_aggregation_reports/swb_status

Parts of other large lakes, such as eutrophied shallow bays receiving diffuse or point source pollution may also be in less than good status, but these do not appear among the large lake water bodies shown in figure 4.12 because they are delineated as separate water bodies with surface area less than 150 km^2. Only half of the large lake water bodies in the rest of Europe (excluding Sweden and Finland) are in good or better ecological status or potential.

Slightly more than half of the large lake water bodies (53%) are reported to have no significant pressures (fig. 4.13), while close to 80% are reported to have no impacts, indicating that some of the pressures have little impact on these large lake water bodies. Particularly the hydromorphology pressures seem to cause little impact, as 30% are exposed to hydromorphology pressures, but only 10% are reported to have altered habitats. Also for point source pollution and "other pressures" the proportion of exposed water bodies are higher than the impacted water bodies. The reason for the low impact of those pressures may be that they affect only small parts of these large lake water bodies, in contrast to the diffuse sources which cause nutrient enrichment in almost all the water bodies where this pressure is reported.

Figure 4.13. Percentage of total number of classified large lake water bodies with surface area over 150 km^2 and with or without identified significant pressures (left) and impacts (right).



Notes : The percentage is calculated against the total number of classified large lake water bodies in member states reporting the specific pressure or impact type (or any pressure or impact for the blue bars). The number of member states included is indicated in brackets. “Hydromorphology” denotes the combination of the aggregated pressure types “Water flow regulations and morphological alterations of surface water“,“River management“,“Transitional and coastal water management“ and “Other morphological alterations“. A water body is defined as affected by any of the pressure types in the figures if it is reported with the aggregated pressure type and/or any of the corresponding disaggregated pressure types. The impact type “Contamination” means surface water bodies with the impact contamination by priority substances and/or contaminated sediment. The impact type “Other impacts” means surface water bodies with at least one of the impacts “Saline intrusion”, “Elevated temperatures” or “Other significant impacts”. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.
Source: Based on data available in WISE-WFD database primo February 2012, - country results on pressures and impacts are available here http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_pressure_ & http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_impact_

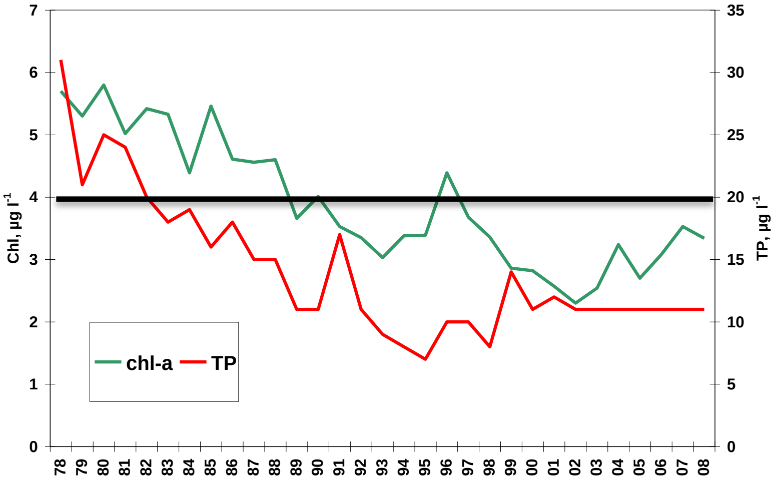
Case studies large lakes.

Lago Maggiore, Italy
Lago Maggiore in Northern Italy close to the Alpine region is a naturally oligotrophic lake with a surface area of 213 km2 and a mean depth of 177 m (max depth 370 m).

Source: http://en.wikipedia.org/wiki/File:Lago-Maggiore_1387.JPG.

The lake was exposed to increasing nutrient pollution from urban waste water in the 1960ies and 1970s, resulting in massive bluegreen algal blooms. However, due to urban waste water treatment, the lake has been gradually restored during the 1980 ies and 1990 ies and is now in good ecological status in terms of phytoplankton biomass (fig. 4.14). Also the taxonomic composition of phytoplankton has been restored from a typically eutrophic community structure dominated by harmful filamentous bluegreen algae and large pennate diatoms to a more diverse phytoplankton community consisting of mostly smaller sized phytoplankton species.

Figure 4.14. Time series of phytoplankton biomass (as chlorophyll a) and total phosphorus (TP) from Lago Maggiore, Northern Italy.



Source: Giuseppe Morabito, CNR-Pallanza (Lyche Solheim et al. 2010). Black line indicates good/moderate boundary for chlorophyll a for this lake type, according to Poikane 2009.

Lake Balaton, Hungary

Source: http://www.ilec.or.jp/database/eur/eur-04.html and Hajnal and Padisak 2008

Lake Balaton in Hungary is a calcareous, large, but very shallow lake with a surface area of 593 km2 and a mean depth of 3 m (max depth 12 m). The distribution of macrophytes is restricted by strong waves and turbid waters to a relatively narrow belt. Only 3 percent of the lake surface is covered by reeds, and even less by submerged macrophytes. The major primary producers are phytoplankton. The annual commercial fish catch is 1200 tons.

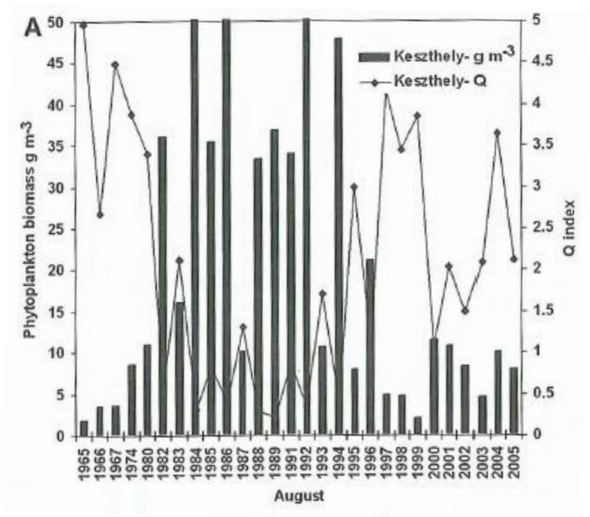
The southern shore of the lake consists of sandy beach, while on the northern shore there are mountains of volcanic origin with old ruins on their tops and vineyards on their slopes. The picturesque landscape and the water ideal for swimming and other water sports attract 2 million tourists annually.

Source: http://www.destination360.com/europe/hungary/lake-balaton

The sewage discharge from rapidly developing towns in the watershed, the growing use of fertilizers in agriculture and large animal farms increased the nutrient loading to the lake in the last decades. A rapid eutrophication became apparent by increased production and biomass of phytoplankton. Blooms of blue-green algae were frequent in the most polluted western part of the lake with biomass of 10-50 mg/l (Figure 4.15).

A restoration program was implemented in the 1990-ies with diversion of most of the municipal sewage, a reservoir was constructed to retain the nutrients carried by the Zala River and pollution due to liquid manure was reduced. The algal biomass has been largely reduced since the mid 1990-ies down to 5-10 mg/l (ref. Hajnal and Padisak 2008), but is still probably above the WFD target for very shallow calcareous lakes (L-CB2 lakes good/moderate boundary for chlorophyll a is 23 µg/l, Poikane 2009, corresponding to a biomass of roughly 2-4 mg/l).

Figure 4.15. Algal biomass (black bars) and taxonomic composition index (Q-line) in the western basin of Lake Balaton, Hungary (Keszthely station) from 1965-2005.



From Hajnal and Padisak, 2008.

Lake Vänern, Sweden

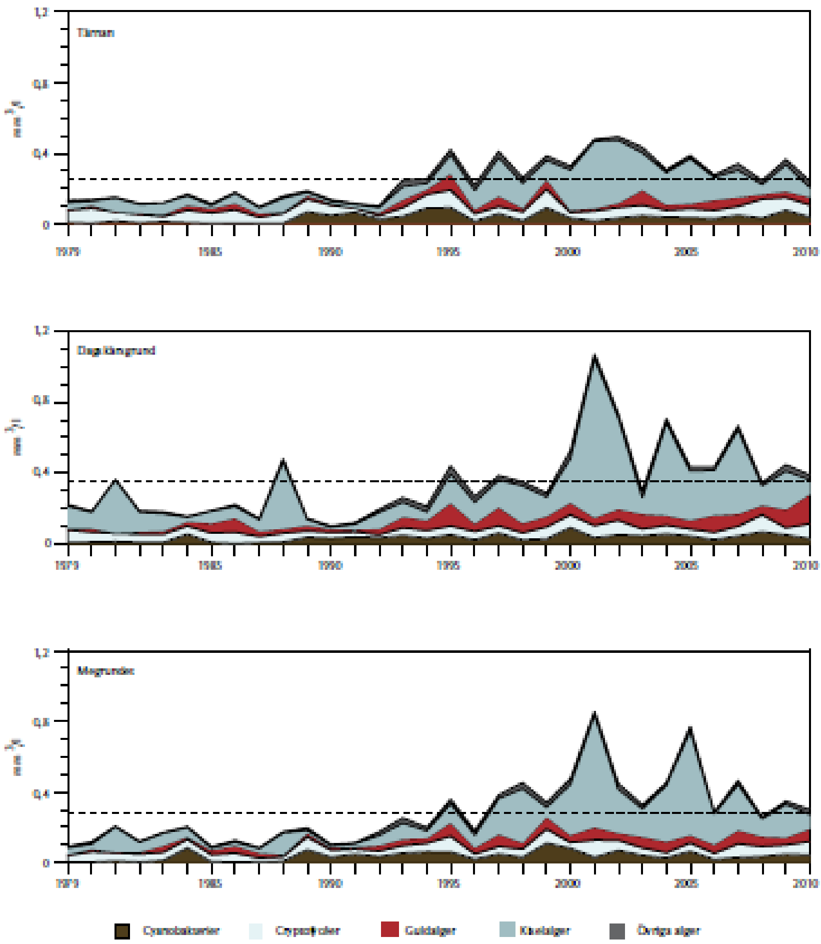
source: http://projektwebbar.lansstyrelsen.se/vanern/SiteCollectionDocuments/sv/Rapporter-publikationer/vvf-arsrapport_2011-webb.pdf) &http://www2.dpes.gu.se/project/Vanern2012/welcome.htm

Source: http://www.panoramio.com/photo/3576437

With a size of 5600 km^2 Vänern is the largest lake within the European Union, and among the 30 largest in the world. The lake is a shallow, lowland lake with a mean depth of 27 m (max depth 106 m). Its location and size gives the lake a maritime character with unique fauna and flora elements, which are recognized in several NATURA2000 areas. Around 300 000 inhabitants lives around the lake and have it as its freshwater source. The lake is the largest water power regulation dam in Sweden with a volume of 153km^3, and it is commercially used both for transport and for fishing. The lake is also important for recreation both for tourists and for those living in the area.
Not all this usages of the lake are without conflicts and the environmental condition for ecosystems are changing due to climate change effects and changed water tapping routines and others pressures.

The current algal biomass in the off-shore waters is low (2-3 µg/l chlorophyll a), reflecting the low phosphorus concentrations (6-8 µg/l), corresponding to good ecological status (Figure 4.16).
While the main basin satisfy the WFD requirement of good ecological status, there are 15 local bays with less than good ecological status, due to nutrient enrichment causing elevated algal biomass and affecting the local flora and fauna.

Figure 4.16. Phytoplankton mean biovolume from 1979-2010 of dominant taxonomic algal groups at three stations in Lake Vänern. The horizontal lines are long-term mean values for the whole period.



4.3.3. **Case studies: Ecological status of lakes in The Netherlands and Denmark**

Both the Netherlands and Denmark have a long tradition for monitoring and reporting water quality of their lakes. A brief summary of the results are included below.

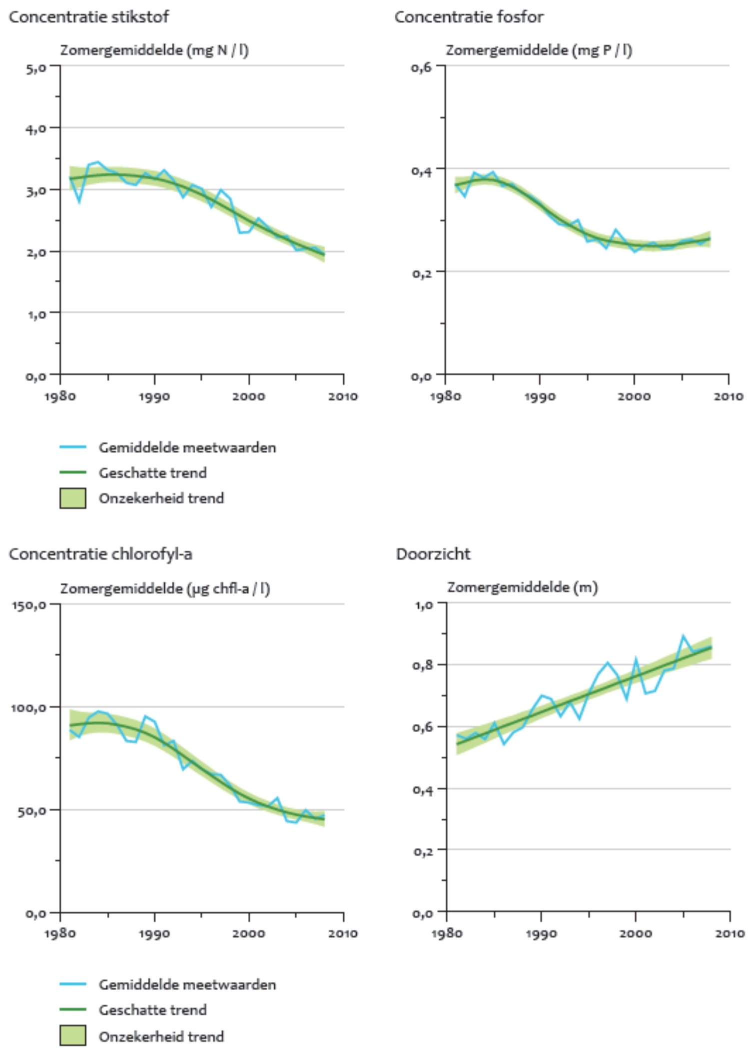
The Netherlands

Source: PBL 2010: Nutriënten in het Nederlandse zoete oppervlaktewater: toestand en trends. & http://www.compendiumvoordeleefomgeving.nl/indicatoren/nl0503-Vermesting-van-meren-en-plassen.html?i=26-79 & Pot, R. 2010: Status and trends in water quality of Dutch lakes and ponds.

The eutrophication in Dutch lakes and ponds is greatly reduced since 1985, but the concentrations of nitrogen, phosphorus and chlorophyll- a, and transparency are still high (Figure 5.y). In recent years water quality has not improved very much.

Mainly due to eutrophication 444 out of 447 Dutch lake water bodies have less than good ecological status and potential.

Figure 4.17: Trend in summer average concentration of nitrogen, phosphorus and Chlorophyll and water transparency (Secchi depth) in Dutch lakes



Source: PBL 2010

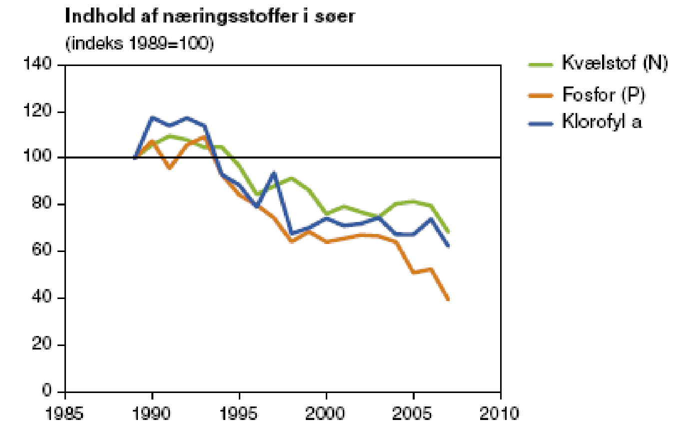
Denmark

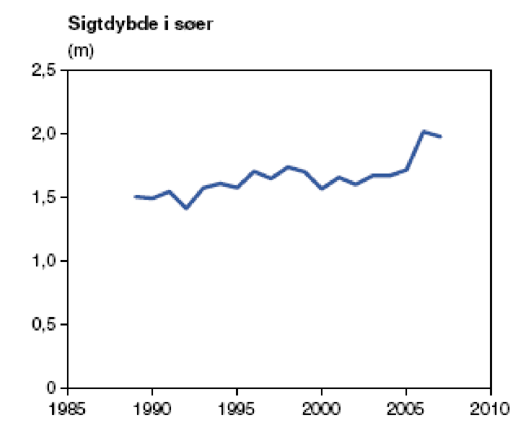
Source: Normander et al. 2009: Natur og Miljø 2009 and Nordeman et al. 2011: Vandmiljø og Natur 2010. NOVANA. Tilstand og udvikling – faglig sammenfatning.

Similar to the Dutch lakes there have since the 1990s been a significant improvement in the water quality of the Danish lakes, with marked reductions in nutrient concentrations and chlorophyll and improvement in water transparency. However, as with the Dutch lakes the majority of Danish lakes do not yet achieve good ecological state and additional reduction in nutrient loading are needed for most of the lakes to achieve good ecological status.

Figure 4.18. Trend in average concentration of nitrogen, phosphorus and Chlorophyll and water transparency (Secchi depth) in Danish lakes

Trend in concentration of nitrogen, phosphorus and chlorophyll in 20 Danish lakes	Trend in water transparency (Secchi depth) in 20 Danish lakes





Source: NERI/Aarhus University

4.4. Transitional waters

4.4.1. **Main assessment status and main pressures and impacts**

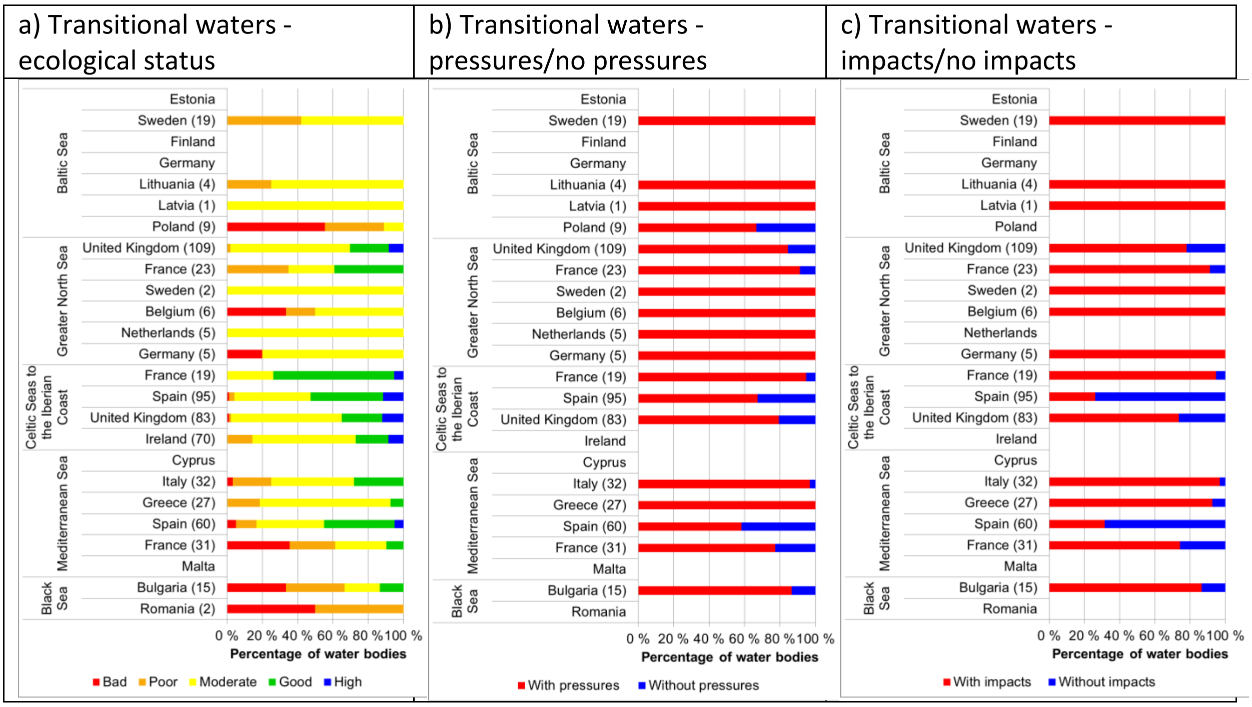
Figure 4.19.a shows that there are eight member states (Sweden, Lithuania, Latvia, Poland, Netherlands, Germany, Belgium (Flanders) and Romania) in which all transitional water bodies are in less than good status (moderate, poor or bad). A high percentage (> 80%) of transitional water bodies in less than good status is also reported for Greece and Bulgaria as well as for the French Mediterranean coast.

The worst ecological status or potential in European transitional waters is found in the Baltic Sea region (data from Sweden, Lithuania, Latvia and Poland), where all reported transitional water bodies are classified as less than good. Poland reported 50% of their transitional waters to be in bad status. Transitional water bodies draining to the Greater North Sea are predominantly in less than good status (moderate and less), with the exception of 30-40 % of the transitional water bodies in UK and France with good or better status.

The best situation is reported for transitional water bodies in the region of the Celtic Sea to the Iberian coast, where more than 74% of the French water bodies and 53% of the Spanish water bodies are in good or better ecological status or potential. Another positive result in this region is that there are almost no water bodies reported to be in bad status, and also very few in poor status. For UK and Ireland however, a large proportion of transitional water bodies are reported to be in moderate status.

In the Mediterranean Sea, all member states with data for transitional water have reported a majority of water bodies to be in less than good ecological status or potential. The situation is worst in France with more than 90% of the classified transitional water bodies reported to be in less than good status and more than 60% in poor or bad status. In Spain the situation is better with more than 40% of the classified transitional water bodies in good or better status or potential, although also in this member state the majority of the transitional waters along the Mediterranean coast are in moderate or worse status. For the EU part of the Black Sea a large majority of the transitional water bodies in Bulgaria and Romania are reported to be in poor or bad status or potential, and only 13% are reported to be in good status (Bulgaria) (Figure 4.19. a).

Figure 4.19. Ecological status or potential, pressures and impacts of classified transitional water bodies in different member states. The figure shows the percentage of total number of transitional water bodies in different status classes (a), with and without pressures reported (b), with and without impacts (c).



Notes: The number of classified river water bodies is given in brackets for each member state. Member States not reporting or not having transitional waters have been included in the current diagram to ensure the comparability with the coastal diagrams included in the next section. Where ecological status or potential has been reported, empty rows in the pressures and impacts plots mean that no data on pressures and/or impacts are reported from those member states. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.

Source: Based on data available in WISE-WFD database primo February 2012, - country results on ecological status, pressures and impacts are available here
http://wfd.atkins.dk/report/WFD_aggregation_reports/swb_status &
http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_pressure_status &
http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_impact_status

Most of the classified transitional waters are reported to be exposed to significant pressures causing significant impacts. The proportion of water bodies with/without pressures and impacts mostly corresponds to the reported ecological status, except for Poland, where one third of the water bodies (3 of 9 water bodies) is reported not to have any significant pressures, despite reporting poor or bad ecological status or potential for more than 85%. The proportion of water bodies exposed to pressures reported from Spain and France in the region of the Celtic Seas to the Iberian Coast is higher than those reported for the same member states for water bodies along the Mediterranean Sea, while the picture for the ecological status or potential is the opposite, with better status in the water bodies in the region of the Celtic Seas to the Iberian Coast than in water bodies along the Mediterranean. This paradox may be related to the more exposed nature of the transitional water bodies along the Atlantic coast of France and Spain than along their Mediterranean coasts, ensuring a better dilution of the pollution pressures causing less ecological effects.

In general, there is a qualitative relation between the proportion of transitional water bodies with/without pressures and those with/without impacts reported by the different member states.

Direct comparison of the selected pressures and impacts provides qualitative information on the correlation between diffuse pressures, predominantly from agricultural runoff, and nutrient enrichment. A similar relation is envisaged between point source pressures, presumably in the form of urban waste water treatment plants and the designated impact organic enrichment.

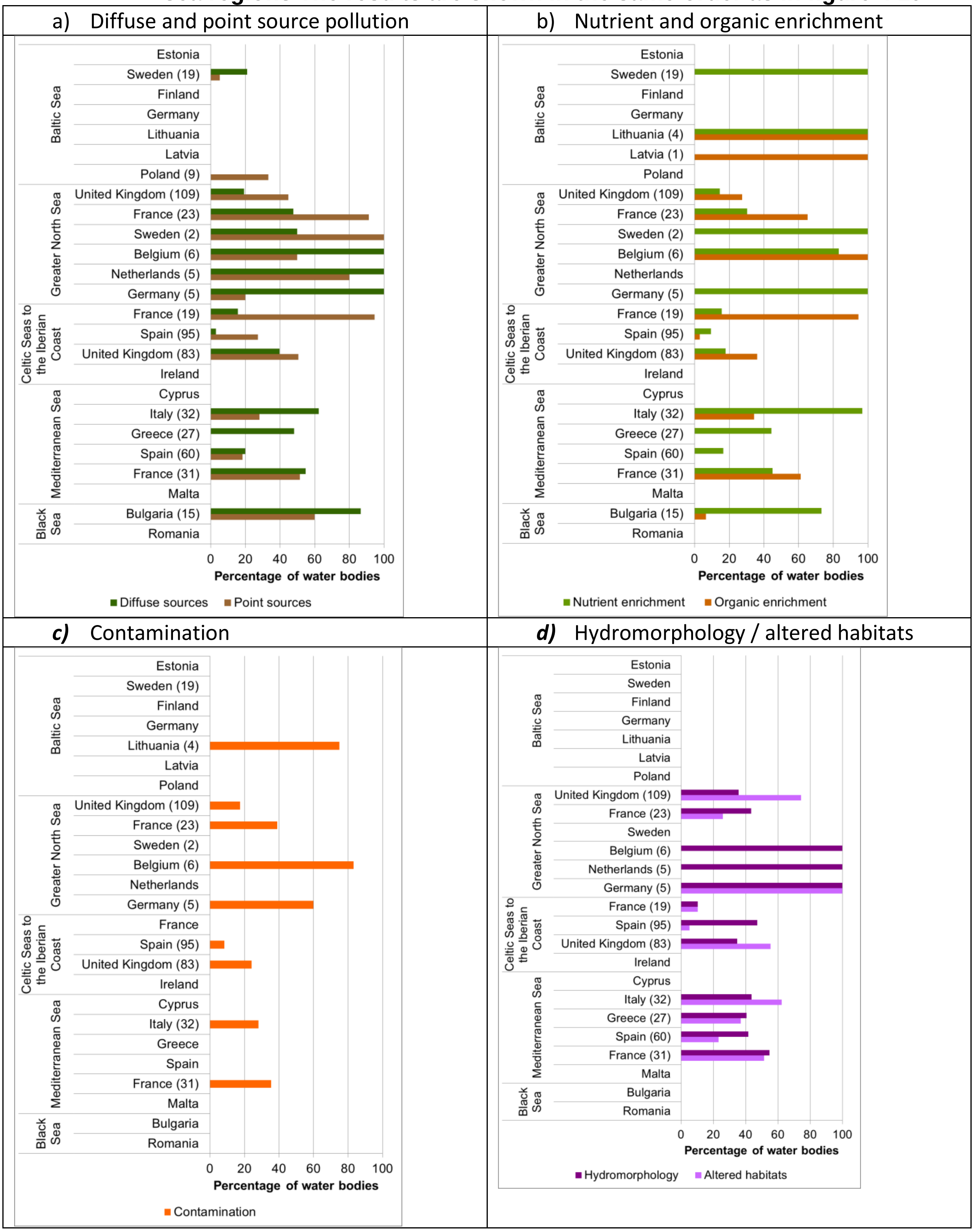
In the Baltic Sea, only Sweden and Poland provided information on significant pressures. At the same time, Sweden, Lithuania and Latvia reported information on impacts by nutrient and organic enrichment. Due to the lack of reporting of both pressures and impacts by Baltic countries, no conclusions can be drawn on the correlation between point/diffuse pressures and related impacts. Yet, this data points towards the problem of nutrient enrichment in the Baltic Sea region, reported in 81% of transitional waters, presumably due to diffuse sources. Organic enrichment is reported for 18% of transitional waters in the Baltic Sea, namely by Latvia and Lithuania.

In the Greater North Sea, point sources are reported in 53% of transitional water bodies as significant pressures, while 30% of waters are influenced by significant diffuse sources. All transitional waters in The Netherlands, Belgium Flanders and Germany are exposed to significant pressures from diffuse sources. All five German transitional water bodies belonging to the North Sea are influenced by diffuse sources, as well as impacted by nutrient enrichment. Both designated transitional water bodies in Sweden and > 80% of waters in The Netherlands and France are exposed to pressures by point sources. Point sources are also significant in 20-50% of the transitional water bodies in the other Greater North Sea countries. Other qualitative correlations between pressures and impacts are observed for UK and France.

16% of transitional water bodies in the Celtic Seas to the Iberian Coast are influenced by significant diffuse sources, reported in 5-40% of waters by Spain, France and UK. In the latter three countries, the proportion of water bodies impacted by nutrient enrichment is also on the same order (10-20 %). 35% of the transitional water bodies in the region are affected by significant point sources. These are reported in 30-50% of waters from Spain and UK and in an outstanding 90 % of transitional water bodies in France. The largest proportion of water bodies subject to organic enrichment is reported in the Celtic Seas to the Iberian Coast (31%), mainly by France (90 %) and to a lower extent by UK (35 %). The high proportion of point sources in French transitional water bodies correlate well with the equally high number of water bodies impacted by organic enrichment (Fig. 4.20. b).

In the Mediterranean Sea, significant diffuse sources are reported in 41% of the transitional water bodies. This pressure is important in 20-60% of waters from Italy, Greece, France and to a lesser extent Spain. Nutrient enrichment is also significant in 44% of transitional waters in the Mediterranean Sea, reported in 20-40% of the transitional water bodies of Spain, France, Greece and Italy. In the latter country, nutrient enrichment is significant in an outstanding 95 % of transitional water bodies, although the proportion of Italian transitional water bodies influenced by diffuse pressures is slightly above 60 %. As for point sources, 20-50% of the transitional water bodies in Spain, Italy and France are affected by significant pressures, equivalent to 24% of the reported transitional water bodies in the Mediterranean region. There is a general agreement between the proportion of diffuse pressures/impacts by nutrient enrichment and pressures by point sources/organic enrichment impacts reported by Mediterranean countries, except for Spain in which around 20 % of the transitional water bodies are impacted by point sources whereas no organic enrichment impacts are reported.

Figure 4.20. Proportion of classified transitional waters exposed to different main pressures and impacts by sea regions and Member States bordering the sea regions.The results are shown in the same order as in figure 4.19.



Notes: The number of classified transitional water bodies is given in brackets for each member state. Empty rows mean either that ecological status or potential has not been reported (see figure 4.19a) or that no data on pressures and/or impacts are reported from those member states. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.
Source: http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_pressure_status & http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_impact_status

In the Black Sea area, both pressures are significant in ~90 % (diffuse sources) and 60 % (point sources) of the transitional water bodies. Impacts by nutrient enrichment are reported in 70 % of the water bodies but only less than 10 % are impacted by organic enrichment. This assessment is primarily based on data from Bulgaria, since no information on pressures and impacts is available for Romania.

There is a direct link between hydromorphological pressures due to the construction of dams, locks, weirs for regulating water flow regimes and altered habitats resulting from the morphological alterations of surface water. Significantly altered habitats in transitional waters are a consequence of engineering works, which directly cause the removal of habitat or indirectly change the natural conditions. For example, dams and weirs cause obstruction for fish migration, lower the waters' natural carrying capacity, aggravating impacts of pollution.

Significant hydromorphological pressures are reported in three regions; the Greater North Sea, the Celtic Seas to the Iberian Coast and the Mediterranean Sea. None of the countries in the Baltic Sea and Black Sea reported information on this particular pressure/impact. The largest share of altered habitats (62%) is reported in the Greater North Sea, ranging from 20% in France to 75-100% in UK and Germany. Despite the high share of altered areas, only 39% of transitional waters are reported to be subject to significant hydromorphological pressures, ranging from ~40% in UK and France to 100% in Netherlands and Germany. Of particular interest are the transitional water bodies in Germany, which are all under the influence of hydromorphological pressures as well as impacted by altered habitats. The reported hydromorphological pressures affecting 100 % of the transitional water bodies in The Netherlands cannot be supported by information on altered habitats due to the lack of reporting of impacts.

In the Celtic Seas to the Iberian Coast, France reported that ~10 % of transitional water bodies are equally affected by hydromorphological pressures and altered habitats. In Spain, > 40 % are influenced by hydromorphological pressures, whereas only 5 % are impacted by altered habitats. On the other hand, in the UK, more than 50 % of the transitional water bodies have been registered as altered habitats while < 40 % are affected by hydromorphological pressures.

44% of transitional water bodies in Mediterranean Sea are subject to significant hydromorphological pressures, ranging between 40-50% in Italy, Greece, Spain and France. Consequently, 40% of habitats in the region are classified as significantly altered.

4.4.2. Case Study: Long-term trends of the ecological status in estuaries and coasts, using multiple ecosystem components, within the Basque Country (northern Spain)

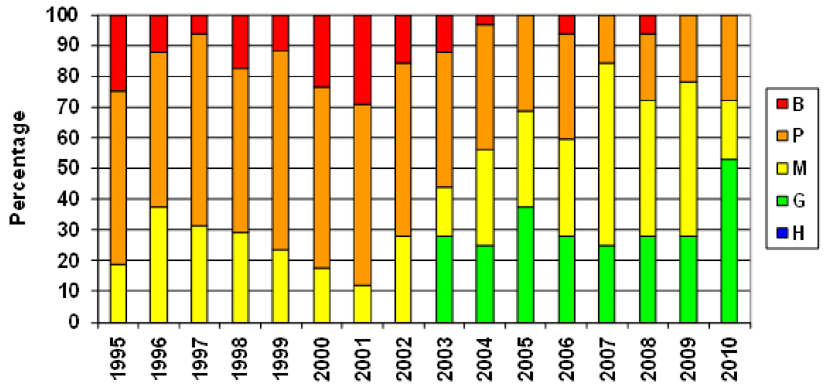
Source: Case study provided by Angel Borja. AZTI-Tecnalia; Marine Research Division; Herrera Kaia, Portualdea s/n; 20110 Pasaia (Spain).

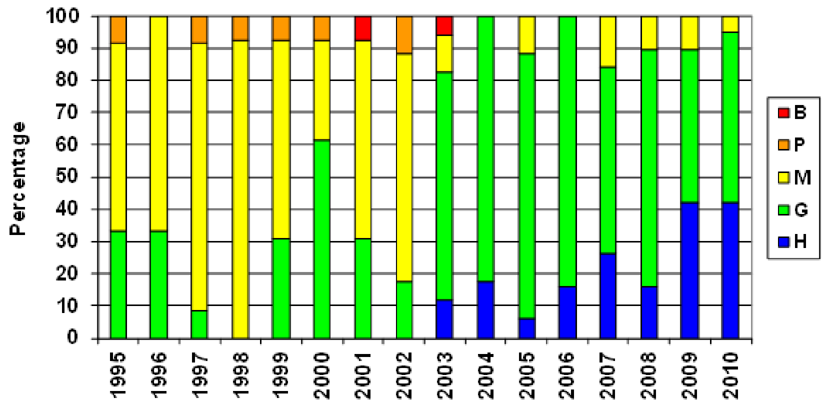
Although the WFD uses the principle 'one-out, all-out', when assessing the ecological status, Borja et al. (2004) proposed an integrated assessment method which takes into consideration the level of confidence of the methods using when assessing the status of each biological quality element (Borja and Rodríguez, 2010). This confidence takes into account the spatial and temporal variability of some of the biological elements, the absence of historical data for some of the elements, the absence of accurate methodologies for some of the biological elements, together with the lack of intercalibration for some of the others. Hence, a 'decision-tree' permits the derivation of a more accurate global classification, including also physico-chemical and chemical elements (see Borja et al., 2004, 2009). This method uses all elements in the assessment, weighting some of them, rather than removing elements and making the assessment with very few.

The Basque Country (northern Spain) has 12 small estuaries and 150 km of coastal waters, which have been monitored by AZTI, since 1995, for the Basque Water Agency. This network includes 51 coastal and estuarine stations sampled, from 1995 to 2010 (some of them since 2002). These stations are distributed amongst 18 water bodies (14 estuarine and 4 coastal).

The Basque Country is an industrialized area, which historically has supported high levels of pollution and diverse hydromorphological changes. Together with the abovementioned network, there is a good knowledge of the human pressures within the area, and their evolution (Borja et al., 2006). When integrating all of the chemical, physic-chemical and biological (phytoplankton, macroalgae, macroinvertebrates and fishes) information, the whole evolution of the ecological status within the Basque estuaries and coasts can be seen (Figures 4.21a, 1b).

Figure 4.21. Ecological status of the Basque sampling stations (as a percentage), determined using an integrative method, which includes physico-chemical, chemical and biological quality elements (see Borja et al., 2004, 2009), in transitional (a) and coastal (b) water bodies.





Note: H: high status; G: good; M: moderate; P: poor; B: bad.

The estuaries show a progressive increase in their ecological status, reducing both bad and poor status and increasing moderate and good, especially after 2001 (Figure 1a). In recent times, around 30-50%

of the transitional sampling locations are consistent with the WFD objective in achieving good status, by 2015. The coastal waters show the same trend in improvement of the quality (Figure 1b) and, in recent times, nearly all of the sampling locations achieve good or high status.

This result is consistent with the pressure evolution. Hence, water treatment in several of the river catchments and estuarine systems started in the 1980s. However, most of the engineering works within this region finished in 2000-2001, when the biological water treatment started, coinciding with a clear recovery in the status (Borja et al., 2009; Pascual et al., 2012). In general, the entire negative pressures (dredging, land reclamation, discharges of polluted waters, engineering works, etc.), or positive actions (water treatment, recovery of degraded wetlands, etc.), resulted finally in a response of biological and physico-chemical elements, as shown in Figure 4.21.

In this way, the integration of data presented here provides a good overview of the response of aquatic systems, to anthropogenic pressures or actions to remove them; this, in turn, shows the way in which these water bodies can reach the WFD objectives, by 2015. The positive trend in the status, and the time required to recover, should be taken into account when managing these aquatic ecosystems, as shown also in Borja et al., 2010).

4.5. Coastal waters

4.5.1. **Main assessment status and main pressures and impacts**

Figure 4.22a shows that all coastal water bodies in six out of 17 member states (Lithuania, Latvia, Poland, Netherlands, Germany (draining in Greater North Sea) and Romania) are in less than good status (moderate, poor or bad).

The worst situation is reported in the Baltic Sea countries, where overall 82% of coastal water bodies are not reaching environmental objectives. Around 2-30% of coastal water bodies in Germany, Finland, Sweden and Estonia are in good/high status. Also in the Greater North Sea, the ecological conditions of the coastal water bodies are not good for most of the member states, except in France and UK, who report good or better status for close to 60% and 70% of their coastal water bodies respectively.

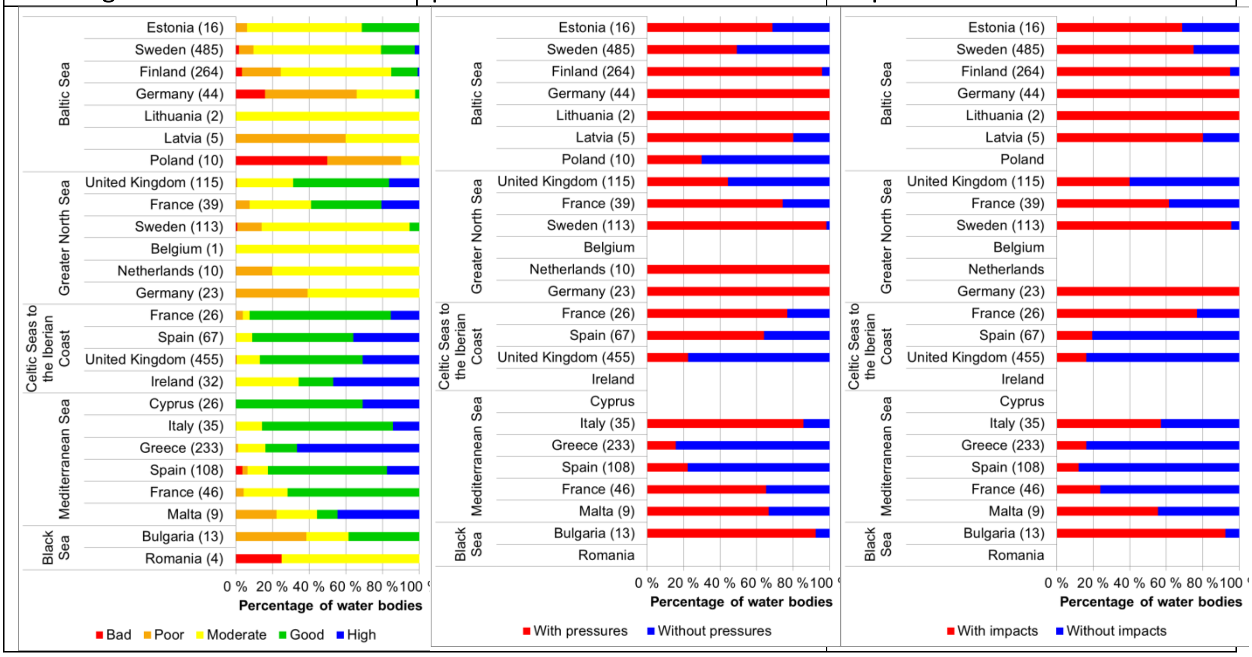
In the EU part of the Black Sea the situation for the coastal water bodies is also quite problematic with 60 % of the coastal water bodies in Bulgaria are in moderate and poor status, whereas all the coastal water bodies in Romania fail to achieve good status (Figure 4.22a).

The best ecological status of coastal waters is found in the Celtic sea to the Iberian coast, where waters from Spain, United Kingdom, France and Ireland are reported. In this area, 70-90% of coastal waters are reaching the environmental objective. There are almost no water bodies in poor or bad status in this region. Similarly, 60-90% of coastal water bodies in the Mediterranean Sea are reported to be in good/high status.

Most coastal waters are subject to significant pressures and impacts, yet to lesser extent than transitional waters. The distribution of pressures and impacts mostly corresponds to reported ecological status, except for Poland, for which a low proportion of coastal water bodies are reported to be exposed to significant pressures, even though all water bodies are reported to be in less than good status. On the contrary, Italy, in which most of coastal water bodies (85%) are in good or high status, reported a high percentage of waters being exposed to significant pressures and impacts (Figure 4.22. b, c). The same is true for the French Atlantic coast (Greater North Sea region and Celtic Sea to Iberian Coast region), where the large majority of coastal water bodies are reported to have good status, but only a minority is reported to be without significant pressures or impacts.

Figure 4.22. Ecological status or potential of classified coastal water bodies in different member states sorted by proportion of good or better ecological status/potential within each sea region. The figure shows the percentage of total number of classified coastal water bodies in different status classes (a), with and without pressures reported (b), with and without impacts (c).

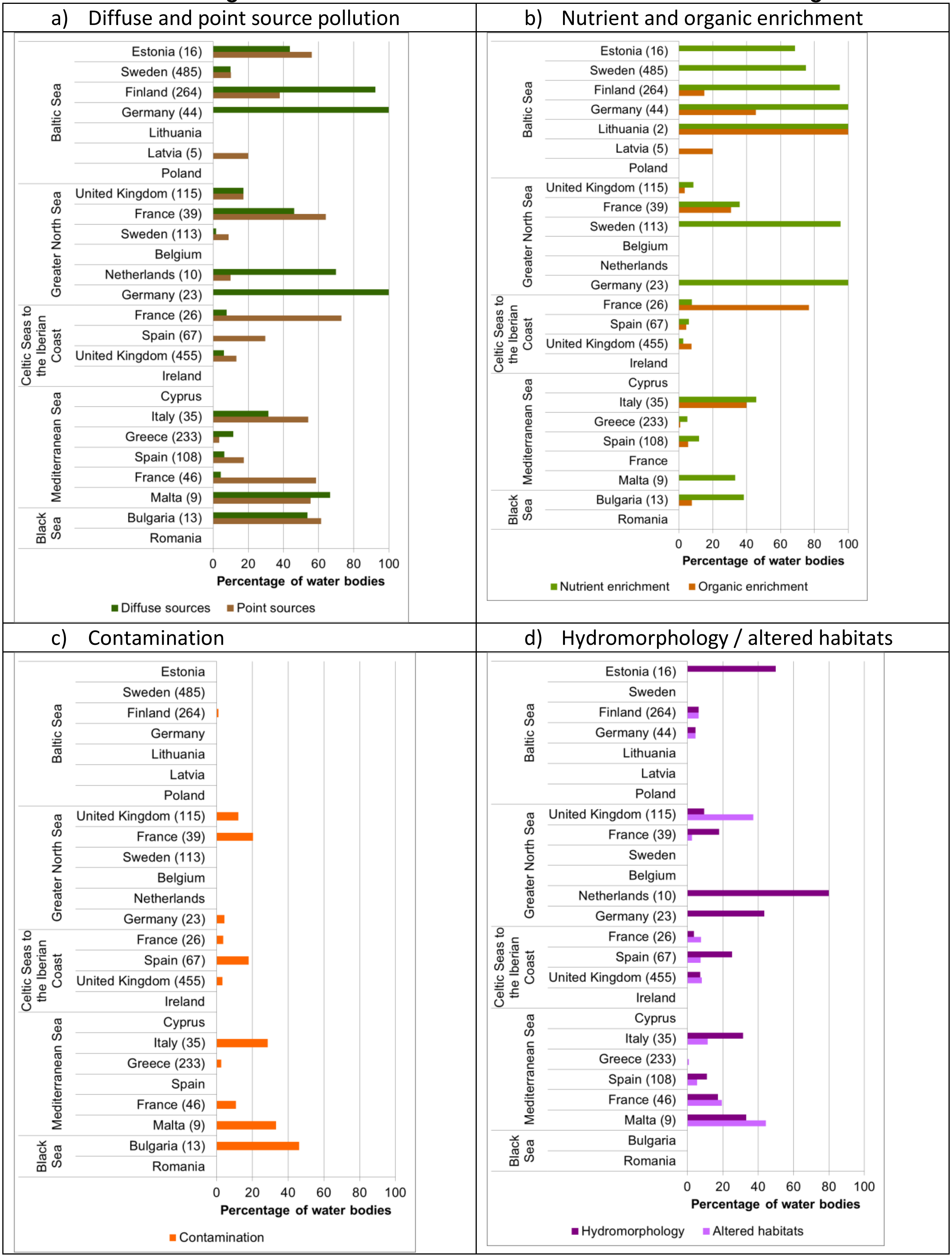
a) Coastal waters - ecological status	b)Coastal waters - pressures/no pressures	c)Coastal waters - impacts/no impacts



Notes: The number of classified river water bodies is given in brackets for each member state. Empty rows in the pressures and impacts plots mean that no data on pressures and/or impacts are reported from those member states. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.
Source: Based on data available in WISE-WFD database primo February 2012- country results on ecological status is available here http://wfd.atkins.dk/report/WFD_aggregation_reports/swb_status

Diffuse sources are reported as significant in 42% of the coastal water bodies in Baltic Sea and ~20 % in the Greater North Sea. Sweden and Estonia reported that 10-40% of their coastal waters are under significant pressure from diffuse sources. Diffuse pressures appear to be more significant in Finland and Germany (Baltic Sea), in which 90-100% of coastal waters are influenced by diffuse sources. In the Greater North Sea, Germany (100 %), The Netherlands (70 %), France (45 %), UK (~20 %) and Sweden (< 5 %) reported diffuse pressures to variable extents. Only 3% of coastal waters in Baltic Sea and ~10 % in the Greater North Sea are impacted by nutrient enrichment (no data from Netherland and Belgium included). Although all of Germany's coastal waters (Baltic Sea and Greater North Sea) are affected by diffuse pressures, the proportion of coastal water bodies affected by nutrient enrichment is only 20 % in the Greater North Sea, whereas no nutrient enrichment impacts were reported in the Baltic German coastal water bodies. In both regions, 19% of coastal water bodies are affected by pressures from point sources, which are generally less important than diffuse pressures. In the Baltic Sea, 8% of coastal water bodies are subject to organic enrichment. Reporting results are similar to those for the Greater North Sea (Figure 4.23.b). Due to the partial reporting on pressures and impacts by countries (Figure 4.23.b), it is not possible to establish a link between sources and nutrient/organic enrichment. For example, Lithuania reported that the two designated coastal water bodies are both impacted by nutrient and organic enrichment, yet no corresponding information on pressures is available.

Figure 4.23. Proportion of classified coastal waters exposed to different main pressures and impacts by sea regions and Member States bordering the sea regions. The results are shown in the same order as in figure 4.22.



Notes: The number of classified coastal water bodies is given in brackets for each member state. Empty rows mean that no data on pressures and/or impacts are reported from those member states. Swedish surface water

bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.
Source: http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_pressure_status & http://wfd.atkins.dk/report/WFD_aggregation_reports/SWB_impact_status

Point sources are reported as significant in 18% of coastal waters in the Celtic Seas to the Iberian Coast (mostly in France; 70%) and in the Mediterranean Sea (mostly in Italy, France and Malta; 50-60%). In France (Celtic Seas to the Iberian Coast), the proportion of coastal bodies impacted by organic enrichment is also relatively high (~80 %), consistent with ~ 70 % affected by point sources. In the Mediterranean Sea, 15% of waters are a subject to organic enrichment mainly reported by Italy (40 %). Despite the relatively high proportion of coastal water bodies affected by point sources (50-60 %) in France (Mediterranean) and Malta, no organic enrichment impacts are reported by these countries. The contribution of significant diffuse sources in these two regional seas is even lower. Diffuse pressures (as well as nutrient enrichment impacts) do not seem to be important in the Celtic Seas to the Iberian Coast. In the Mediterranean Sea, most of the significant diffuse sources of pollution are reported by Malta (~70 %), followed by Italy (~30 %). Only 5% of the coastal water bodies are subject to nutrient enrichment, mainly reported by Italy (90 %) and France (30 %), despite the relatively low proportion of diffuse pressures reported by France (5 %). No impact information on nutrient enrichment is available for Malta.

As for the Black Sea, only data from Bulgaria is available on pressures and impacts. Bulgaria reported that 60 % of its coastal water bodies are impacted by point sources, whereas diffuse pressures affect half of the water bodies. However, merely 10 % are impacted by organic enrichment as opposed to greater than 80 % by nutrient enrichment. Impacts and pressures were not reported consistently in all regions, making it difficult to qualitatively related data on status, pressures and impacts on regional level (Figure 4.23.a, b, c).

Most countries reported significant hydromorphological pressures in 10-40% of the coastal water bodies, with the exception of the Netherlands, where 80 % of the coastal water bodies are under hydrodymorphological pressures. Due to the lack of reporting of impacts by The Netherlands, it is not possible to relate the hydromorphological pressures to altered habitats. Overall 7% of coastal waters are reported to have significant pressures due to hydromorphological alterations. (Figure 4.23.d)

4.5.2. Case study: Baltic Sea

14 countries are in the catchment area of the Baltic Sea (Figure 1). Finland, Russia, Estonia, Latvia, Lithuania, Poland, Germany, Denmark and Sweden are contracting parties in the Helsinki Commission (HELCOM) with the catchment area of 1.602.750 km2, while Belarus, Ukraine, Czech Republic, Slovakia and Norway with a catchment of 117.520 km2 are not Contracting Parties.

Waters from these countries are draining to the sea, bringing large amounts of nutrients, organic substances and pollutants, which accumulate in the sea. Accumulation and impacts of human activities are aggravated by natural characteristics of the Baltic Sea, which is semi-enclosed brackish water area with persistent vertical water layers and water residence time of 25 years. These characteristics make it a very sensitive area

with low self-purification capacity (Tulin and Andrushaitis).	Figure 1. Baltic Sea catchment area (HELCOM, 2011)

HELCOM identified several important pressures, caused by human activities. Coastal areas are mainly affected by point-source pollution and open-sea areas by fishing, riverine pollution and atmospheric nitrogen deposition. Another important issue is also disturbance of the seabed by construction, dredging and disposal of dredged material, which creates large impacts on local environments, whereas bottom trawling affects large areas of the sea. The cumulative impact of human activities is large in all areas except open-sea areas of the Gulf of Bothnia. (HELCOM, 2010)
This HELCOM Initial Holistic Assessment shows that the environmental status of the Baltic Sea is generally impaired (HELCOM, 2010). None of the open basins of the Baltic Sea has an acceptable environmental status at present. The integrated assessment of the 'ecosystem health' has revealed that only very few coastal areas along the Gulf of Bothnia can be considered healthy. In most of the coastal waters, nutrient concentrations and chlorophyll-a concentrations generally are elevated compared to both target values and reference conditions. (HELCOM, 2011).

Pollution
Nutrient concentrations in the Baltic Sea increased until the 1980s. In all areas except for the Gulf of Finland, phosphorus concentrations have declined during the past two decades but good environmental quality has not yet been re-established. Nitrogen concentrations have declined in the Gulf of Riga, Baltic Proper and Danish Straits. These declines are partly caused by lower nutrient loads from land-based sources, but changing volumes of hypoxia in the Baltic Proper significantly alter nutrient concentrations in bottom waters and, through subsequent mixing, also surface waters (HELCOM 2010). Countries have reduced the inputs of phosphorus and nitrogen to the Baltic Sea from 1990–2006d by 45% for phosphorus and 30% for nitrogen. Decrease of atmospheric nitrogen deposition was smaller, mainly because the increasing shipping activities in the Baltic, which is an important contributor to the atmospheric nitrogen deposition. (HELCOM, 2011).

Environmental problems in the Baltic Sea have been aggravated by the presence of heavy metals such as mercury and cadmium, which have been shown to have harmful effects on aquatic life when accumulated over a period of time as well as physical loss and physical damage of the seabed. (HELCOM 2010)

WFD reporting

Results of reporting under WFD reflect problems, identified by HELCOM in the reporting of transitional and coastal waters status/potential, since 83% of transitional and coastal waters are reported in less than good status, while 50% of fresh waters reported under WFD are in good or high status.

Pressures and impacts were not reported consistently by countries, but most of them reported high share of waters with significant diffuse and point sources pollution as well as significant impacts from nutrient and organic enrichment.

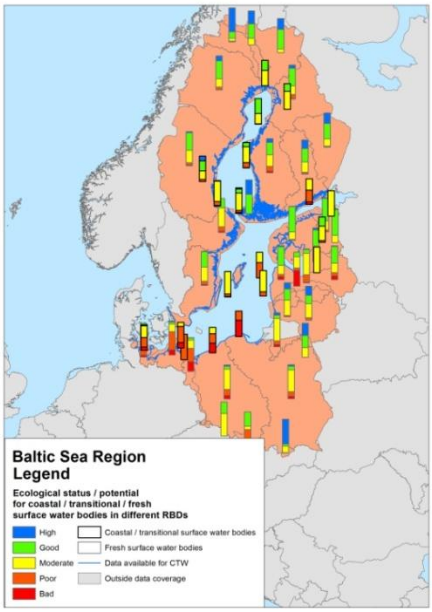
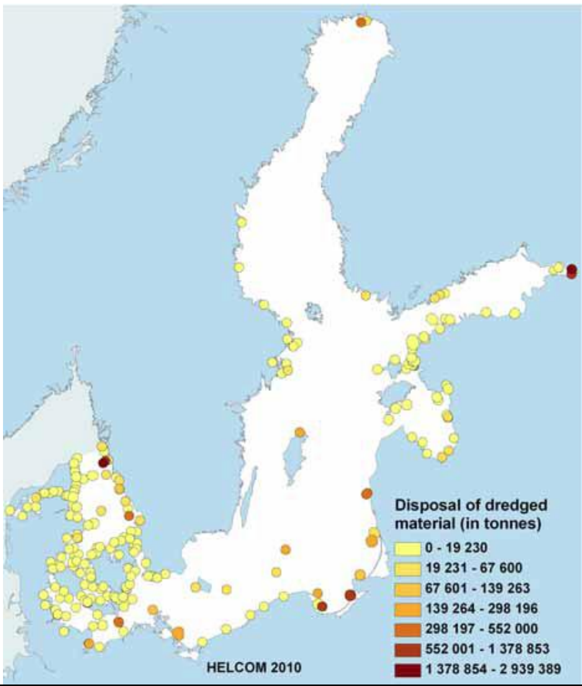


	Figure 2. Ecological status and potential of waters in the Baltic Sea catchment area

Physical loss of the seabed
One of the largest concerns in the Baltic, the decline of biodiversity and abundance of species, is directly linked also to the physical damage and loss of the seabed and the associated destruction of the natural habitats. Natural seabed habitats are locally destroyed when constructions seal the sea floor or are altered, e.g., when sediments are dumped onto the sea floor smothering the benthic communities (Powilleit et al. 2006). This occurs at disposal sites of dredged material, when beaches are replenished with new sand, or the seabed is damaged during construction work for wind farms, cables, bridges, or pipelines. Scientific investigations have shown that the species composition at a smothered site is altered by favouring opportunistic species for several years (Harvey et al. 1998, Boyd et al. 2000, Martin et al. 2005).

Disposal sites occur near large harbor projects but also further out at sea. Most Baltic countries dispose of their dredged material at selected sites where special features hinder the dumped material from spreading to larger areas. (Figure 3a) However, the local hydrographic conditions also affect the recovery time of the site. Harbors, offshore wind farms, cables, bridges, coastal dams, coastal defence structures and oil platforms are distributed along the coasts of the Baltic Sea, especially on the south-western shores (Figure 3b). They cover the sea floor and have replaced the local habitats. In the future, additional sea floor areas in the Baltic are likely to be disturbed. Increasingly, sea areas are being reserved for more wind farms, underwater pipelines, data and electricity cables as well as the enlargement of municipalities, harbors, platforms, coastal erosion defence structures, piers and bridges at sea. Whilst the sealing structures destroy natural habitats, they also create new artificial habitats. (HELCOM, 2010)



Fifure 3a. Sites for the disposal of dredged material in 2003–2007, showing the maximum annual amount dumped. The sites have been artificially enlarged to increase their visibility. (From HELCOM, 2010)

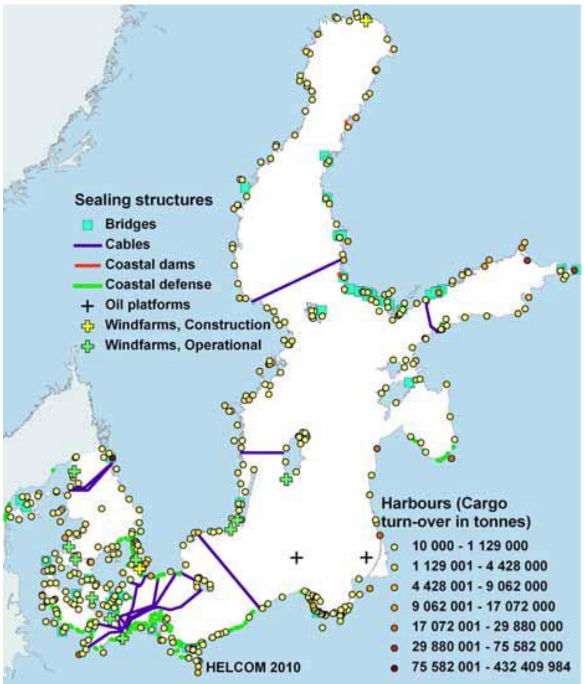


Figure 3b. Structures sealing marine biotopes: harbors, bridges, coastal dams, oil platforms, cables and pipelines, coastal defence structures and wind farms. . (From HELCOM, 2010)

Physical damage to the seabed

Physical damage to the seabed constitutes also one of the major pressures on the Baltic marine environment (Jones 1992, Jennings et al. 2001). It is caused by the exploitation of mineral resources, dredging, disposal of dredged material, bottom trawling, constructions on the seabed, and coastal shipping. The seabed is damaged by different types of activities causing pressures, including abrasion, siltation and selective extraction of mineral resources like sand and gravel. All three types of pressures change the sediment structure and damage the bottom-dwelling communities. When the seabed is left to recover, it should eventually re-stabilize and at a later stage be able to support a functional community again. (HELCOM, 2010)

4.6. References

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4.7. Appendix with Notes for figures and tables

Figure 4.1 /4.2/4.10/4.11/4.13/4.19/4.20/4.22/4.23

Ireland only reported pressures and impacts for one RBD, so Irish water bodies are removed both from the number of water bodies affected and from the number of total classified water bodies in all pressure and impacts plots. For Sweden, the aggregated diffuse pressure type and the impact contamination by priority substances are considered to represent airborne mercury pollution only. Water bodies only affected by these specific pressure or impact types are considered not to be affected by pressures or impacts, respectively. The numbers of such redefined water bodies are:

Figure 4.1: Pressures: 7987, Impacts: 11452

Figure 4.2a: Diffuse sources: 14149

Figure 4.2c: Contamination: 15474

Figure 4.10: Pressures: 4677, Impacts: 5050

Figure 4.11a: Diffuse sources: 6842

Figure 4.11b: Contamination: 7196

Figure 4.13: No pressures: 1, Diffuse sources: 13, No impacts: 13, Contamination: 16

Figure 4.19: Pressures: Greater North Sea: 0, Baltic Sea: 0, Impacts: Greater North Sea: 0, Baltic Sea: 0

Figure 4.20a: Diffuse sources: Greater North Sea: 1, Baltic Sea: 15

Figure 4.20c: Contamination: Greater North Sea: 2, Baltic Sea: 19

Figure 4.22: Pressures: Greater North Sea: 2, Baltic Sea: 246, Impacts: Greater North Sea: 5, Baltic Sea: 121

Figure 4.23a: Diffuse sources: Greater North Sea: 111, Baltic Sea: 437

Figure 4.23c: Contamination: Greater North Sea: 113, Baltic Sea: 485

Figure 4.2/4.11/4.20/4.23

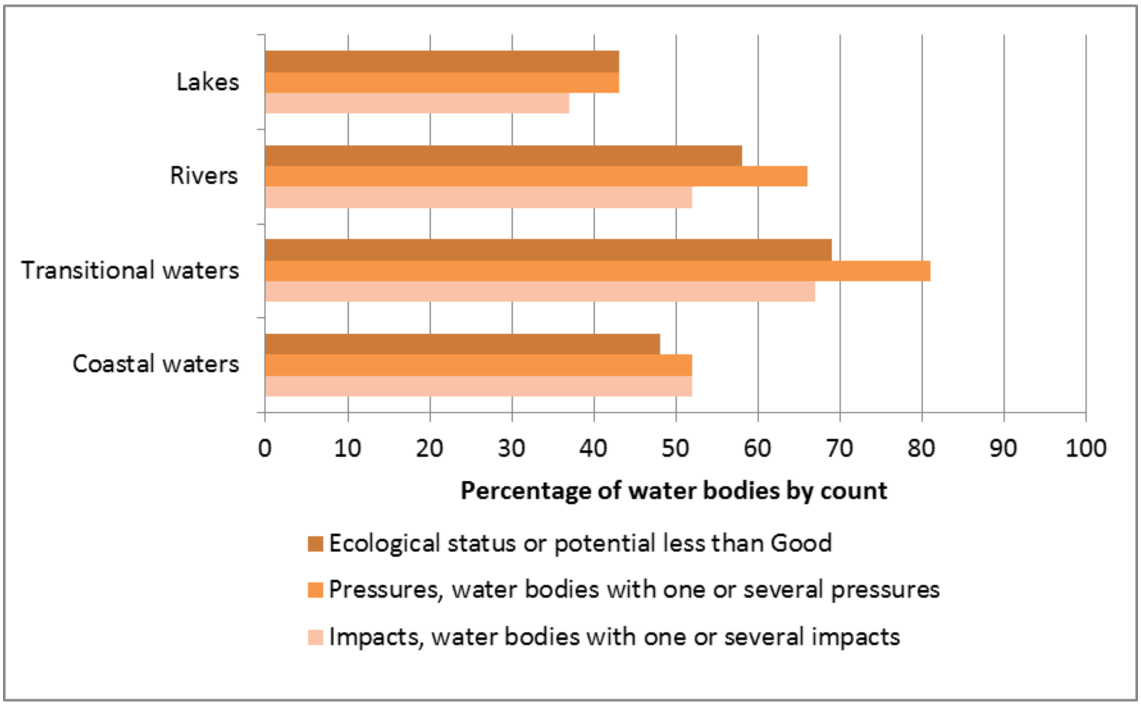
A water body is defined as affected by any of the pressure types in the figures if it is reported with the aggregated pressure type and/or any of the corresponding disaggregated pressure types. “Hydromorphology” denotes the combination of the aggregated pressure types “Water abstraction”, “Water flow regulations and morphological alterations of surface water“,“River management“,“Transitional and coastal water management“ and “Other morphological alterations“. The impact type “Contamination” means surface water bodies with the impact contamination by priority substances and/or contaminated sediment.

5. European overview of ecological status, pressures and impacts

5.1. Key messages

- 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 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 than water bodies in lakes and coastal waters.
- The pressures reported to affect most surface water bodies are pollution from diffuse sources causing nutrient enrichment, and hydromorphological pressures causing altered habitats.
- The worst areas of Europe concerning ecological status and pressures in freshwater are in Central Europe, in particular in Northern Germany, the Netherlands and Belgium, while for coastal and transitional waters the Baltic Sea and Greater North Sea regions are the worst.

Figure 5.0. Proportion of classified water bodies in less than good ecological status or potential, with pressures and with impacts in different water categories.

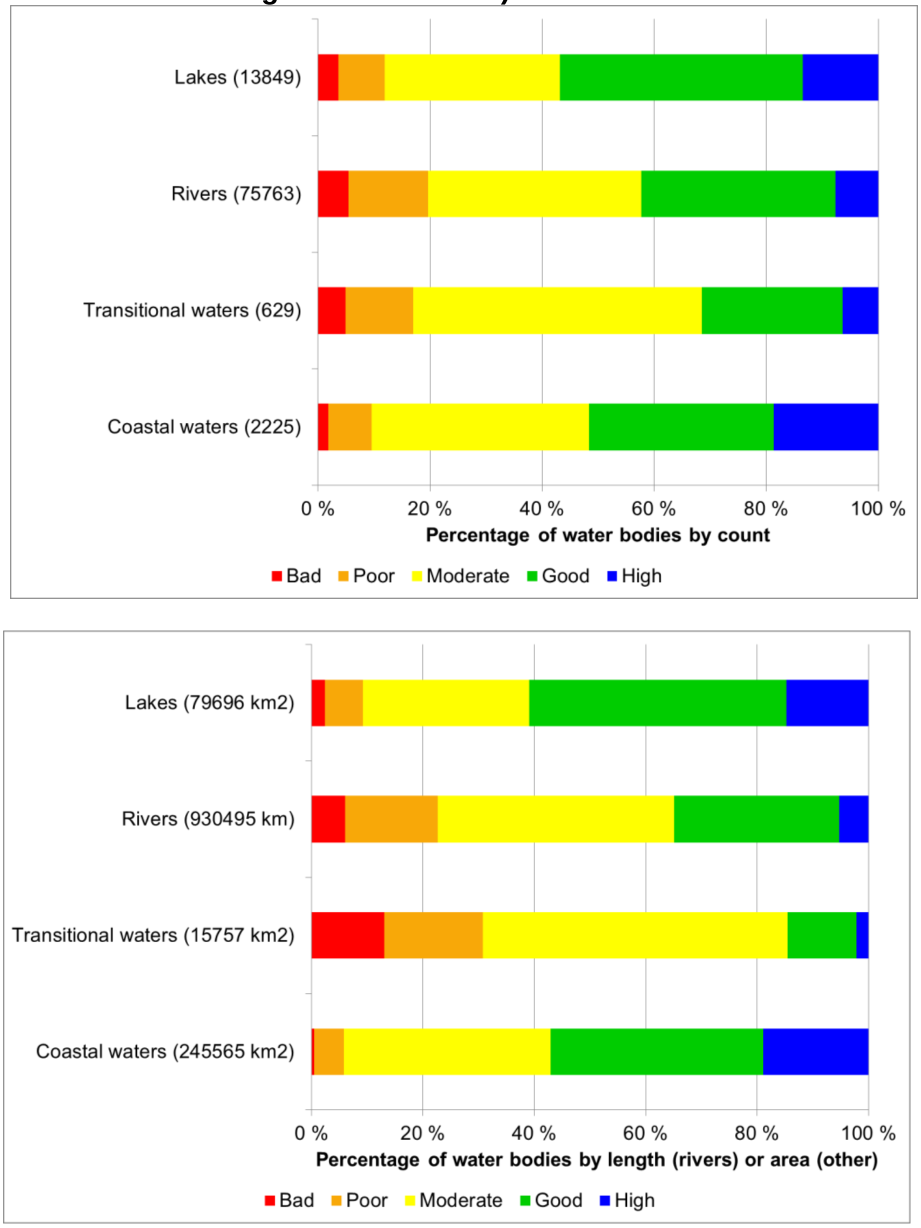


Notes: For pressures and impacts, the percentage is calculated against the total number of classified surface water bodies in countries reporting pressures or impacts. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.

5.2. Ecological status or potential for different water categories

Overall, more than half (55 %) of the total number of classified surface water bodies in Europe are reported to have less than good ecological status/potential. All these water bodies thereby need management measures to restore their ecological status or potential to fulfil the WFD objective. A higher proportion of water bodies with moderate or worse ecological status/potential is reported for rivers and transitional waters (60-70%) than for lakes and coastal waters (40-50%) (Figure 5.1).

Figure 5.1 Distribution of ecological status or potential of classified rivers, lakes, coastal and transitional waters, calculated as percentage of the total number of classified water bodies (upper panel: number given in brackets)or total length (classified rivers) or surface area (classified lakes, coastal and transitional waters) (lower panel: length or surface area given in brackets).



Notes: See chapter 3 for methodology used for assessing ecological status or potential and appendix notes for figure 5.0 on countries reporting and water bodies classified. For length/area issues see appendix notes.

For rivers, ca. 44000 water bodies (58% of the total number), or ca. 606 000 km (65% of total river length) are reported to have less than good ecological status or potential. For lakes, almost 6000 lake water bodies (43% of total number) or close to 31 000 km^2 (39% of total surface area) are reported to be in less than good ecological status or potential. The reason why lakes are better than rivers is probably related to the large proportion of lakes in Sweden and Finland, where the population density is low and there are large natural areas (boreal forests). The rivers are more evenly distributed throughout Europe with a larger proportion of rivers in densely populated and cultivated areas in Central Europe. However, also within countries lakes are generally reported to have better status than rivers (see chapter 4).

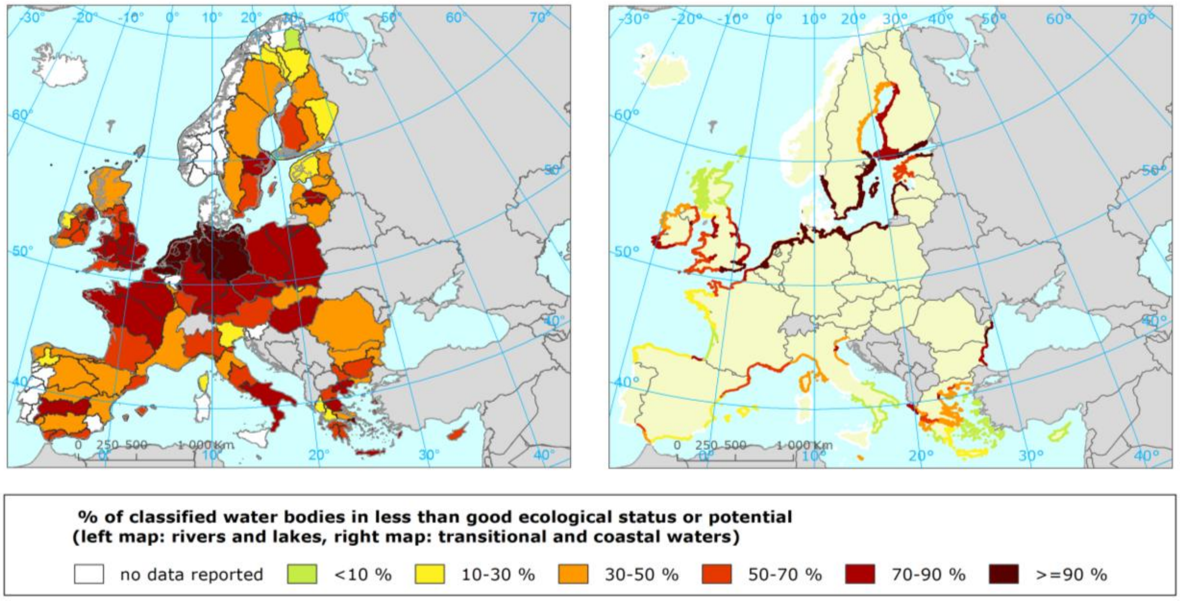
The worst water category is transitional waters, where 69% of the total number or 85% of the total surface area is reported to be in less than good ecological status/potential. In coastal waters, the situation is somewhat better with 48% of total number or 43% of total surface area reported to be in less than good ecological status or potential. The reason why transitional waters are so much worse than coastal waters is probably related to the smaller volume of water in transitional waters, as well as their proximity to pollution sources being located at the mouth of rivers with high pollution loads. Moreover, transitional waters are exposed to extensive hydromorphological pressures caused by land reclamation, flood protection, as well as large harbours causing altered habitats in these water bodies.
Rivers and transitional waters are both worse as proportion of length or area than as proportion of total number (comparing the upper and lower panels of figure 5.1 for each water category), whereas for lakes and coastal waters the picture is opposite. This means that for lakes and coastal waters the large water bodies are generally in better status than the smaller ones, whereas the largest rivers and transitional water bodies are in worse status than the smaller ones. The reason for this difference may be that the largest lakes and coastal waters have larger volumes of water and thus dilute the pollution to a larger extent than smaller water bodies, whereas large rivers and transitional waters are subject to more uses and are often located in areas with more pressures than the smaller ones.

The basis for assessing ecological status or potential of water bodies in the first RBMPs is quite weak in some countries, causing uncertainty in the results described below. The comparability across countries and RBDs is therefore limited. Further details on the basis of the assessment done by the different Member States are outlined in chapter 3 above. The main differences in ecological status or potential between MSs / RBDs shown in figure 5.2 below may still reflect the general situation in Europe, although some of the details may be wrong.

5.3. Ecological status or potential in different river basin districts

The worst ecological status or potential in **river and lake water bodies** are reported in River Basin Districts in Northern Germany, the Netherlands and Belgium (Flanders), where more than 90% are reported to be in less than good ecological status/potential (Figure 5.2, see also chapter 4 for country specific results). Other problem areas are in Poland, Southern Germany, Czech Republic, Southern England, Northern France, Hungary, as well as several single RBDs in other member states, where 70-90% of freshwater bodies are reported to be in less than good status/potential. The ecological conditions are reported to be slightly better in the southern part of Germany compared to the northern part, probably reflecting a combination of higher precipitation, less industry and more tourism (i.e. more interest in maintaining/restoring a natural landscape for the enjoyment of tourists), as well as lower population density and relatively less agricultural activity. The map also illustrates the high variability in ecological conditions within single Member States, e.g. UK, Italy and Spain, and shows that even in the Member States with the best ecological conditions, there are regions that are less good (e.g. western Finland, south-eastern Sweden).

Figure 5.2 Proportion of classified surface water bodies in different River Basin Districts in less than good ecological status or potential for rivers and lakes (left panel) and for coastal and transitional waters (right panel) (percentage, based on number of classified water bodies).



Notes: **Member states which have reported should indicate why classification of ecological status or potential is missing for certain RBDs, and if this information will be reported at a later stage.**

For **coastal and transitional waters**, the worst areas where more than 90% of the water bodies are reported to have less than good ecological status are in the Baltic region (Southern Sweden, a part of the Finnish coast, Lithuania, Poland and Germany) and in the Greater North Sea region (north-western Germany, the Netherland, Belgium (Flanders) and south-eastern coast of UK). Also in the EU part of the Black Sea (RO, BG) the situation is poor with more than 70% of classified water bodies reported to be in less than good ecological status or potential.

The best ecological status or potential in coastal and transitional waters in Europe are found in Scotland and around the Mediterranean islands of Greece and Cyprus, as well as in the French part of the Bay of Biscay and in southern Italy, where more than 90% of the coastal and transitional water bodies are reported to be in good or better ecological status or potential. The results reported from the French Bay of Biscay and southern Italy are however quite uncertain, as the classified water bodies only constitute 20% and 2% of all the coastal water bodies in these two RBDs respectively (see also chapter 3 above). Another area with large numbers of water bodies in high and good status is the French coast of Brittany, the southern tip of Greece and most of the Spanish coast, including the Balearic islands.

5.4. Main pressures and impacts affecting ecological status for all water categories

5.4.1. Water bodies without pressures and impacts

In rivers and transitional waters, low proportions of water bodies are reported without significant pressures (figure 5.3), while somewhat higher proportions are reported to be without significant impacts. For coastal waters, ca. half of the classified water bodies are reported to be without pressures and impacts. A majority of lake water bodies are reported without significant pressures and impacts. This pattern is consistent with the differences found between the water categories for ecological status or potential (see section 5.2 above).

5.4.2. Pollution pressures and water quality impacts

In general, rivers and transitional waters have more pollution pressures and water quality impacts than lakes and coastal waters, corresponding to the pattern found for ecological status/potential (figure 5.1).

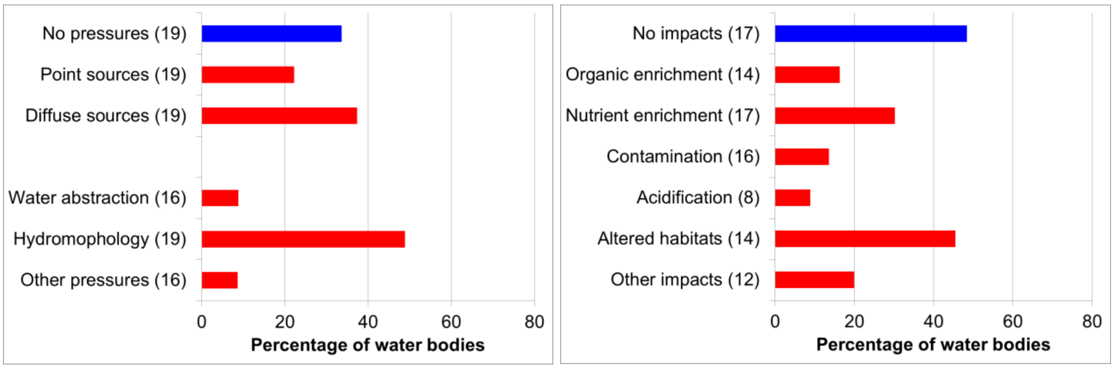
Pollution pressures from diffuse sources are reported for 30-40% of the classified water bodies in rivers and transitional waters, but only for ca. 20% of the classified water bodies in lakes and coastal waters (figure 5.3). The relatively low proportion of water bodies reported with diffuse pressures is caused by the high number of water bodies in Sweden and Finland located in remote areas with low population density and only small areas of intensive agriculture. The proportion of water bodies affected by diffuse source pollution would much higher if the water bodies affected by general diffuse pollution from Sweden were included, because all their water bodies are reported to be exposed to airborne pollution of contaminants, primarily mercury. The reason is that Sweden has used the biota standard for mercury of the new EQS directive to classify the chemical status of their water bodies, whereas other member states have used the “old” standards for mercury in water. Thus, in Sweden virtually all water bodies are in less than good chemical status due to mercury in fish. As this mercury pressure and impact may be less relevant for the ecological status, and also prevent the comparison of diffuse source pollution reported from other countries, it is important to show the picture without these data.

Point source pollution is reported as a significant pressure in more than 40% of classified water bodies in transitional waters, but is less important in the other water categories, due to improved urban waste water treatment during the past decades (more information in chapter 7 below). The high proportion of point source pollution reported for transitional waters indicates that there are remaining challenges related to urban and industrial waste water in many estuaries in Europe.

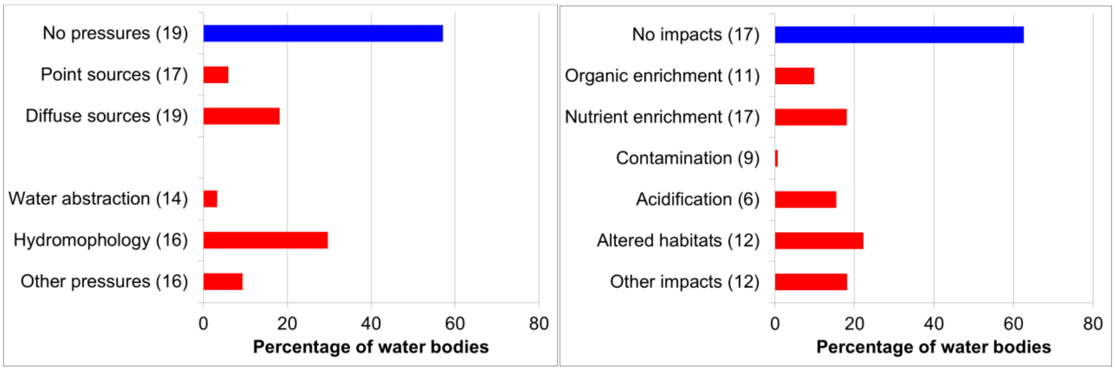
The most important impacts of these pollution pressures is nutrient enrichment (figure 5.3). In rivers as well as in transitional waters, there are almost similar proportions of water bodies exposed to diffuse source pollution as those affected by nutrient enrichment (ca. 30%). In coastal waters more than 40% of the classified water bodies are reported to be affected by nutrient enrichment, which is twice as much as the proportion exposed to diffuse pollution. This reasons for this discrepancy is unclear, but may be related to reporting mistakes or other unidentified pressures. For lakes, less than 20% of the classified water bodies are reported to be affected by nutrient enrichment. As for diffuse pollution this low proportion of lakes affected by nutrient enrichment is due to the high number of lakes found in the northern parts of Sweden and Finland. Organic enrichment is reported to affect between 10-15% of all classified water bodies in rivers, lakes and coastal waters, but is more important in transitional waters, where the proportion of affected water bodies is close to 30%. The latter is consistent with the high proportion of transitional water bodies exposed to point source pollution.

Figure 5.3. Percentage of total number of classified water bodies with identified significant pressures (left) and impacts (right) for a) rivers, b) lakes, c) coastal waters, d) transitional waters.

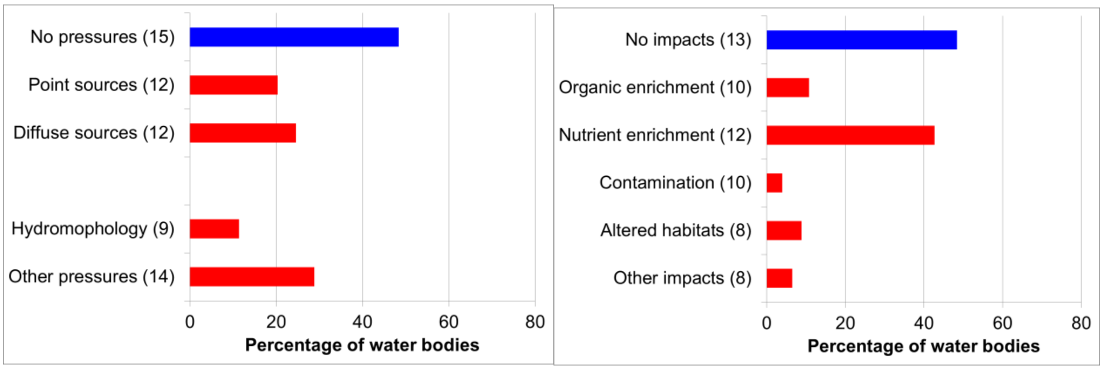
Rivers



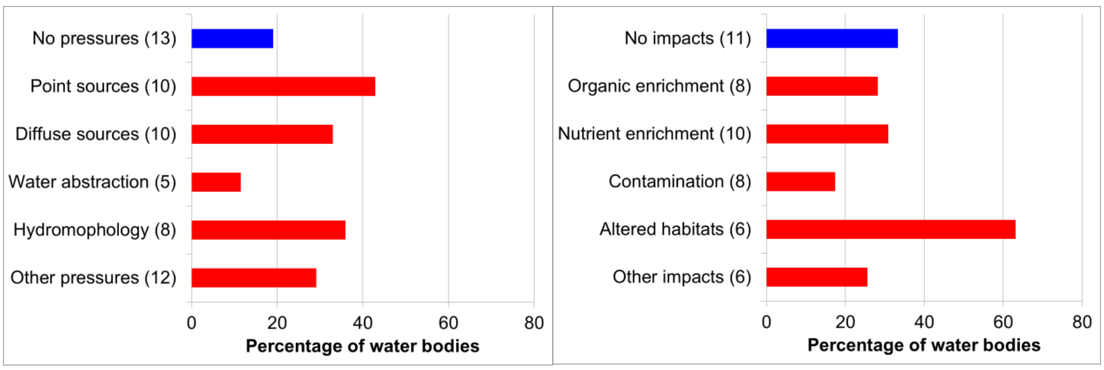
Lakes



Coastal waters



Transitional waters



Notes:

The percentage is calculated against the total number of classified surface water bodies in member states reporting the specific pressure or impact type (or any pressure or impact for the blue bars). The number of member states included is indicated in brackets. “Hydromorphology” denotes the combination of the aggregated pressure types “Water flow regulations and morphological alterations of surface water“,“River management“,“Transitional and coastal water management“ and “Other morphological alterations“. A water body is defined as affected by any of the pressure types in the figures if it is reported with the aggregated pressure type and/or any of the corresponding disaggregated pressure types. The impact type “Contamination” means surface water bodies with the impact contamination by priority substances and/or contaminated sediment. Swedish surface water bodies where the pressure or impact reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details. The impact type “Other impacts” menas surface water bodies with at least one of the impacts “Saline intrusion”, “Elevated temperatures” or “Other significant impacts”.

Acidification from long-range transported diffuse pollution are reported to affect ca. 10% of river water bodies and ca. 15% of lake water bodies in the few member states reporting this impact. Further information on acidification status and trends are included in chapter 7.

Contamination by priority substances and contaminated sediments are seemingly minor impacts in all water categories, affecting less than 20% of all classified water bodies, after excluding Sweden. The low percentage may be an artefact of the choices made by Member States on how to assess chemical status in the first river basin management plan in terms of chosen substances, standards (old vs. new EQS directive) and matrices (water or biota or sediment). If other member states than just Sweden had also used biota standards of the new EQS directive, this impact would probably be larger. This would have implications primarily for chemical status classification, as most currently used assessment systems for ecological status classification are not sensitive to effects of hazardous substances.

5.4.3. **Hydromorphological pressures and altered habitats**

Hydromorphological pressures and altered habitats are reported for a large proportion of classified water bodies in all the water categories, except in coastal waters, where these pressures and impacts are reported for a low proportion of classified water bodies (figure 5.3). The proportions of water bodies exposed to hydromorphological pressures are almost the same as those having altered habitats. In rivers and transitional waters these pressures and impacts are reported for ca. half of all classified water bodies, while in lakes ca. 30% of classified water bodies are affected.

Hydromorphological pressures and altered habitats are the most commonly occurring pressure and impact in rivers, lakes and transitional waters. However, as the numbers includes heavily modified and artificial water bodies, this pressure and impact is less important in natural water bodies. Moreover, hydromorphological pressures and altered habitats are sometimes affecting only a minor part of a water body (for example, physical shore-line alterations in lakes), and may thus have less serious ecological consequences than pollution pressures which often deteriorate the water quality of the whole water body.
More information about hydromorphological pressures and altered habitats can be found in a separate thematic assessment report (EEA 2012 Hydromorphological alterations and pressures).

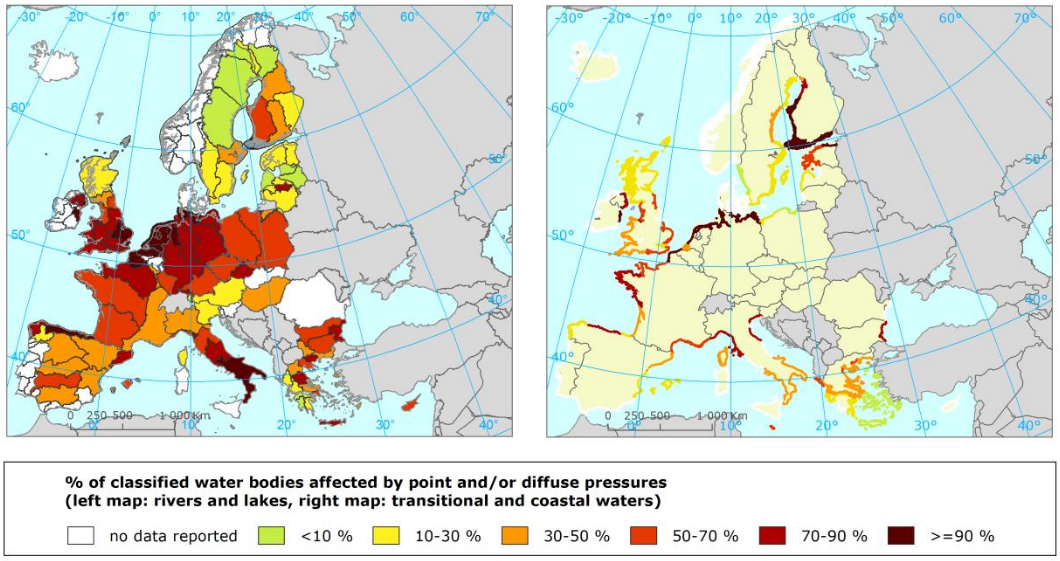
5.5. Main pressures and impacts in different river basin districts

5.5.1. **Pollution pressures**

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.
The highest pollution pressures in **river and lake water bodies** are reported in River Basin Districts in the Netherlands and Belgium (Flanders), as well as in southern Italy, south-eastern England, and smaller parts of northern Germany, where more than 90% of the water bodies are exposed to pollution pressures (chapter 4 for country specific results). Other problem areas are in the rest of Germany

(except the two RBDs in the southeastern and southwestern part), Czech Republic, Southern England, Northern France, as well as several single RBDs in other member states, where 70-90% of freshwater bodies are reported to be exposed to pollution pressures. The map also illustrates the high variability in pollution pressures within single Member States, e.g. UK, Italy and Spain, and shows that even in the Member States with low pollution pressures, there are regions that are have higher pollution pressures (e.g. western Finland, south-eastern Sweden).

Figure 5.4. Proportion of classified water bodies in different River Basin Districts affected by pollution pressures for rivers and lakes (left panel) and for coastal and transitional waters (right panel) (percentage, based on number of classified water bodies).



Notes: A water body is defined as 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. Swedish surface water bodies where the pressure reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details. Member states which have reported pressures, but where certain RBDs are marked as "no data reported" should indicate whether this particular pressure has not been reported in this RBD or whether no water bodies in this RBD are affected by this particular pressure.

The general overview of pollution pressures reported for different RBDs (figure 5.4) is largely consistent with the results reported for ecological status or potential (figure 5.2). However, in some RBDs the ecological status or potential in rivers and lakes is worse than anticipated from the pollution pressures, such as in most of the RBDs in Sweden, the Baltic countries, Scotland, Poland, Austria and Hungary, as well as Brittany in France. The reason for this inconsistency is probably the impact of hydromorphological pressures (figure 5.5).

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 (Finland and Germany) and in the Greater North Sea region (north-western Germany, the Netherland and Belgium (Flanders)). Also along the coast of Brittany in France, most of the northern coast of Spain, both sides of northern Italy as well as in the Bulgarian part of the Black Sea, more than 70% of classified water bodies are reported to be exposed to pollution pressures.

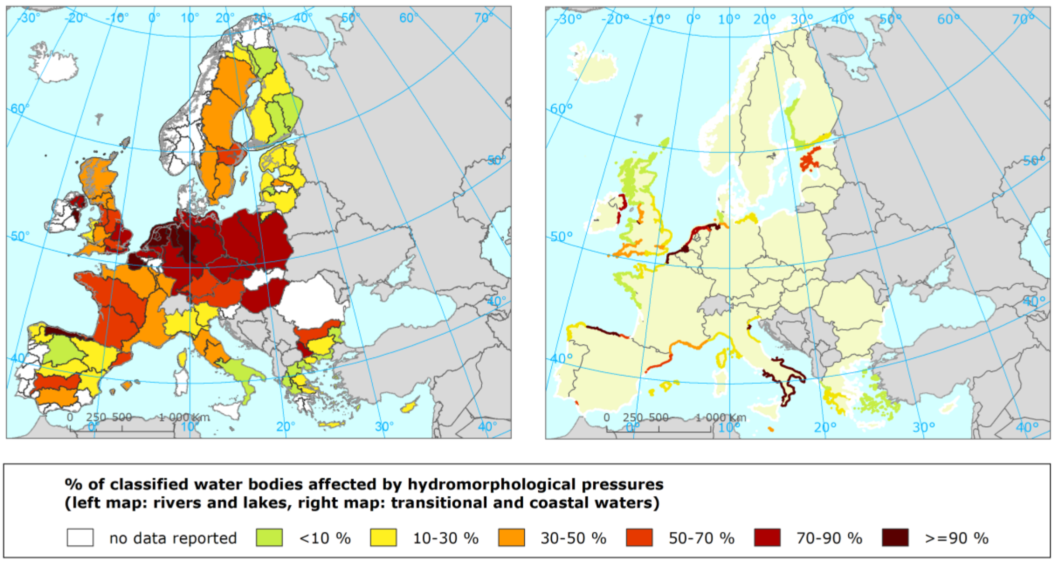
The lowest proportion of coastal and transitional water bodies exposed to pollution pressures are reported from the west coast of Sweden, the north-eastern coast of Poland, as well as around the Greek islands, where more than 90% of the coastal and transitional water bodies are reported to be without significant pollution pressures.

For coastal and transitional waters the consistency between the reported pollution pressures and the ecological status or potential is less clear. In some areas the ecological status or potential in these water categories is worse than what is suggested by the pollution pressures, e.g. in southern Sweden and Poland, which can be explained by hydromorphological or other pressures, as well as by pressures coming from outside the EU. However, in other areas the ecological status or potential is better than what is suggested by the pollution pressures, e.g. in Scotland, Brittany in France, northern coast of Spain and most of Italy. The reason can be that the pollution pressures are rapidly diluted in large, exposed coastal water bodies in these areas and therefore have less effect on their ecological status. However, also reporting mistakes and methodological artifacts may contribute to these inconsistencies.

5.5.2. **Hydromorphological pressures**

Hydromorphological pressures comprise all physical alterations of water bodies modifying their shores, riparian/littoral zones, water level and flow, (except water abstraction). Examples of such pressures are damming, embankment, channelization, non-natural water level fluctuations.
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, as well as in many RBDs in Spain, Italy, Greece, Bulgaria and Cyprus. 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 the in the northern coast of Spain and southern coast of Italy. Further details on hydromorphological pressures can be found in the Hydromorphology Thematic Assessment report.

Figure 5.5 Proportion of classified water bodies in different River Basin Districts affected by hydromorphological pressures for rivers and lakes (left panel) and for coastal and transitional waters (right panel) (percentage, based on number of classified water bodies).



Notes: A water body is defined as 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" and "Other morphological alterations" and/or any of the corresponding disaggregated pressure types. **Member states which have reported pressures, but where certain RBDs are marked as "no data reported" should indicate whether this particular pressure has not been reported in this RBD or whether no water bodies in this RBD are affected by this particular pressure.**

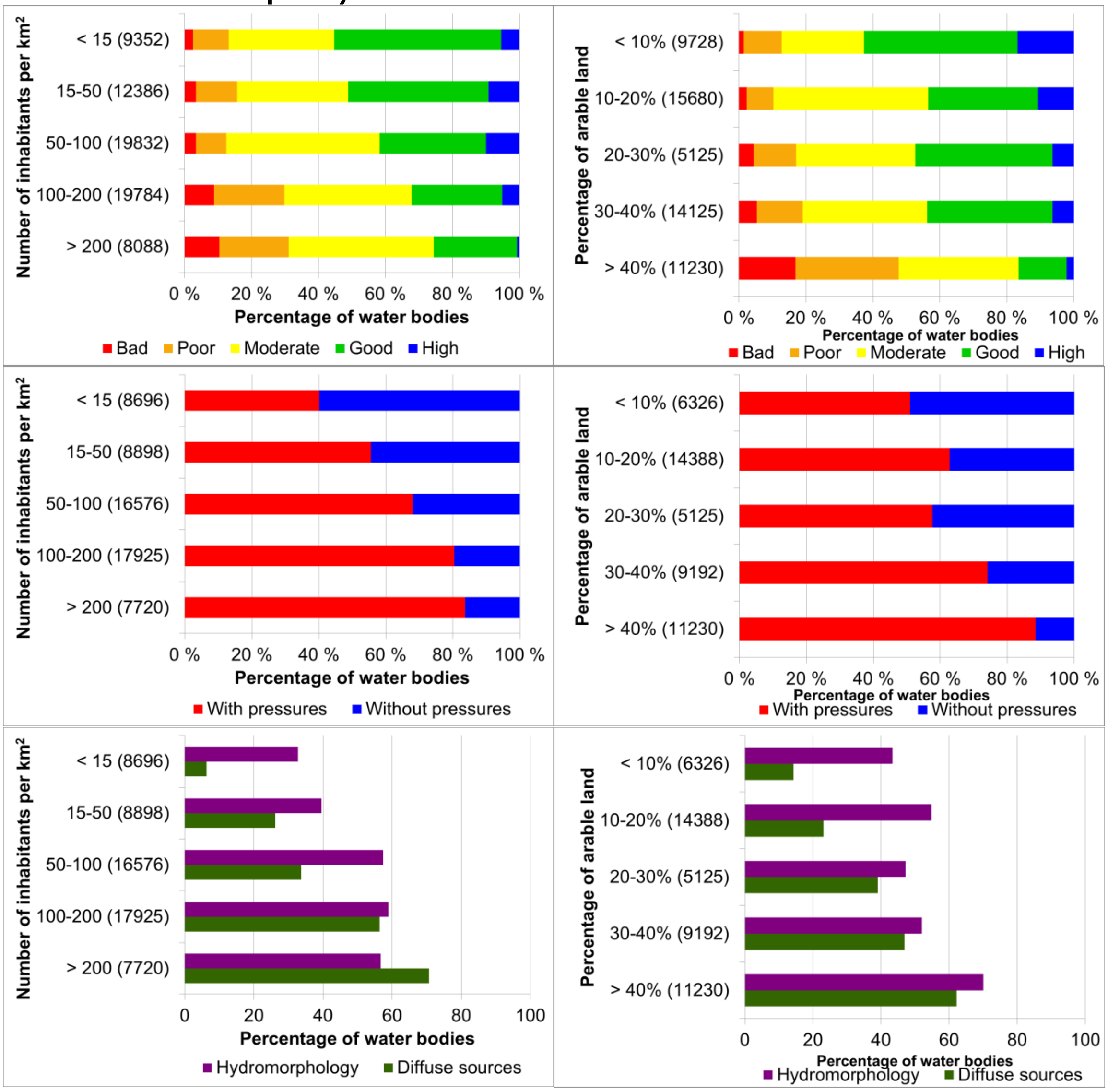
5.6. Relationships of ecological status or potential and pressures in rivers with population density and proportion of arable land

When population density and proportion of arable land increases, the ecological status or potential of river water bodies clearly deteriorates and the pressure increases, both for diffuse pollution, as well as for hydromorphological pressures (figure 5.6). The ecological status or potential changes from ca. 40% to ca. 80% of classified river water bodies in less than good status when population density and proportion of arable land increases 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.

When population density and proportion of arable land is low (less than 15 inhabitants per km^2 and 10% arable land), the majority of classified river water bodies are reported to have good or better ecological status or potential and to be without significant pressures. Diffuse pollution affects only a small proportion of the river water bodies (less than 15%). Hydromorphological pressures are nevertheless reported for a substantial proportion of the classified river water bodies (30-40%) even at the lowest level of population density and proportion of arable land, which is probably related to the use of many upstream rivers in mountain areas for hydropower production.

At the highest levels of population density and proportion of arable land (more than 200 inhabitants per km^2 and 40% arable land), less than 25% of the classified river water bodies are in good or better ecological status or potential, and between one third and half of these water bodies are reported to be in poor or bad ecological status or potential. At this highest level of the two major drivers, as much as 80-90% of the river water bodies are exposed to significant pressures, with diffuse pollution and hydromorphological alterations affecting 60-70% of the classified river water bodies.

Figure 5.6. Ecological status or potential of classified river water bodies in different categories of population density (left upper panel) and in different categories of arable land in the river basin (right upper panel) , proportion of classified river water bodies with and without pressures in different categories of population density (left middle panel) and in different categories of arable land in the river basin (right middle panel), proportion of classified river water bodies with hydromorphological or diffuse pressures in different categories of population density (left lower panel) and in different categories of arable land in the river basin (right lower panel).



Notes: The designation of river water bodies to population 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 brackets. In the pressure plots the member states not reporting the given pressures are excluded from the number of classified water bodies. Swedish surface water bodies where the pressure reporting is considered only to be related to airborne mercury contamination are defined as not affected (see text). See appendix for further details.

5.7. Appendix with Notes for figures and tables.

Figure 5.0

Table 5.0 *Proportion of classified water bodies in less than good ecological status or potential, with pressures and with impacts in different water categories.*

Water category	Rivers	Lakes	Transitional waters	Coastal waters
Ecological status or potential, % water bodies in less than good status or potential	58	43	69	48
Pressures, % water bodies with one or several pressures	66	43	81	52
Impacts, % water bodies with one or several impacts	52	37	67	52

Ecological status or potential: Surface water bodies that are not classified include water bodies in Denmark, Portugal, Malta and Slovenia, who have not yet reported, water bodies in some RBDs which are not reported (see figure 5.2) and water bodies reported as unclassified (see chapter 3.1). The total numbers of classified water bodies are thus: Rivers: 75763, Lakes: 13849, Transitional waters: 629, Coastal waters: 2225.

Pressures and impacts: The member states excluded from the number of total classified water bodies due to non-reporting are: Pressures: Luxembourg, Romania, Slovakia, Belgium and Cyprus (the latter two only for coastal waters). Impacts : Poland, the Netherlands, Luxembourg, Romania, Slovakia, Belgium and Cyprus (the latter two only for coastal waters). Ireland only reported pressures and impacts for one RBD, so Irish water bodies are removed both from the number of water bodies affected and from the number of total classified water bodies. The total numbers of classified water bodies are thus :
Pressures : Rivers: 66136, Lakes: 12918, Transitional waters: 557, Coastal waters: 2162.
Impacts: Rivers: 64895, Lakes: 12291, Transitional waters: 543, Coastal waters: 2142.
For Sweden, the aggregated diffuse pressure type and the impact contamination by priority substances are considered to represent airborne mercury pollution only. Water bodies only affected by these specific pressure or impact types are considered not to be affected by pressures or impacts, respectively. The numbers of such redefined water bodies are:
Pressures: Rivers: 7987, Lakes: 4677, Transitional waters: 0, Coastal waters: 248.
Impacts: Rivers: 11452, Lakes: 5050, Transitional waters: 0, Coastal waters: 126.

Figure 5.1:
In cases where length (rivers) and area (remaining water categories) data were considered suspicious, these water bodies were excluded from the analysis by length or area. These were cases when length or area was 0 or below or when data were not reported. This occurred in all water categories. In addition there were cases of unrealistically high numbers, indicating erroneous unit. For rivers, all water bodies with length > 1000 km were removed. These were all Italian. No lake or transitional water bodies were removed due to too large area, but all coastal water bodies >6000 km2 were removed. These were all from the Spanish RBD ES100. The total numbers of classified water bodies used in this analysis were thus somewhat lower than in the analysis by count (see notes figure 5.0), i.e.:
Rivers: 74413, Lakes: 13828, Transitional waters: 614, Coastal waters: 2181.

Figure 5.3:
For the “No pressures”» and “No impacts” bars, the same member states are removed from the total number of classified water bodies as in figure 5.0. In the other bars, more member states may be removed from the total classified, if they have not reported that specific pressure or impact (for most pressures and impacts the member states can be identified in the member state plots in chapter 4). In some cases the lack of reporting may actually mean that no water bodies in the member state are affected by the specific pressure or impact. If that is the case, these member states should clarify this, as excluding these member states from the number total classified water bodies leads to overestimation of the proportion of water bodies affected by the specific pressure or impact.

For the “No pressures” and “No impacts” bars, the same numbers of Swedish water bodies are redefined as in the pressures and impacts bars in figure 5.0, respectively. In the “Diffuse sources” bars, Swedish water bodies reported with the aggregated diffuse pressure type as the only diffuse pressure are defined as not affected, that is:
Rivers: 14149, Lakes: 6842, Transitional waters: 16, Coastal waters: 548.
In the “Contamination” bars, all Swedish water bodies with this impact are defined as not affected (because Sweden did not report the impact type “contaminated sediments”), that is :
Rivers: 15474, Lakes: 7196, Transitional waters: 21, Coastal waters: 598.

Figure 5.4: For Sweden, water bodies are redefined as not affected by pollution pressures if the aggregated diffuse pressure type is the only pollution type reported (see notes figure 5.0). The following numbers of water bodies are redefined (EU RBD codes):

EU RBD code	Lakes and rivers	Transitional and coastal waters
SE1	5737	86
SE1TO	918	3
SE2	10581	44
SE3	549	146
SE4	1038	140
SE5	1829	98
SENO1102	66	
SENO1103	121	
SENO1104	4	
SENO5101	52	

Figure 5.6: Only river water bodies from RBDs where category data are available are included (Population: 128, Arable land: 92 RBDs). In the final version of the report the aim is to include all reported RBDs in this analysis. The Member States removed from the number of classified river water bodies are the same as in figure 5.0 (for rivers, all Member States reporting pressures overall report hydromorphological and diffuse pressures). In the with/without pressures plots, all Swedish river water bodies with the aggregated diffuse pressure type only are defined as without pressures. In the diffuse sources bars, all Swedish river water bodies with the aggregated diffuse pressure type as the only diffuse pressure are defined as without diffuse pressures. The numbers are given here:

Population category	Redefined as without pressures	Redefined as without diffuse pressures	Arable land category	Redefined as without pressures	Redefined as without diffuse pressures
<15	4305	7025	<10%	2188	4138
15-50	753	1843	10-20%	848	2182
50-100	95	339	20-30%		
100-200			30-40%		
>200			>40%		

6. European overview of chemical status, pressures and impacts

6.1. Key Messages

The chemical status of more than 100,000 surface and groundwater bodies has been reported under the WFD. Poor status for each of the four surface water categories – rivers, lakes, transitional and coastal - does not exceed 10%, aggregated across Europe as a whole, although poor status rises to 25% for groundwaters.

Notably, the chemical status of many of Europe's surface waters remains unknown, ranging between 39% for rivers and 59% in transitional waters. In addition, understanding of the link between pressures and chemical status remains incomplete.

Sixteen Member States have more than 10% of groundwater bodies in poor chemical status whilst this figure exceeds 50% in Spain, Luxembourg, Czech Republic, Belgium-Flanders and Malta. 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 fertilizers 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 set to protect groundwater vary markedly between Member States for some pollutants.

Nine countries report poor status in more than 20% of rivers and lakes whilst in Hungary, Belgium-Flanders, Poland and Sweden this figure rises to above 40%, reaching 100% in Sweden. Polycyclic aromatic hydrocarbons (PAHs) are a widespread cause of poor status in rivers. 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. Heavy metals are also a significant contributor to poor status in rivers and lakes, with levels of mercury in Swedish freshwater biota being the cause of 100% failure to reach good chemical status. Industrial chemicals such as the plasticiser DEHP, and pesticides, are also widespread causes of poor chemical status in rivers.

Six Member States – France, Germany, Belgium-Flanders, Sweden, Romania and the Netherlands - report poor status in transitional waters to be 50% or more. PAHs, the antifouling biocide tributyltin (TBT) and heavy metals are the most common cause. TBT is now banned across Europe and high concentrations locally reflect the historical use and persistence of this substance.

Six Member States report their coastal waters to be in 100% good status, although in four others – Netherlands, Sweden, Romania and Belgium-Flanders poor status exceeds 90%. A variety of pollutant groups contribute to poor status in coastal waters reflecting a diverse range of sources.

Those waterbodies across Europe that exhibit particularly poor chemical status are, typically, subject to pollution from a range of different chemicals, including heavy metals, industrial chemicals and pesticides, that derive from a variety of sources.

Some hazardous substances are hydrophobic and tend to accumulate in sediment and biota, with the result that their concentrations in these matrices are likely to be higher and, therefore, more detectable and measurable than in water. If measurements are made 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. A harmonisation at EU level is, therefore, needed.

6.2. Introduction

6.2.1. **Background**

Chemicals are an essential part of our daily lives. They are used, for example, to produce consumer goods, to protect or restore our health, to boost food production and are involved within a growing range of environmental technologies. Europe's chemical and associated industries have developed rapidly in recent decades, making a significant contribution to Europe's economy and to the global trade in chemicals.

Whilst synthetic chemicals clearly bring important benefits to society, some of them are hazardous, raising concerns for human health and the environment depending on their pattern of use and the potential for exposure. Certain types of naturally occurring chemicals, such as metals, can also be hazardous. Emissions of hazardous substances to the environment can occur at every stage of their life cycle and arise from a wide range of land-based and marine sources, including agriculture and aquaculture, industry, oil exploration and mining, transport, shipping and waste disposal, as well as domestic premises. In addition, concern regarding chemical contamination arising from the exploitation of shale gas has grown recently.

Hazardous substances are emitted to water bodies both directly and indirectly through a range of diffuse and point source pathways. Their presence in fresh and marine waters and associated biota and sediment is documented by various information sources, including national monitoring programmes, monitoring initiatives undertaken by the Joint Research Centre (JRC), reporting under the Water Framework Directive (WFD), international marine conventions (e.g. HELCOM and OSPAR) and European research studies. These substances comprise a wide range of industrial and household chemicals, metals, pesticides and pharmaceuticals.

Hazardous substances can have detrimental effects on aquatic biota at molecular, cellular, tissue, organ and ecosystem level. Substances with endocrine-disrupting properties, for example, have been shown to impair reproduction in fish and shellfish in Europe, raising concerns for fertility and population survival. The impact of organochlorines upon sea birds and marine mammals is also well documented, as is the toxicity of metals and pesticides to freshwater biota. From a socio-economic point of view, such impacts diminish the services provided by aquatic ecosystems, and consequently the revenue that can be derived from them.

Persistent hazardous substances found in aquatic environments can bio-accumulate throughout the food chain, raising implications for human health with respect to the consumption of seafood (fish, crustaceans, molluscs and marine mammals) and freshwater fish. The bio-accumulation of mercury and various POPs in particular can cause health concerns for vulnerable population groups (EC, 2004; EFSA, 2005). The exceedance of regulatory levels in seafood is documented for several hazardous substances in the seas around Europe (Isosaari et al., 2006; Kiljunen et al., 2007; HELCOM, 2010; Bilau et al., 2007).

Human exposure to hazardous substances can also potentially occur through the ingestion of contaminated drinking water. The Drinking Water Directive sets quality standards for water at the tap, based on guidelines issued by the World Health Organization (WHO), for a range of microbiological and chemical parameters. Much of Europe is now connected to municipal systems supplying treated water under quality-controlled conditions. However, reporting under the Directive (for the period 2002–2004) indicates some non- compliance with respect to a range of chemical parameters (EC, 2007). In recent years, concern has been raised with respect to the presence of some emerging pollutants within treated municipal drinking water. Understanding of the effects of long-term human exposure to trace amounts of such substances — in concentrations of parts per billion or trillion — remains incomplete.

In some, typically rural, areas of Europe, the local population relies upon small individual or community-managed non-piped supplies of water, usually wells or boreholes. Such small-scale supplies are not covered by the Drinking Water Directive and the provision of safe drinking water can present a challenge: any chemical (or microbiological) pollution of groundwater in the vicinity of such wells will pose a threat to public health. The World Health Organization reports that chemical contamination of drinking water across the (WHO) pan-European region, whilst restricted to specific local areas, can have a significant impact upon human health (WHO, 2010).

This assessment describes the chemical status of Europe's inland and coastal waterbodies as reported through the river basin management plans of the Water Framework Directive. It draws also on other supporting information. In addition to highlighting current chemical status, this assessment also describes the factors causing degradation in chemical water quality, including the sources of such pollution and their emissions to water.

6.2.2. **Sources, pathways and emissions**

Emissions and releases of hazardous substances can occur at all stages of their life-cycle, from production, processing, manufacturing and use in downstream production sectors and by the general public to their eventual disposal. Such substances can arise from numerous sources and are emitted to fresh and marine waters via numerous pathways. The key sources and their pathways of emission are overviewed below.

Urban environment

Hazardous substances arise from various sources in the urban environment. These include household chemicals such as personal care products and medicines, a wide range of industrial chemicals, substances such as hydrocarbons and heavy metals released by the transport sector, building and construction materials, and pesticides used to control unwanted plant growth on sports grounds and buildings, in public parks and private gardens, and on roads and railways. Certain hazardous substances are released to air from industrial and waste facilities and vehicle emissions. Subsequently, their deposition to water bodies can occur both directly and indirectly, for example via soil and urban drainage systems.

Residential wastewater in Europe is predominantly collected by a sewer network and directed to municipal wastewater treatment plants. Industrial wastewaters are also typically treated, either on-site or by transfer to a municipal plant. Other urban pollutants, however, particularly those deposited from the atmosphere or released from vehicles (e.g. from wear on brakes and tyres) are, originally at least, diffuse in nature, as they are washed from impervious areas by surface run-off. Their subsequent fate depends upon whether the run-off is collected and directed to a treatment plant or discharged untreated to a receiving water body. Whilst household and industrial wastewater treatment has been implemented progressively across Europe, the process does not remove all hazardous substances, with household and industrial chemicals and pharmaceuticals, for example, being detected in treated effluent that is subsequently discharged to surface waters (Ashton et al., 2004; Gros et al., 2010; HELCOM, 2010; Miège et al., 2009; Reemtsma et al., 2006).

In many cities across Europe, the sewage collection system has also been designed to collect run-off from streets, roofs and other impervious surfaces. The collection pipes and treatment plants of such combined systems are designed to be able to handle both sewage and urban run-off generated during rain storms, but only up to a certain level. During larger storm events, the combined flow generated can exceed the capacity of the system. When this happens, relief structures are built into the collection system to prevent sewage back-up into streets and homes, enabling the flows to bypass the treatment plants and discharge the combined waste more or less untreated to a receiving watercourse. Such combined sewer overflows (CSOs), together with discharges from separate stormwater systems, typically discharge a range of pollutants including hazardous substances (Chon et al., 2010; Gounou et al., 2011; Sally et al., 2011) and can cause rapid depletion of oxygen levels in receiving waters (Even et al., 2007). In addition, the quality of coastal waters near such discharges can deteriorate very quickly.

Agriculture
Pesticides used in agriculture are widely detected in freshwater, often transported by diffuse pathways via surface run-off and leaching. Point discharges of pesticides are also important, however, and occur through accidental spillage, sprayer loading and wash-down, and inappropriate storage and disposal. Just how much pesticide pollution of freshwater occurs depends on a range of factors including the chemical nature of the pesticide, the physical properties of the landscape, and weather conditions.

Metal emissions from agriculture include cadmium, found naturally in the phosphate rock used to make fertilizer. In addition, both zinc and copper are added to animal feed as essential trace elements, and hence a proportion can be excreted and susceptible to being washed into rural streams. While metals are generally well retained in soil, there is evidence that agricultural sources can make a significant contribution to freshwater loads (RIVM, 2008a and 2008b).

Following use in livestock treatment, 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 as a fertilizer (Boxall et al., 2004). As a consequence, veterinary medicines may subsequently be transported to surface waters via runoff or field drains (Burkhard et al., 2005) or leach to groundwaters (Blackwell et al., 2007).

Mining
Mining exerts a localised but significant pressure upon the chemical and ecological quality of water resources in parts of Europe, particularly with respect to the discharge of heavy metals. Abandoned mines represent a particular threat since, in the absence of continued pumping, groundwater levels rise and, ultimately, discharge contaminants within the mine workings. Mine discharges threaten the attainment of good water quality in a number of locations across Europe.

Landfills and contaminated land
Landfill sites can be a source of pollution to the aquatic environment. Precipitation percolates down through the waste, picking up a range of pollutants including hazardous substances whilst water is also released from the waste itself as it degrades (Slack et al., 2005). The leachate subsequently collects at the base of the landfill where it can, potentially, contaminate groundwater. In modern landfills, leachate is collected by pipes and either treated on site, with the effluent discharged to a neighbouring watercourse, or transported to a sewage treatment plant for processing. Older landfills, however, do not incorporate such measures and as a consequence, contaminated leachate is free to flow downwards unrestricted (Baun et al., 2004). Aside from landfill sites, land can be contaminated by a range of hazardous substances released from historical industrial activities or, more recently, from unintentional leaks and spills. Such substances can include solvents, oil, petrol, heavy metals and radioactive substances. Without appropriate remedial action, ground and surface waters can also be polluted.

Transport of hazardous substances to coastal waters
Once released to rivers, hazardous substances can be transported downstream and ultimately discharged to coastal waters, although numerous processes can occur 'in-stream' to attenuate this transport. Of particular note is the deposition of substances onto the river bed. Hazardous substances attached to other particles, such as organic material and eroded soil, are particularly susceptible to this sedimentation process and, once settled on the river bed, can pose a threat to benthic biota. During periods of higher river flow, however, bed sediments and their associated contaminants can be re-

suspended into the water column and transported downstream until flow declines and sedimentation occurs again. The proportion of a hazardous substance load that is ultimately discharged to estuarine and coastal waters remains susceptible to sedimentation once more. Re-suspension of hazardous substances can also occur when sediments are disturbed and displaced, for example, through dredging.

Sources emitted directly into the marine environment
In addition to the waterborne transport of 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, whilst the discharge of sewage and industrial wastewater directly (i.e. not via rivers) into coastal waters can also occur.

6.2.3. **Protection of Europe's fresh and marine waters from chemical pollution**

The chemical status of Europe's surface waters is addressed by the EQSD, a 'daughter' directive of the WFD. The EQSD defines environmental quality standards (EQSs) in fresh and coastal waters for pollutants of EU-wide relevance known as priority substances (PSs). The EQSs associated with the PSs are defined both in terms of annual average and maximum allowable concentrations, with the former protecting against long-term chronic pollution problems and the latter against short-term acute pollution. Member States are required to monitor the PSs in surface water bodies and to report EQS exceedances. PSs designated thus far include metals, herbicides, insecticides, fungicides, biocides, volatile organic compounds, alkylphenols, PAHs and phthalates. The European Commission is required to review the list of PSs every four years and identify, where appropriate, new PSs or PHSs and any need to revise the EQSs or the status of existing PSs.

The EQSs must not only protect freshwater and marine ecosystems from possible adverse effects of hazardous substances; they must also safeguard human health, which potentially can be put at risk via drinking water or the ingestion of food originating from aquatic environments. In this way, all direct and indirect exposure routes in aquatic systems are to be accounted for when establishing the EQSs. For example, the setting of an EQS for the water column alone may be insufficient with respect to a chemical with a tendency to bioaccumulate and one that may therefore pose a risk through secondary poisoning resulting from food chain transfer. Instead, in this case, a biota standard may be required alongside the water column EQS.

Some pollutants have been designated as priority hazardous substances (PHSs) due to their toxicity, their persistence in the environment and bioaccumulation in plant and animal tissues, or an equivalent cause for concern. The cessation or phase-out of discharges, emissions and losses of PHSs to the aquatic environment is required within 20 years of the date of the adoption of measures.

For substances identified as being of concern at local, river-basin or national level (known as river basin specific pollutants) but not as a PS or PHS at EU level, standards are set by national governments and the results of monitoring are considered in the assessment of ecological status under the WFD.

The WFD objective of good groundwater chemical status is directly supported by the Groundwater Directive (GWD), which has established EU-wide groundwater quality standards for two (Annex I) groups of pollutants; nitrates and pesticides. Annex II of the GWD sets a minimum list of other pollutants (such as heavy metals) for which Member States have to consider establishing threshold standards in terms of concentration. The establishment of standards at Community level for these other pollutants has not, however, been adopted, due to the inherent high natural variability caused by hydrogeological conditions, background levels, pollutant pathways and interactions with different environmental compartments. Instead, the GWD requires Member States to establish their own groundwater standards for the Annex II pollutants, to be set as threshold values. These thresholds are primarily based on two criteria, which respectively address the protection of associated aquatic ecosystems and groundwater- dependent terrestrial ecosystems, and the protection of water used for drinking and other purposes. To date, the thresholds established for some pollutants (e.g. arsenic, cadmium and mercury) vary markedly between Member States.

A suite of other European legislation lends support to the attainment of good chemical status under WFD. This includes REACH (EC Regulation 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals) which aims to improve the protection of human health and the environment from the risks of chemicals. REACH attributes greater responsibility to industry with regard to managing risks and providing safety information on substances used. It also calls for the progressive substitution of the most dangerous chemicals once suitable alternatives have been found. Other legislation is specific to a particular substance or group of substances. This includes the Pesticides Framework Directive which calls for the establishment of national action plans to set objectives in order to reduce hazards, risks and dependence on chemical control for plant protection.

6.2.4. **Chemical Status – reporting requirements**

Surface Water
Whilst the EQS Directive designates a number of priority substances, finalisation of the legislation occurred relatively late with respect to the monitoring of chemical water quality and its reporting within the river basin management plans. As a consequence a majority of member states reported surface water chemical status using a grouping, recommended in WFD reporting guidance, into four categories; heavy metals, pesticides, industrial pollutants and 'other pollutants'. The latter category included a mix of individual chemical types including polycyclic aromatic hydrocarbons (PAHs) and tributyltin compunds. Inconsistency in reporting was apparent between countries, however, with some reporting a mix of pollutant groups and individual pollutants, whilst others reported either individual pollutants or groups only. Moreover, different matrices (i.e. water column, sediment and biota) have sometimes been used to assess the risk of particular chemicals across different Member States, meaning that the results arising are not always directly comparable.

Groundwater
Reporting with respect to WFD groundwater chemical status required a grouping into three categories; nitrate, certain pesticides and the Annex II pollutants including Arsenic, Cadmium, Lead, Mercury, Ammonium, Chloride, Sulphate, Trichloroethylene and Tetrachloroethylene. Inconsistency in reporting was apparent between countries, however, with some reporting a mix of pollutant groups and individual pollutants, whilst others reported either individual pollutants or groups only. Moreover, the defining of pollutants and their associated threshold values (as required under the GWD) vary markedly between Member States (EC, 2010). Failure to achieve groundwater chemical status is not solely dependent upon the excedance of threshold standards but upon a number of other factors too, including the occurrence of saline intrusion and significant damage to terrestrial ecosystems that depend directly upon a groundwater body.

6.3. European Overview of chemical status

The chemical status of more than 12,000 groundwater bodies has been reported across Europe, encompassing 24 different Member States (Figure 6.1) . Good status is apparent in more than 70% of them (by surface area) whilst about 25% are in poor status. Approximately 5% are classified as unknown. The dominant reason for poor status (63%) is the exceedance of a threshold value for one or more pollutants. Other causal factors include the deterioration in quality of waters for human consumption and the occurrence of saline intrusion.

The chemical status of nearly 80 000 surface freshwaters has been evaluated across more than 20 countries across Europe, with 53 % of rivers and 48 % of lakes (by count) being classified as good, with 8 % and 2 %, respectively, being in poor status. Notably, the chemical status of 39 % of rivers and 49 % of lakes remain unknown. These overall statistics do not, however, include the results from

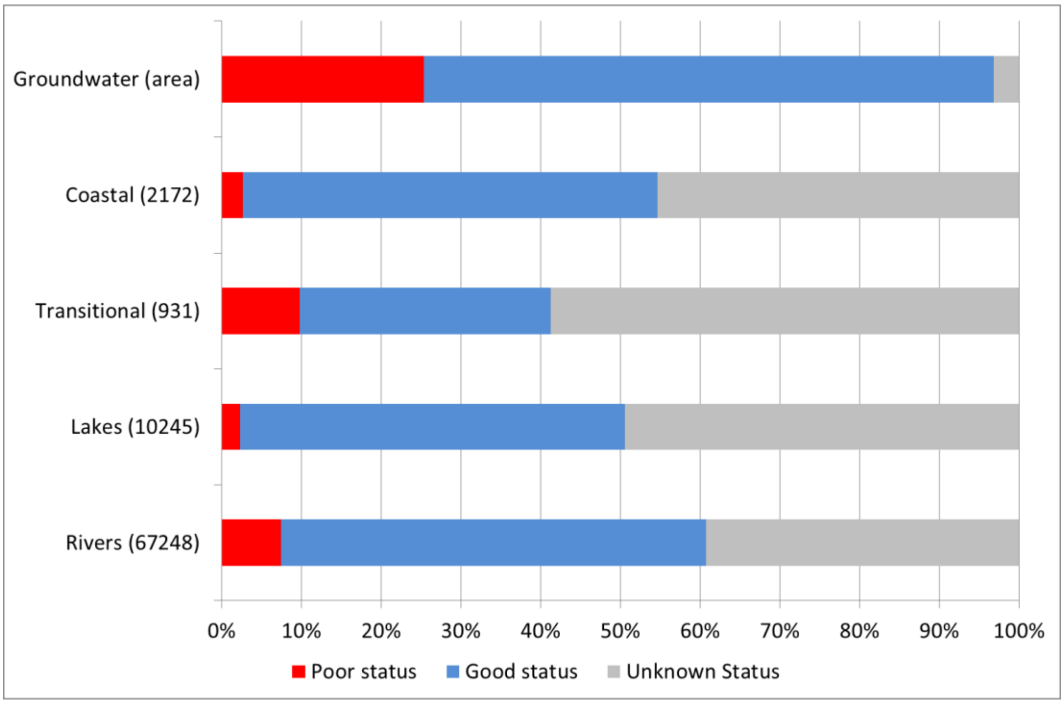
Sweden that contributed a disproportionately large amount to the total information reported across Europe for surface waters. Additionally all such waters in Sweden are classified as being in poor status due to the levels of mercury found in biota (see textbox).

Text box 7.1: Importance of the matrix used to evaluate chemical status

Some hazardous substances are hydrophobic and tend to accumulate in sediment and biota, with the result that their concentrations in these matrices are likely to be higher and therefore, more detectable and measurable than in the water column. If measurements are made in the water column only, the risk to the aquatic environment may be underestimated. Mercury is an example of a hydrophobic substance and its high level in freshwater biota in Sweden has led to a nationwide classification of poor chemical status. WFD reporting shows, however, that at least one other Member State has monitored mercury levels in the water column only. This has resulted in a substantially lower percentage of water bodies being classified in poor chemical status compared to Sweden, despite a comparable problem with mercury in soils and freshwater.

Chemical status for nearly 1000 transitional and more than 2,000 coastal waterbodies has been reported across 15 and 18 Member States, respectively. Marked variation in the surface area of these is apparent both within and between countries, although since this information was not reported consistently, the results are presented here by count. Poor chemical status is reported in 10% of transitional and 3% of coastal waterbodies, whilst good status is achieved in 31% and 51%, respectively. Of note is the amount of unknown status reported, 59% of transitional and 45% of coastal waterbodies are classified in this category.

Figure 6.1. Percentage of rivers, lakes, groundwater, transitional and coastal waters in good, poor and unknown chemical status.



Note: Number of Member States contributing to the dataset: Groundwater (23); Rivers (22); Lakes (20); Transitional (15) and Coastal (18). Percentages shown for rivers, lakes, transitional and coastal are by waterbody count. Groundwater percentages, however, are expressed by area. The total number of water bodies is shown in parenthesis.

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 poor status since levels of mercury found within biota in both fresh and coastal waters exceed threshold standards.

Source: Based on data available in WISE-WFD database primo February 2012- country results on chemical status is available here http://wfd.atkins.dk/report/WFD_aggregation_reports/gwb_status and http://wfd.atkins.dk/report/WFD_aggregation_reports/swb_status

6.3.1. Chemical groups causing poor status – an overview

Excessive nitrate concentration is the cause of more than 40% of those groundwater bodies classified as being in poor chemical status across Europe, whilst the Annex II pollutants account for more than 25%. It should be noted; however, that more than one chemical group can cause failure to reach good status in any single water body. Pesticides are the cause of more than 15% of groundwater bodies in poor chemical status. In general, shallow groundwater horizons are more likely to exhibit poor chemical status than lower horizons.

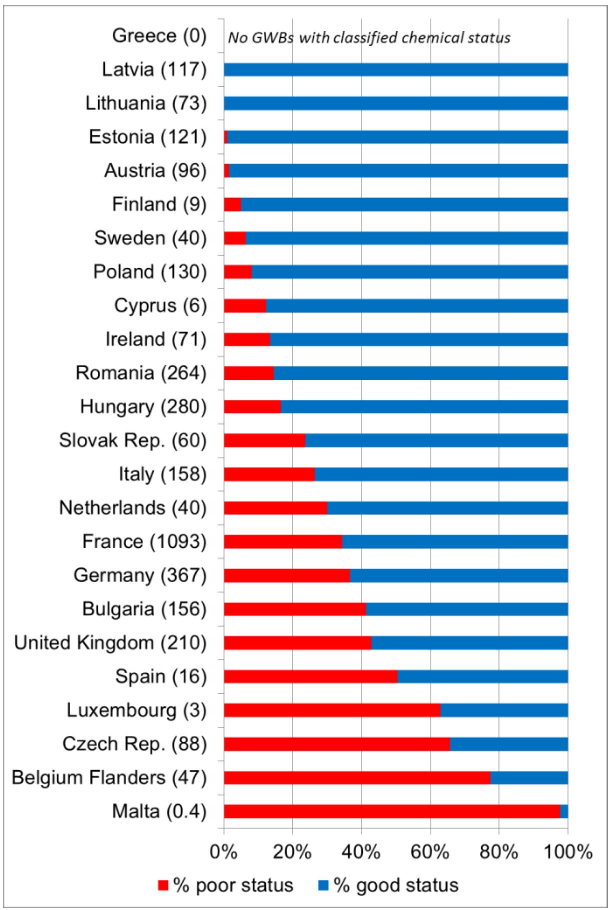
'Other pollutants' are the causal factor for nearly 50% of European rivers classified as being in poor chemical status, whilst heavy metals account for nearly 20% and pesticides about 15%. For lakes, heavy metals are the dominant pollutant, accounting for more than 50% of those in poor status. 'Other pollutants' are the causal factor for nearly 45% of those transitional water bodies classified as being in poor chemical status, whilst heavy metals account for more than 30%. Both pesticides and industrial pollutants each account for around 10%. In coastal waters, 'other pollutants' account for more than 70% of poor status, with heavy metals and industrial pollutants also of importance.

6.4. National and River Basin District Chemical Status

6.4.1. Groundwater

Only Latvia and Lithuania report 100% of groundwater bodies to be in good chemical status whilst 16 member states have more than 10% of groundwater bodies in poor status. In Spain, Luxembourg, Czech Republic, Belgium-Flanders and Malta, more than 50% of groundwater bodies are in poor status. (Figure 6.2, Map 6.1).

Figure 6.2. Percentage of groundwater bodies in poor and good status, by area.



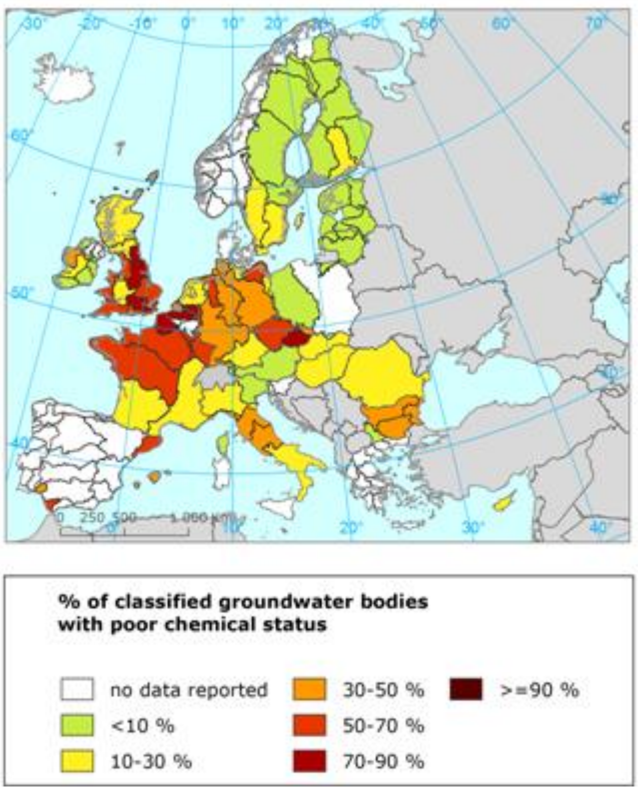
Note: Groundwater bodies in unknown status are not shown in this figure. In parenthesis is shown per Member State the total area covered by ground water bodies in 1000 km^2

Source: Based on data available in WISE-WFD database primo February 2012- country results on chemical status is available at http://wfd.atkins.dk/report/WFD_aggregation_reports/gwb_status

Excessive nitrate concentration is at least a contributing factor in all but one of those Member States that report some (>0%) poor status in groundwater, and is the major cause of failure to reach good status in 10 countries – Austria, Malta, Luxembourg, Spain, UK, Bulgaria, Germany, Italy, Hungary and Romania. In Spain, for example, in the Catalan and Guadiana RBDs, together with some southern coastal river basins, excessive nitrate accounts for at least 30% of poor groundwater status, whilst in the Jucar, Ebro, Segura and Guadalquivir RBDs, the contribution ranges between 15 and 30%. In much of England, Bulgaria, Hungary and central Italy, nitrate levels also contribute 15-30% of those groundwaters in poor status, whilst the problem is greater still in all 3 of the Czech Republic RBDs. Nitrates in groundwater are problematic across France but especially so in the Loire and Scheldt, Somme and North Sea coastal waters RBDs. Groundwater nitrate is primarily attributable to agricultural sources (see textbox).

In France pesticides are the most significant casual factor of poor status in groundwater, contributing at least 30% to failing to achieve good chemical status (poor status) in all RBDs, with this figure rising to more than 50% in the Seine. Pesticides are also problematic in the Ems RBD in Northern Germany and the Mino-Sil RBD in northern Spain. Pesticides contribute between 5 and 15% of groundwater poor status across much of central and eastern Europe, together with Italy, England, southern Sweden, southern Finland and coastal groundwater in southern Spain. Atrazine and isoproturon are the most commonly identified individual pesticides in groundwater across all Member States. In Belgium-Flanders, Czech Republic, Finland, Ireland, Netherlands, Poland and Slovakia, the Annex II pollutants are the most frequent cause of poor status in groundwater. Across all Member States, the Annex II pollutants most commonly identified are chlorides, ammonium, sulphate, tetrachloroethylene, lead and arsenic.

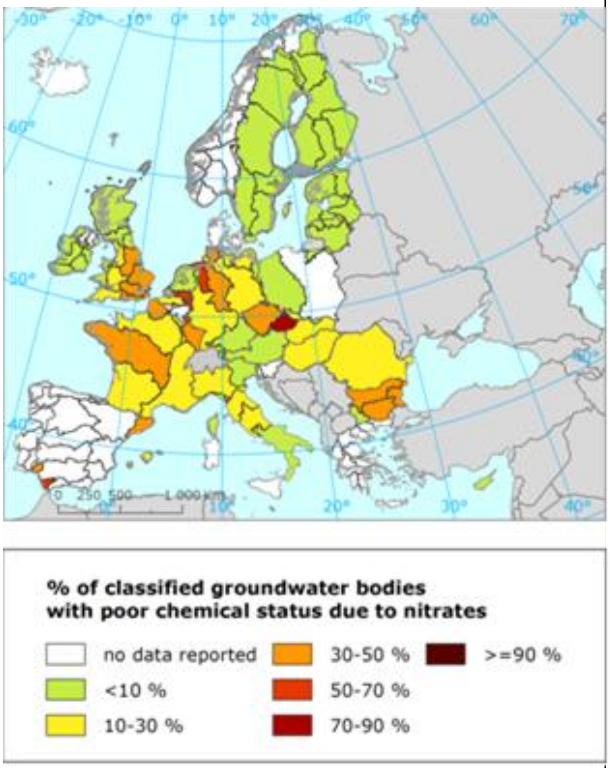
Map 6.1 Chemical status of groundwater per RBD – percentage of groundwater area not achieving good chemical status



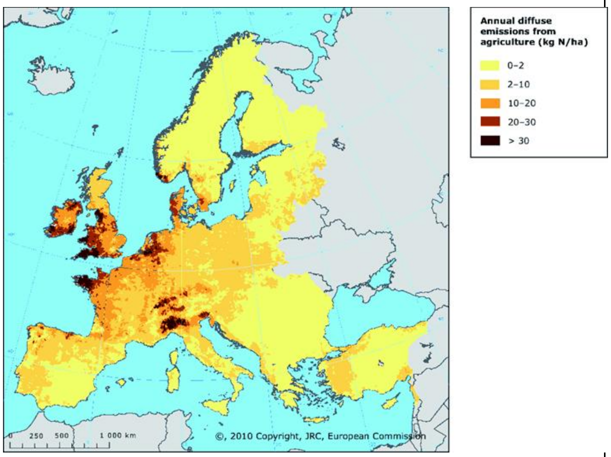
Note: Groundwater bodies in unknown status are not included in calculating percentage of poor chemical status. River Basin Districts with high proportion of groundwater bodies with unknown chemical status is hatched..
Source: Based on data available in WISE-WFD database primo February 2012- RBD results on chemical status is available at http://wfd.atkins.dk/report/WFD_aggregation_reports/gwb_status

Text box 6.2 Nitrate in Groundwater

Map 2 Percentage of groundwater area not achieving good chemical status due to nitrate



Map 3: Annual diffuse agricultural emissions of nitrogen to freshwater (kg nitrogen per hectare of total land area)



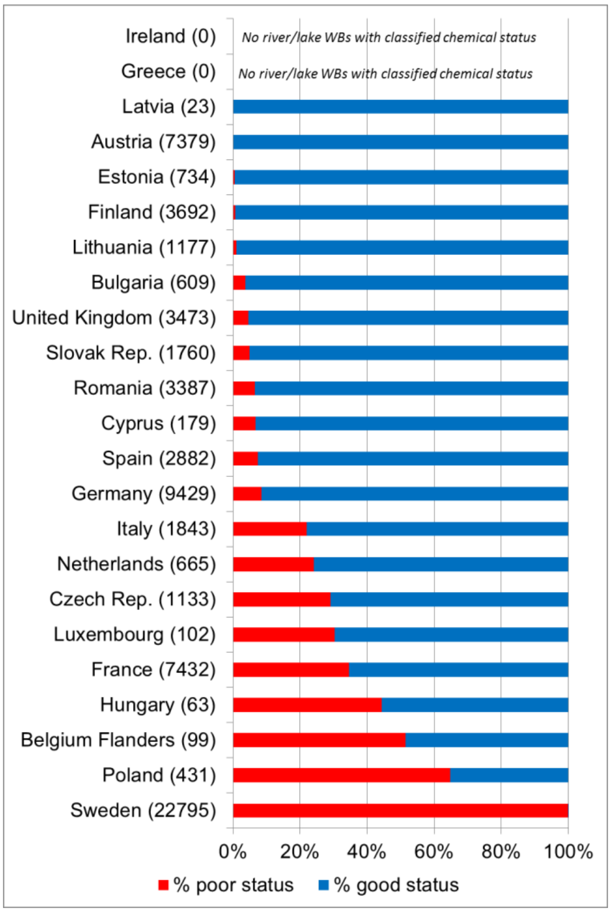
Note: Groundwater bodies in unknown status are not included in calculating percentage of poor chemical status due to nitrate.
Source: Nitrate in groundwater map based on data available in WISE-WFD database primo February 2012- RBD results on chemical status is available at http://wfd.atkins.dk/report/WFD_aggregation_reports/gwb_status
Source: Bouraoui, F, Grizzetti, B and Aloe, A. 2009. Nutrient discharge from rivers and seas JRC EUR 24002 EN, 72 pp

Pollution from nitrate is a major cause of poor chemical status in groundwater across Europe, with agricultural sources typically of the greatest significance. While nitrogen fixation, atmospheric deposition and the application of treated sewage sludge can all be important, the major nitrogen inputs to agricultural land are generally from inorganic mineral fertilisers and organic manure from livestock. Today, the highest total fertiliser nitrogen application rates — mineral and organic combined — generally, although not exclusively, occur in Western Europe. Ireland, England and Wales, the Netherlands, Belgium, Denmark, Luxembourg, north-western and southern Germany, the Brittany region of France and the Po valley in Italy all have high nitrogen inputs (Grizzetti et al., 2007; Bouraoui et al., 2009). 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 reflects the potential for detrimental impacts on the environment since it is available for gaseous loss to the atmosphere as ammonia, transport to the nearest surface waterbody or, leaching to groundwater as nitrate. It is the process of leaching of nitrate that gives rise to the poor groundwater chemical status illustrated above. Improvement in groundwater nitrate water quality will take some time because of transport processes in soils and groundwater. As a result, reported timescales for substantial restoration of water quality reflect this time lag, with recovery times ranging from 4–8 years in Germany and Hungary to several decades for deep groundwater in the Netherlands (EC, 2010a).

6.4.2. Rivers and lakes

Only Latvia and Austria report 100% good chemical status across all rivers and lakes although a further 10 countries report combined poor status across both rivers and lakes to be no greater than 10% (Figure 6.3, Map 6.2). Nine countries report poor status in more than 20% of rivers and lakes whilst in Hungary, Belgium-Flanders, Poland and Sweden this figure rises to above 40%, reaching 100% in Sweden.

Figure 6.3 Percentage of river and lake water bodies in poor and good status, by count of water bodies



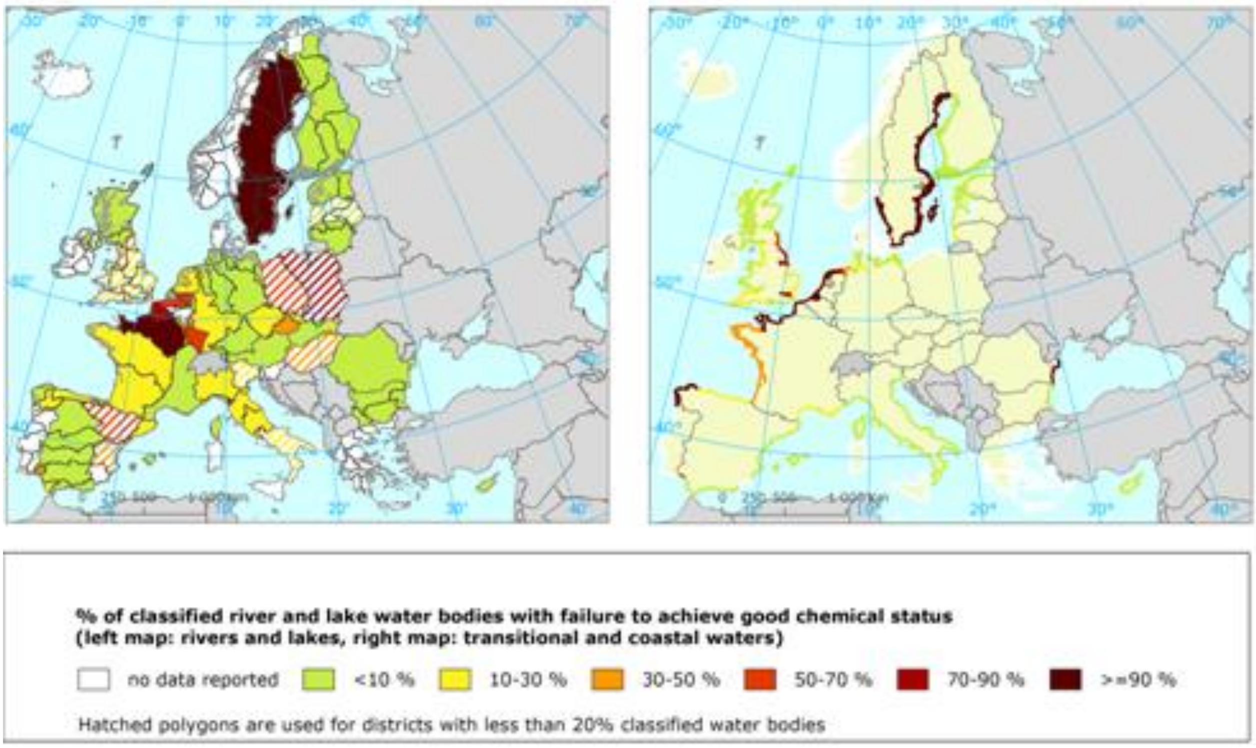
Note: Water bodies in unknown status are not shown in this figure. Number of water bodies per Member States are shown in parenthesis.

Source: Based on data available in WISE-WFD database primo February 2012- country results on chemical status is available at http://wfd.atkins.dk/report/WFD_aggregation_reports/swb_status

Excluding data for Sweden to avoid a distortion of results indicates that the 'other pollutants' group is the most frequent overall cause of poor status in rivers, but particularly in Belgium-Flanders, Germany, France and the UK. A substantial number of rivers also fail to reach good status due to this pollutant group in the Czech Republic, Netherlands and Romania. Within the 'other pollutant' grouping, PAHs are identified as being problematic by nine Member States including most of the RBDs in France, all UK RBDs except for Scotland, the Belgian Schelde and the Czech and German parts of the Elbe. PAHs result from incomplete combustion processes such as those related to the production of electricity, the transport sector, various industrial sectors and waste incineration. They are released to the atmosphere and are known to be subject to long-range transboundary atmospheric transport. As a result, subsequent deposition and adverse impacts upon aquatic environments may occur a great distance from the original point of emission, including remote mountainous regions. Addressing the impacts of such pollutants requires political initiative at the regional and global scale.

Tributyltin (TBT), used primarily as an anti-fouling biocide for boats and ships, is one of those ‘other pollutants’ identified as problematic. Despite now being banned in Europe, high levels in rivers are found locally, reflecting the historical use and persistence of this substance. TBT is a particular issue in the Belgium-Schelde, the Rhone in France and the Humber and Thames RBDs in the UK.

Map 6.2 Chemical status of rivers and lakes and transitional and coastal waters per RBD – percentage of water bodies not achieving good chemical status are shown.



Note: Surface water bodies in unknown status are not included in calculating percentage of poor chemical status. River Basin Districts with high proportion of water bodies with unknown chemical status is hatched..
Source: Based on data available in WISE-WFD database primo February 2012- RBD results on chemical status is available at http://wfd.atkins.dk/report/WFD_aggregation_reports/swb_status

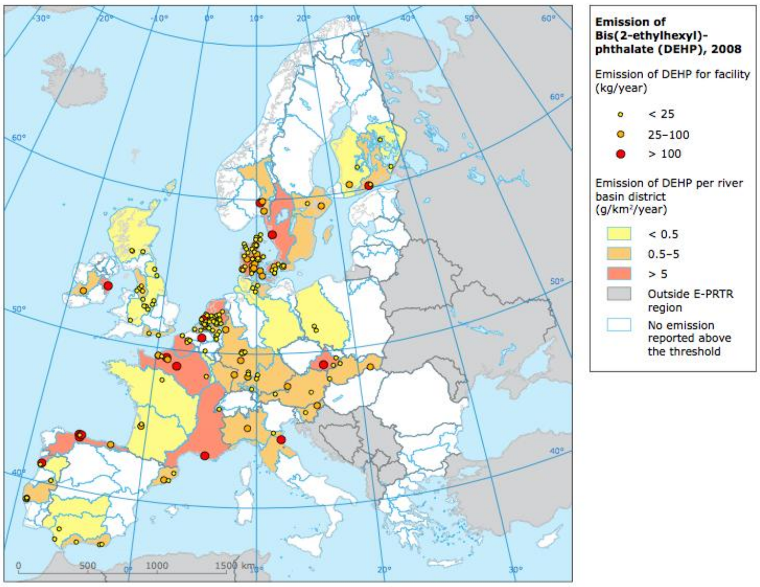
Heavy metals are the dominant cause of poor status in rivers across nine countries, but markedly so in Sweden, Bulgaria, Czech Republic, Spain, Finland, Northern and Central Italy and Romania. In the Czech Republic, for example, nickel, cadmium, lead and mercury are problematic in all 3 RBDs – the Danube, Elbe and Oder, whilst nickel contributes to poor status in four UK RBDs – the Humber, South West, Severn and Western Wales. Heavy metals are also a significant cause of poor status in the German Rhine. Fifteen 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. Cadmium is primarily produced as a by-product from the extraction, smelting and refining of zinc and other non-ferrous metals, although it is also found in phosphate rock used to manufacture fertilizer. Emissions of cadmium to water occur, therefore, via both diffuse and point source pathways. Mercury is also a priority hazardous substance and is identified as problematic in 11 Member States. The exceedance of regulatory levels of mercury in aquatic biota is the cause of 100% poor status in Swedish rivers and lakes. Mercury is also a major issue in the Slovak Republic part of the Danube River.

Industrial Pollutants are the predominant reason for poor chemical status in rivers within Estonia, Lithuania and the Slovak Republic but are a significant factor in a number of others including Belgium-Flanders, Czech Republic, Germany, Spain, France, Italy, Lithuania, Luxembourg, Romania, Sweden and the UK. Within this group, DEHP, widely used as a plasticiser (see textbox) is identified by nine Member States as being problematic. DEHP is a particular issue in the Danube RBD in the Slovak Republic and the Meuse, Rhine and Loire RBDs in France. In the Czech Danube, octylphenol, used as an intermediate in the production of chemicals used in rubber, pesticides and paints, is an issue. Nonylphenol, an industrial surfactant and a known endocrine disruptor, contributes to poor status in 12 RBD’s across Europe and is a particular problem in rivers of the Belgium Scheldt and the Catalan RBD in Spain.

Pesticides are the predominant cause of poor chemical status in rivers in Luxembourg, whilst a substantial number of waterbodies also fail to reach good status due to pesticides in France, Belgium-Flanders, Czech Republic, Germany, Spain, Hungary, Italy, Luxembourg, Netherlands, Romania and the UK. Diuron is identified as a cause of poor status in 9 Member States including the North West and Thames RBDs in the UK, the Belgium Scheldt and the Seine in France. 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 contribute to poor status in six Member States. In the Ebro RBD (Spain) the organochlorine insecticides – endosulfan and hexachlorocyclohexane – are significant contributors to poor status.

Those RBD’s illustrating particularly poor riverine chemical status are generally subject to pollution by a range of different chemicals. This is the case, for example, in the German Rhine where ‘other pollutants’, pesticides and heavy metals each cause poor status in more than 100 waterbodies and industrial chemicals contribute to poor status in 14 waterbodies. Similarly, 14 different chemicals contribute to poor status in the Jucar RBD in Spain. Poor status is relatively high across the Polish Oder RBD although the causes are not reported.

Text box 6.3: Emissions of DEHP to water



Source:

Di(2-ethylhexyl)phthalate (DEHP) is an organic compound classified as a Priority Substance under the WFD and as a substance of very high concern under REACH. It is used as a plasticiser in polymer products (mainly in flexible PVC) including pipes and tubes, flooring and wall lining, sealants, food packaging, cables and wire sheathing, underseal for cars, guttering, tarpaulins, clothing and footwear, toys, office supplies and medical products such as blood bags and catheters. The content of DEHP in polymer products varies but typically approximates 30 %, although it migrates slowly from such products over their lifetime. A proportion of the DEHP released to the aquatic environment stems from discharge of effluent from municipal sewage treatment plants, deriving originally from the wide use of PVC in residential, commercial, medical and industrial premises and their direct connection to a sewer system. DEHP is also released into urban run-off. In this case, it originates from building materials and vehicles and is subsequently discharged to a water body directly or indirectly, via a municipal treatment plant. Storm water overflows are also a significant emission pathway (OSPAR, 2006). Data reported to the European Pollutant Release and Transfer Registry (E-PRTR) and mapped above, show that 17.9 tonnes of DEHP were emitted to water from 180 facilities in 2008, 97 % of which was emitted via 143 urban wastewater treatment plants. However, given its widespread use and the high likelihood of DEHP discharges from all large municipal wastewater treatment plants, the map above suggests that reporting under E-PRTR is incomplete. Estimates from other sources indicate that diffuse emissions — not reported under E-PRTR — are also a significant source of DEHP (OSPAR, 2006).

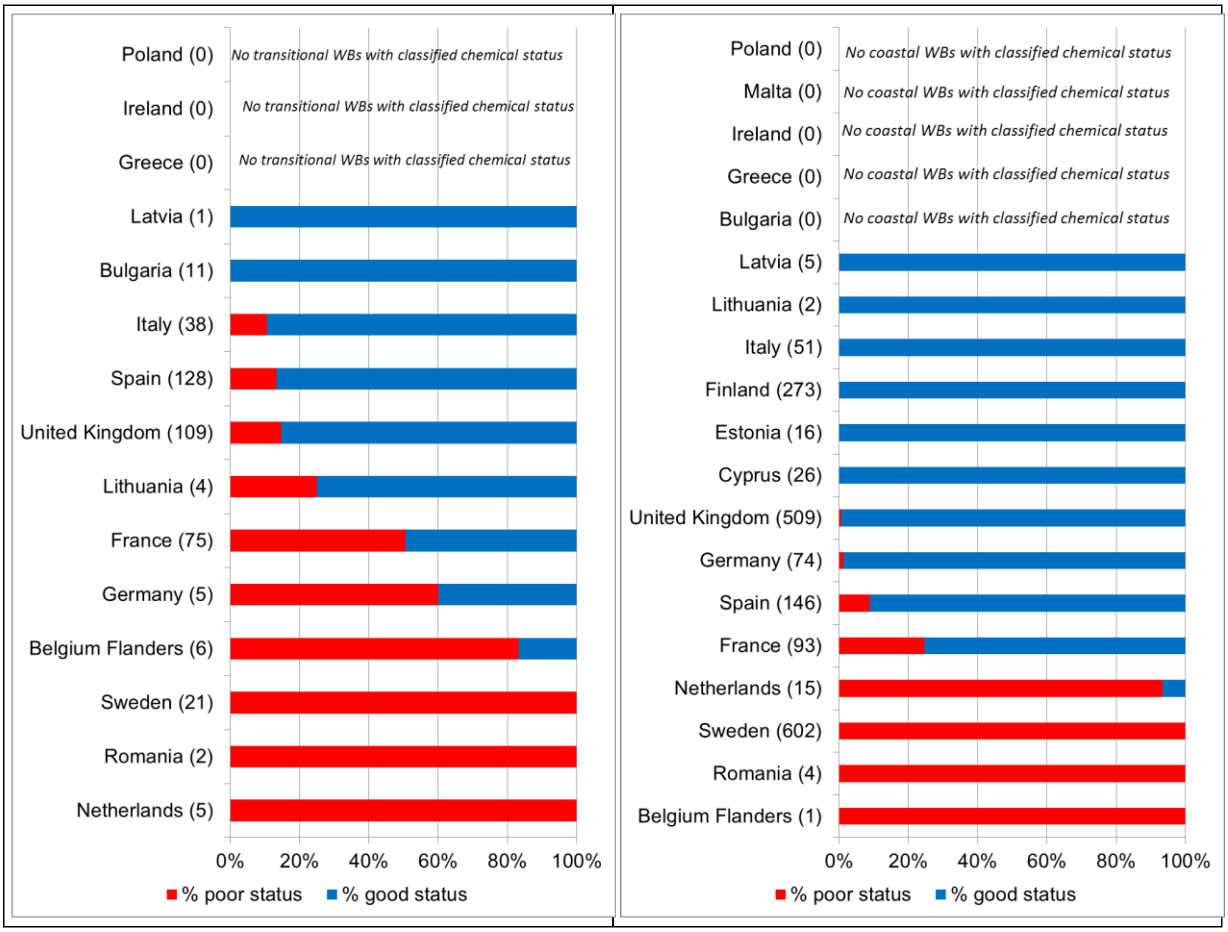
Data reported for lakes is relatively limited across Europe with the exception of Sweden. Seven countries report 100% good chemical status in lakes whilst in a further four countries poor status applies to less than 10%. Poor chemical status of 10% or greater is only observed in lakes in the Netherlands, Italy, Romania and Sweden. Heavy metals are identified as the dominant cause of poor status in lakes in Italy, Netherlands, Romania and Finland, whilst pesticides are the dominant cause in France only. Industrial pollutants are not a dominant cause within any Member States but are identified as causing poor status in France and the Netherlands. 'Other pollutants' are a dominant cause only in the Czech Republic but are identified as being problematic in six other Member States, particularly the Netherlands. A recent survey of PAH levels in mountain lakes in Europe showed total concentrations in all lakes monitored to be above the no-effects threshold (Quiroz et al., 2010). This finding highlights the challenge of addressing substances that are largely ubiquitous, subject to transport over large distances in the atmosphere and detectable in remote regions away from human activity.

6.4.3. **Transitional and Coastal Waters**

Latvia and Bulgaria report their transitional waterbodies to be in 100% good status, whilst in Italy, Spain and the UK poor status is below 20%. Six countries – France, Germany, Belgium-Flanders, Sweden, Romania and the Netherlands - report poor status to be 50% or more (Figure 6.4, Map 6.2). 'Other pollutants' are the most frequent cause of poor status in transitional waters overall, but particularly in Belgium-Flanders, Germany, France, Netherlands and the UK. TBT is one of those 'other pollutants' identified as problematic and is the main cause of poor status in transitional waters in the Thames, Anglian, Humber, Northumbria, Southwest and Northwest RBDs of the UK, and a contributing factor in the Belgian-Schelde, the Nemunas in Lithuania and the Loire in France. PAHs also contribute to poor status in transitional waters in Romania.

Heavy metals are the most frequently reported cause of poor status in Spain but are a particular issue in the Tinto-Odiel-Piedras RBD with mining discharges being the primary cause. Mercury is a cause of poor status in Swedish transitional waters, although the problem is not as widespread as for Swedish freshwaters and is limited in transitional waters to the Skagerrak and Kattegat, and North Baltic Sea RBDs. In France, heavy metals cause poor status in transitional waters of the Rhone, Loire and Seine RBDs. Heavy metals are also problematic in the Northern Apennines RBD in Italy and the Romanian Danube.

Figure 6.4 Percentage of transitional (left panel) and coastal (right panel) water bodies in poor and good status, by count of water bodies



Note: Water bodies in unknown status are not shown in this figure.

Source: Based on data available in WISE-WFD database primo February 2012- country results on chemical status is available at http://wfd.atkins.dk/report/WFD_aggregation_reports/swb_status

Six Member States report their coastal waters to be in 100% good status, although 4 – Netherlands, Sweden, Romania and Belgium-Flanders indicate that poor status exceeds 90% (Figure 4d, Map 2b). In the coastal waters of the Belgium Noordzee RBD a range of different chemicals contribute to poor status including mercury, pesticides, industrial chemicals and PAHs. In the coastal waters of the Danube RBD in Romania, the heavy metals – cadmium, lead and nickel – all contribute to poor status, as with the transitional waters in this RBD. Pesticides and PAH's are also problematic here.

Some industrial pollutants are also identified as a cause of poor status in transitional waters but only in France does this apply to more than two water bodies in any individual Member State. DEHP, for example, is a cause of poor status in the Rhône and Loire RBDs in France and the Nemunas RBD in Lithuania.

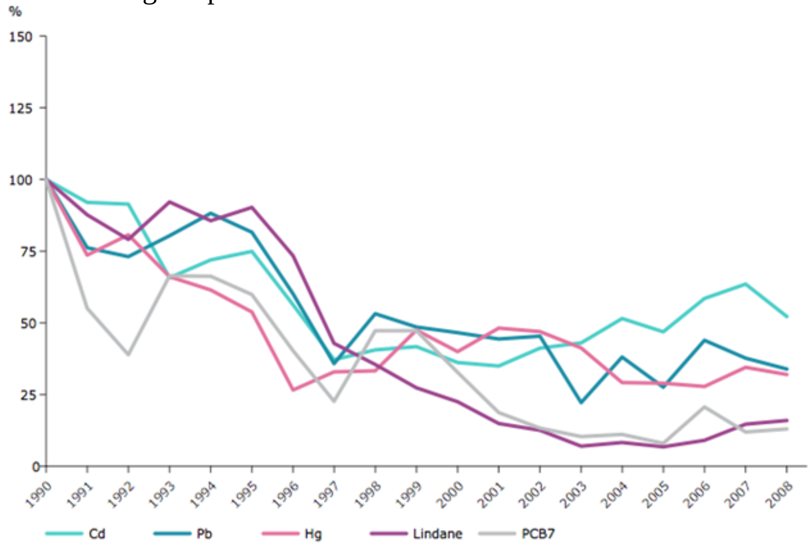
Those transitional waters with the poorest chemical quality across Europe are typically subject to pollution from a range of individual pollutants. The Seine in France, for example, reports heavy metals, pesticides and PAHs to be an issue, whilst in the Belgium-Schelde, 12 chemicals including mercury, 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 - a range of PAHs and some pesticides.

In Sweden, cadmium, lead and mercury, although predominantly the latter, contribute to poor status in the coastal waters of 6 RBDs. Heavy metals also cause poor status in the Galician coast and Tinto-Odiel-Piedras RBDs in Spain.

In Dutch coastal waters, ‘other pollutants’ are the sole cause of poor status. TBT causes poor status in the coastal waters of the Southwest, Northwest and Southeast RBDs in the UK, and the Loire and Rhône in France. In the latter, pesticides and industrial chemicals also contribute to poor status.

Text box 6.4: Riverine Loads - Linking Fresh and Coastal Waters

Figure Input of chemical pollutants (via riverine loads and direct discharges) into the North-East Atlantic during the period 1990 to 2008



Source:

Riverine loads and direct discharges of chemical pollutants to coastal waters are not, as a rule, widely reported across Europe, although the OSPAR regions of the North Atlantic form an exception. Here data are available for five chemicals, which include three metals (cadmium, mercury and lead), the insecticide lindane and PCBs, a group of chemicals previously widely used in electrical equipment. Despite some uncertainties in the data and the need for caution in interpretation, downward trends are detected for all five substances as regards their total inputs to the OSPAR region. For example, statistically significant downward trends in combined riverine inputs and direct discharges of mercury to the Greater North Sea and Celtic Sea regions, of about 75 % and 85 % respectively, are reported for the period 1990–2006. These trends observed in the OSPAR regions are attributable to a decline in emissions to water, both through the implementation of best available abatement techniques at industrial facilities and improvements in municipal wastewater treatment (OSPAR, 2009).

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7. Ecological status and water quality

Water is a key resource for our quality of life, industrial and agricultural production as well as the condition of many ecosystems in Europe. The quality of water in Europe is influenced by direct and diffuse pollution from urban and rural settlements, industrial emissions as well as the agriculture sector. Due to the overall progress in the treatment of urban waste water, diffuse pollution from agriculture is now the single most important source of pollution, in particular nutrient pollution, in Europe. Yet, despite the importance given to reducing pollution in recent environmental legislation, concentrations of pollutants in many European waters have remained high – illustrated by the results in the previous chapters that a large proportion of European water bodies are affected by pressures from diffuse and point source pollutants.

The status and pressure assessments in the previous chapters revealed that many European surface water bodies currently fail the Water Framework Directive's objective. This raises the following questions:

- What should be done to achieve good ecological status?
- How can nutrient and pollutant input be reduced and water quality improved? And
- How are the hydromorphological pressures lowered and the status of altered habitats improved?

The Program of Measures (PoM) included in the RBMPs addresses these issues. The Program of Measures (PoM) describes the actions that must be taken to bring water bodies into "good status", for which the key measures are as follows: reduced pollution emissions into water bodies by better wastewater treatment and implementation of good agricultural practice; and improving hydromorphology via restoration and changed land-use (e.g. buffer strips); ensuring minimum or environmental flows; removing migratory obstacles and transverse structures such as weirs so as to restore river continuity.

Text box 8.1: Program of Measures

Article 11 of the WFD requires each Member state to establish a program of measures "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 PoM is subject to review at six year intervals beginning in 2015.The WFD distinguishes between basic and supplementary measures (Annex VI Article11(2) and (3) of the Water Framework Directive).

- **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 (pursuant to Article 11(3) of the WFD), 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 programs, rehabilitation projects, legislative, administrative and fiscal instruments, and educational projects.

To protect freshwater from pollution, a comprehensive range of legislation has been established in Europe. The WFD has via the basic measures on compliance with the requirement of the Urban Waste Water Treatment Directive (UWWTD) and Nitrates Directive (ND) a clear target on reducing pollutants. Full implementation of these Directives will improve water quality and aid, although not necessarily guarantee, the achievement of good ecological status under the WFD.

The European Commission, DG Environment, is currently examining the measures included in the RBMPs and evaluating if the PoMs set of for the different RBMPs are sufficient for achieving the objectives of the WFD. EEA are following this process and will in the fin al version of this report include results from CEC, DG Environments study on measures and PoMs.

The sources of water pollution are extremely diverse and can vary considerably with geographical location. However, while landfills, forestry, mining, aquaculture and dwellings un-connected to a municipal sewage treatment works, for example, can all be of great importance locally, two broad sources alone contribute most to the freshwater pollution observed across Europe: urban wastewater and diffuse pollution from agriculture. In the current chapter the focus is on describing the effect of policies on reducing emissions to and improving water quality. The main focus is on illustrating the effect of Directive 91/271/EEC concerning urban wastewater treatment and Directive 91/676/EEC relating to nitrate pollution. These two Directives are import for achieving good water quality

In a separate but parallel EEA thematic assessment on ecological status and hydromorphological pressures are status and pressures in relation to hydromorphology described and measures discussed. This assessment will also be further updated when results from DG Environment evaluations are ready.

7.1. Urban waste water and water quality (10 pp)

7.1.1. **Key messages**

- Pollutants in in many of Europe's surface waters have led to detrimental effects on aquatic ecosystems and the loss of freshwater flora and fauna.
- Implementation of the Urban Waste Water Treatment Directive, together with comparable non-EU 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.
- 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 in recent years.

Clean unpolluted water is also essential for our ecosystems. Plants and animals in freshwaters react to changes in their environment caused by changes in water quality. Many human activities results water pollutants with the main sources being discharge from urban waste water treatment and industrial effluents and losses from farming. Pollution takes many forms. Faecal contamination from sewage makes water aesthetically unpleasant and unsafe for recreational activities, such as swimming, boating or fishing. Many organic pollutants, including sewage effluent as well as farm and food-processing wastes consume oxygen, suffocating fish and other aquatic life.

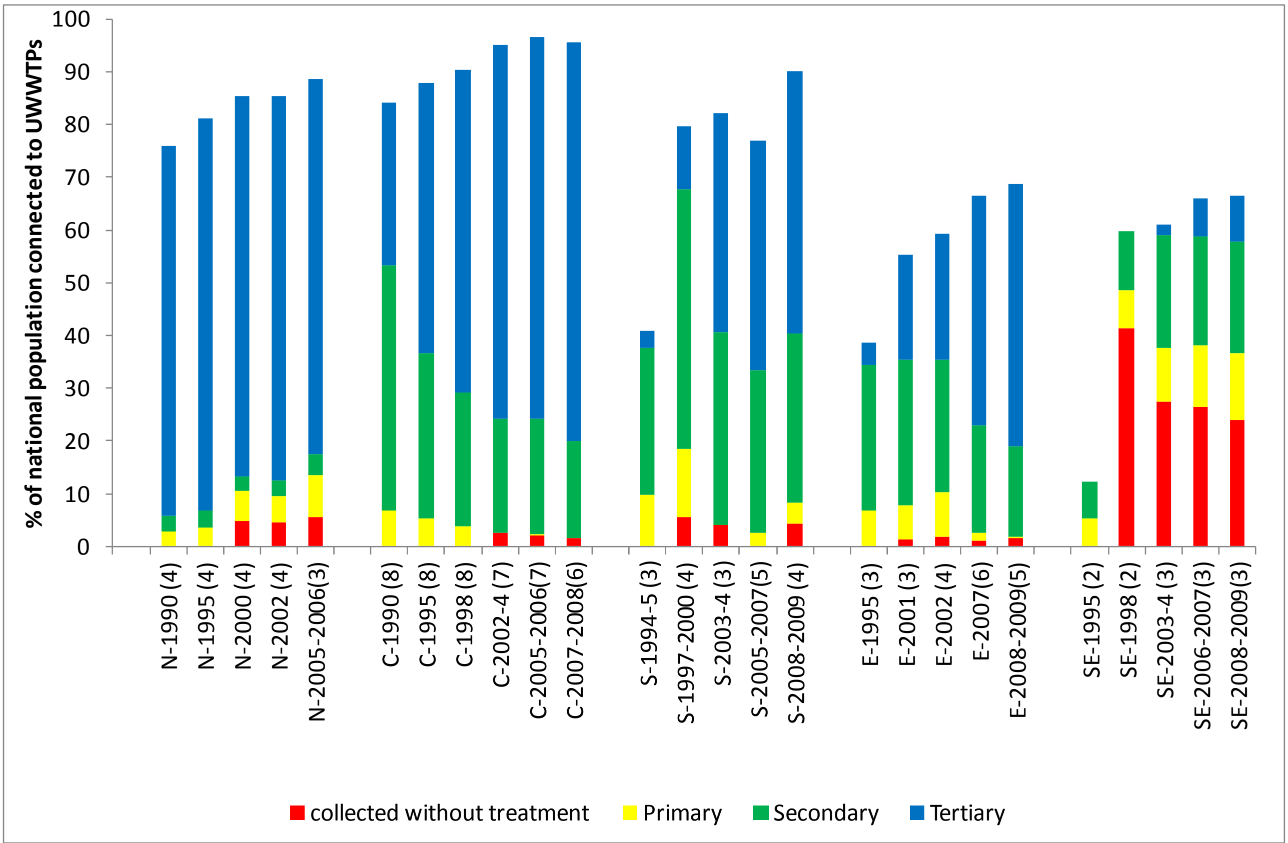
7.1.2. **Trend in urban wastewater treatment**

During the last century increased population growth and increased wastewater production, coupled with a greater percentage of the population being connected to sewerage systems, initially resulted in most European countries in increases in the discharge of pollutants into surface water. Over the past 20 to 35 years, however, the biological treatment (secondary treatment) of waste water has increased, and organic discharges have consequently decreased throughout Europe. During the last 20 years tertiary (advanced/more stringent) treatment with nutrient removal (phosphorus and nitrogen) has been introduced at many waste water treatment plants resulting in markedly lower nutrient discharge to receiving waters.

The Urban Waste Water Treatment has the objective to protect the environment from the adverse effects of discharges of urban waste water from settlement areas and biodegradable industrial waste water from the agro-food sector, by requiring Member States to ensure that such water is collected and adequately treated. Full implementation of the Directive is also a pre-requisite for meeting the environmental objectives set out in the EU Water Framework Directive as well as in the Marine Strategy Framework Directive.

The UWWTD requires the collection and treatment of wastewater from all agglomerations of more than 2 000 people and its ongoing implementation has led to an increasing proportion of the EU's population being connected to a municipal treatment works via a sewer network (see Figure 7.1). Connection rates in northern Europe now exceed 80 % of the population while in central Europe the figure is above 95 %. Elsewhere in Europe, however, connection rates are lower, although in the case of the newer Member States this is explained by the later compliance dates agreed in the accession treaties.

Figure 7.1 Changes in wastewater treatment in regions of Europe between 1990 and 2009



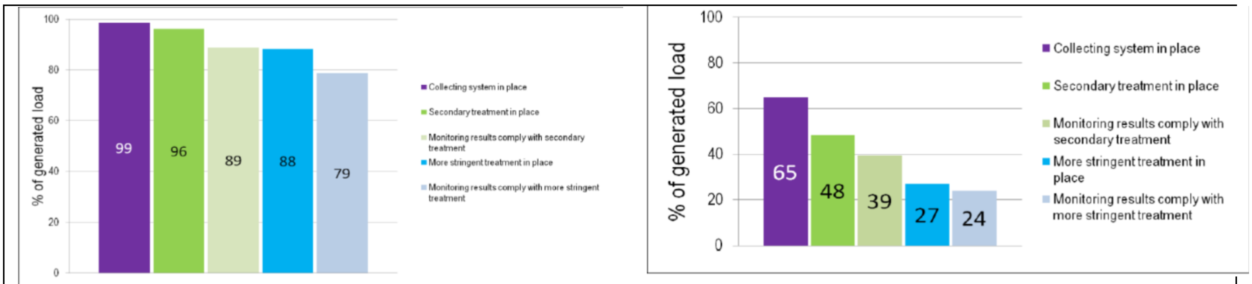
Notes: The numbers of countries are given in parentheses. Regional percentages have been weighted by country population.
N-North: Norway, Sweden, Finland and Iceland, only data up to 2006 available
C-Central: Austria, Denmark, England & Wales, Scotland, the Netherlands, Germany, Switzerland, Luxembourg and Ireland
S-Southern: Cyprus, Greece, France, Malta, Spain and Portugal (Greece only up to 1997 and then since 2007)
E-East: Czech Republic, Estonia, Hungary , Latvia, Lithuania, Poland, Slovenia, Slovakia (for Hungary and Latvia only data up to 2007 available)
South Eastern: Bulgaria , Romania and Turkey
The percentage values have been weighted with country population when calculating the group values. Data on population connected to collecting systems without treatment available only since late 90-ies.
Source: CSI24/EEA-ETC/ICM based on data reported to OECD/EUROSTATJoint Questionnaire 2010 (July 2011 update)

The UWWTD requires secondary biological wastewater treatment and, therefore, the substantial removal of both biodegradable and nutrient pollution. In addition, in catchments with waters designated as sensitive to eutrophication, the legislation demands more stringent tertiary treatment to remove much of the nutrient load from wastewater. Consequently, in addition to higher collection rates, the UWWTD has also driven improvements in the level of wastewater treatment over recent years.

The majority of wastewater plants in northern and central Europe now apply tertiary treatment although elsewhere in the EU, particularly in the south-east, the proportion of primary and secondary treatment is higher (see Figure 7.1). While considerable progress has been made in implementing the UWWTD, excluding the longer compliance timelines for the newer Member State, full compliance is yet to be achieved, including the lack of more stringent tertiary treatment in some sensitive areas and inadequate treatment levels in wastewater treatment plants in some larger cities (Text box; EC, 2011).

Text Box: Status of implementation of the Urban Waste Water Treatment Directive

In December 2011 published the 6th report on implementation of the UWWT Directive. The report covers the implementation of the Directive up to the reference year 2007/2008. Below is listed a summary of the key messages from the implementation report.
For the reference year 2007/2008, Member States reported 22,626 agglomerations (72% in EU-15 and 28% in EU-12) larger than 2,000 person equivalents (p.e.), generating a total pollution load of around 550 million p.e. A breakdown taking into account the different size ranges shows that: • 2% of the agglomerations are larger than 150,000 p.e. (i.e. 586 big cities/big discharges), generating 43% of the pollution load (equivalent to around 248 million p.e.). • 32% of the agglomerations range between 10,000 and 150,000 p.e., generating 45% of the pollution load. • 66% of agglomerations range between 2,000 and 10,000 p.e., generating 12% of the pollution load.
Waste water collecting systems were in place for 99% of the total polluting load of EU-15 and for 65% of the total generated load of EU-12. Most EU-15 Member States had largely implemented this provision except for Italy and Greece which have 93% and 87% of generated load collected in collecting systems, respectively.
Secondary treatment was in place for 96% of the load for EU-15 and for 48% of the load for EU-12. As the infrastructure in place cannot always achieve quality standards in line with the Directive's requirements (possible reasons: inadequate capacity, performance or design etc.), 89% of the total generated load for EU-15 and 39% of the total generated load for EU-12 were reported to work adequately showing compliant monitoring results for secondary and more stringent treatment respectively.
More stringent treatment was in place for 89% of the load for EU-15 and for 27% of the generated load for EU-12. As the infrastructure in place cannot always achieve quality standards in line with the Directive's requirements (same reasons as for secondary treatment), 79% of the total generated load for EU-15 and 24% of the total generated load for EU-12 were reported to work adequately.
Figure 7.x: Average share of generated load collected in collecting systems, treated by secondary treatment and more stringent treatment for EU-15 (left) and EU-12 (right)



EU-15 refers to Member States which joined the EU before the 2004 enlargement: Austria, Belgium, Denmark, Germany, France, Finland, Greece, Ireland, Italy, Luxemburg, Portugal, Spain, Sweden, The Netherlands and United Kingdom (due to missing/late reporting UK is not included).
EU-12 refers to Member States who acceded to the EU in 2004 and 2007 enlargements: Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Bulgaria and Romania.

Note:
For 15 Member States (hereinafter referred to as EU-15) all deadlines in the Directive have expired. Therefore proper waste water collection and treatment has to be in place for all agglomerations within the scope of the Directive.
For the other EU Member States, (hereinafter referred to as EU-12), transitional periods were granted by their Accession Treaties. None of these transitional periods exceed the year 2015 except for some small agglomerations (less than 10,000 p.e.) in Romania, which have to comply by the end of 2018.

Source: CEC 2011: Commission Staff Working Paper - 6th Commission Summary on the Implementation of the Urban Waste Water Treatment Directive. Available at http://ec.europa.eu/environment/water/water-urbanwaste/implementation/pdf/SEC_2011_1561_F_EN.pdf

7.1.3. Improved water quality

Implementation of the UWWTD has led to a reduction in the wastewater discharge of pollutants to receiving waters. The economic recession of the 1990s in central and eastern European countries also contributed to this fall, 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 in recent years.

Organic matter, measured as Biochemical Oxygen Demand (BOD) and ammonium, are key indicators of the oxygen content of water bodies. Severe organic pollution may lead to rapid de-oxygenation 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 concentrations of BOD and total ammonium have decreased in European rivers in the period 1992 to 2009 (Fig. 7.2a).

The average concentrations of orthophosphate in European rivers halved over the past 20 years (Fig 7.2a). During the past few decades there has also been a gradual reduction in phosphorus concentrations in many European lakes (Fig 7.2a). Phosphorus levels have declined in recent years due primarily to improved wastewater treatment and bans on phosphates in detergents.

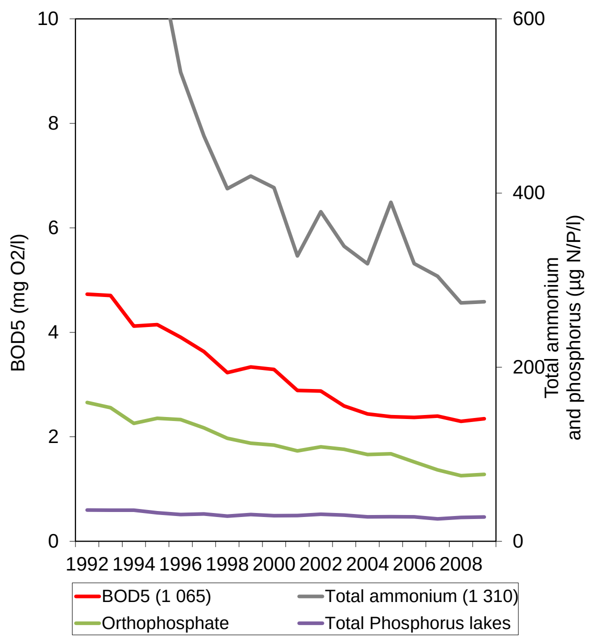
Decrease in phosphate concentrate in European is less marked than for rivers, 80 % of the measurement stations show no change in phosphate concentrations. Significant decreases were observed at 13 % of stations in the Baltic, 28 % in the North Sea, and 5 % in the Mediterranean Sea (Figure 7.2b). In the Netherlands, phosphate concentrations showed a statistically significant decreasing trend at 15 of 20 stations. The improvements are attributed to implementation of urban wastewater treatment.

The quality of EU bathing waters has improved significantly since 1990 — in 2010, (more than 90 %) of bathing areas complied with mandatory values (Fig 7.2c).

The emission of some hazardous chemicals has also been reduced, as evidenced, for example, by a decline in the discharge of heavy metals from waste water treatment plants in the Netherlands (Fig. 7.2d) and to the River Seine (Meybeck et al., 2007).

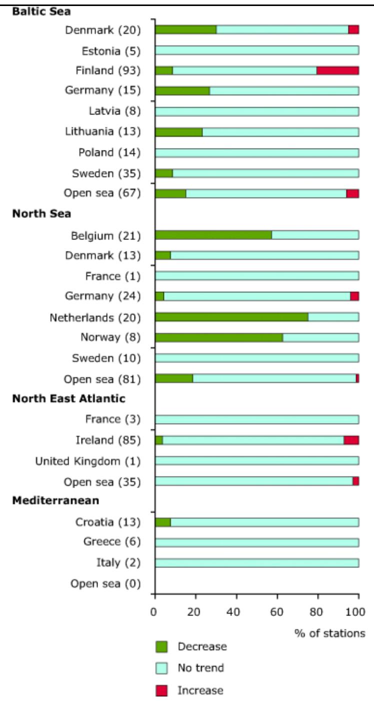
Figure 7.2 Changes in water quality variables related to improved wastewater treatment

A) Biochemical Oxygen Demand (BOD5), total ammonium orthophosphate concentrations in rivers and total phosphorus concentration in lakes between 1992 and 2009



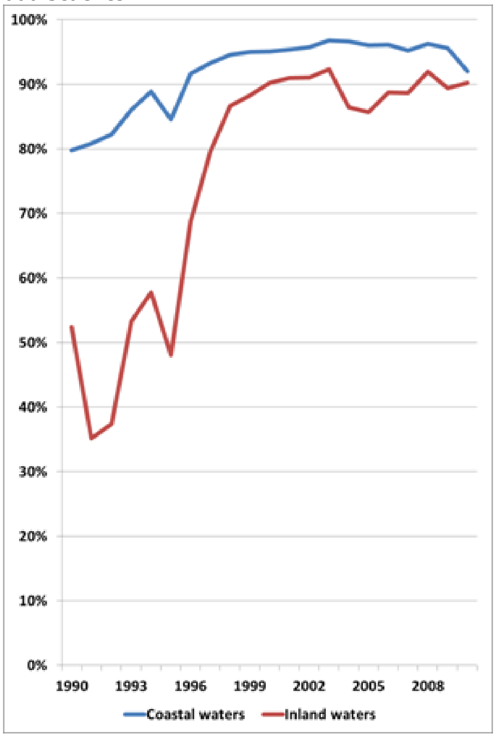
Source: CSI19

B) Change in winter orthophosphate concentrations in coastal and open waters of the North East Atlantic, Baltic, Mediterranean and North Seas



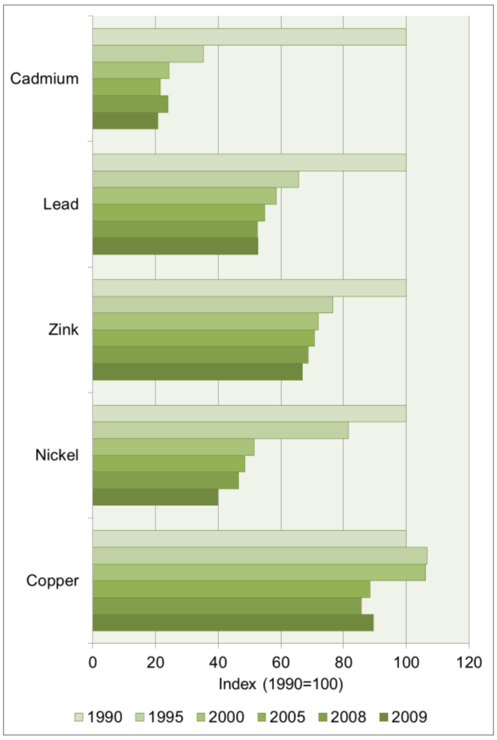
Source: CSI21

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



Source: CSI22

D) Emission of heavy metals from waste water treatment plants - **Netherlands**



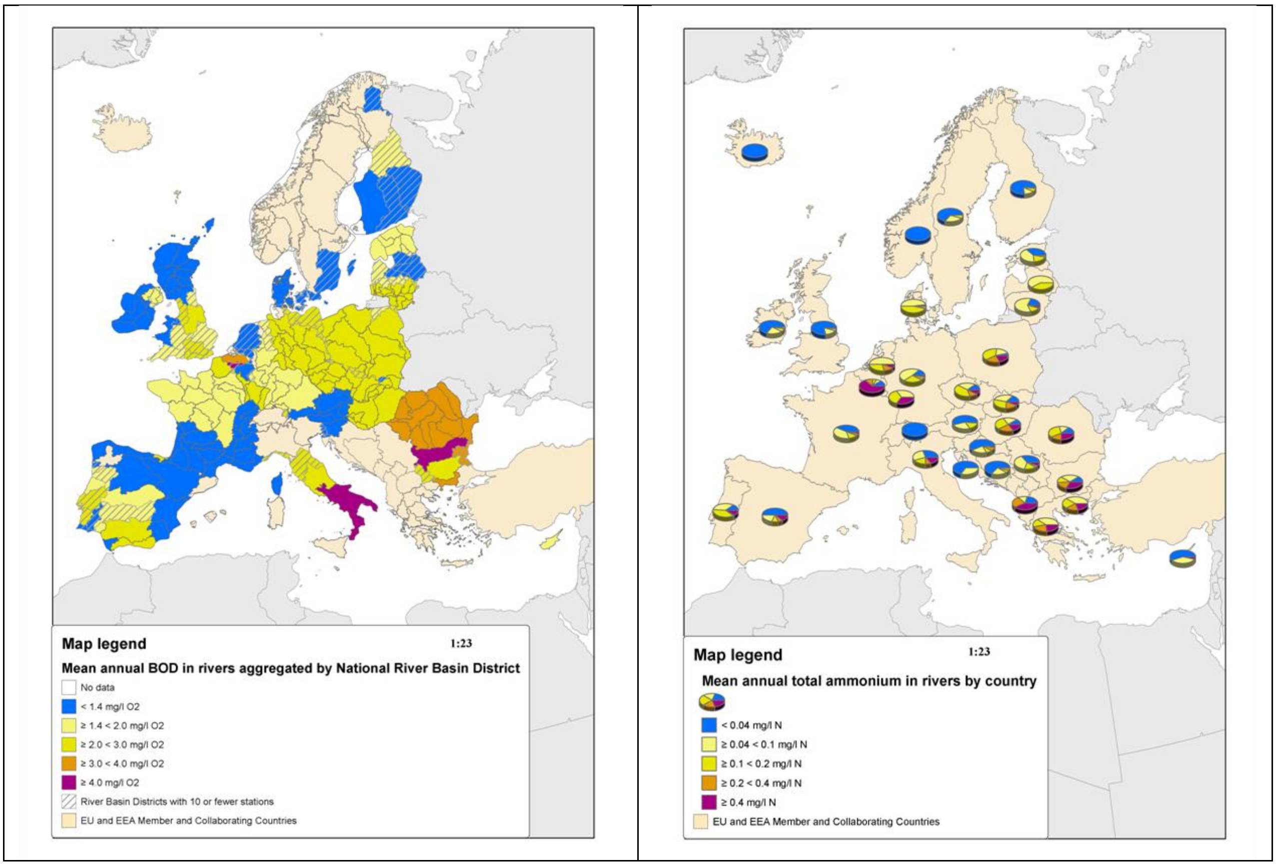
Source: http://www.compendiumvoordeleefomgeving.nl/indicatoren/nl0549-Emissies-naar-oppervlaktewater-en-riool.html?i=26-165

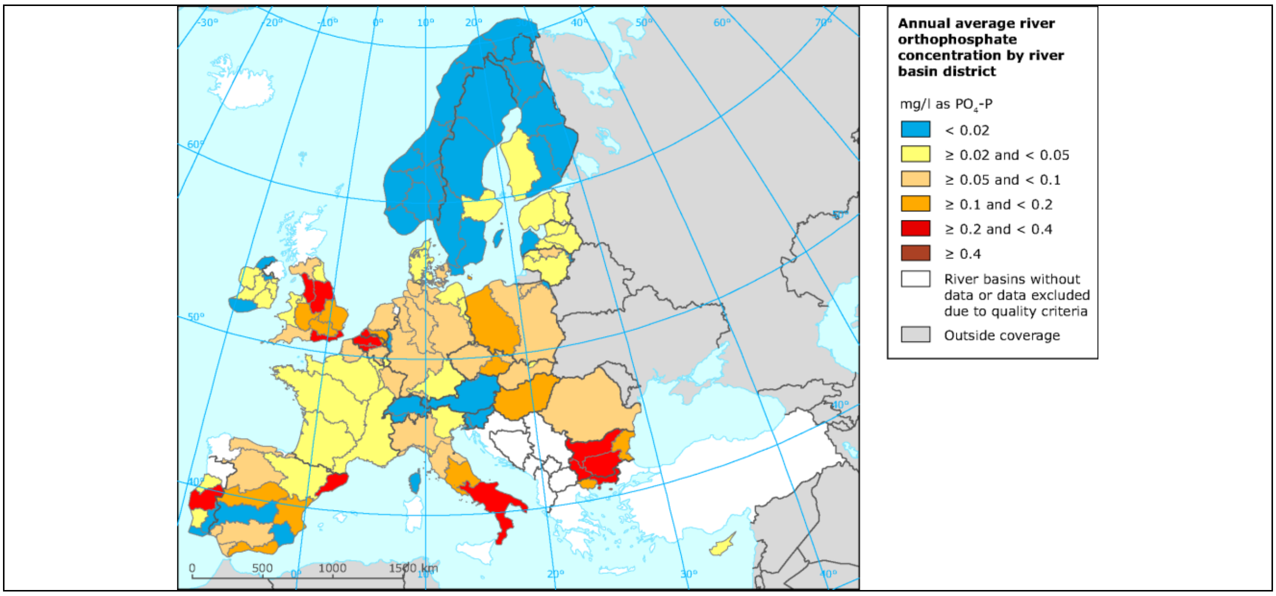
Compared to 10-15 years ago many countries and RBD now have low concentration of BOD. River basins with the lowest BOD concentration (class 1: < 1.4 mg O_2/l) are for example found in Ireland, Scotland, and Wales, in Denmark and southern Finland and in Austria and southern France. RBDs with the highest BOD concentrations (class 4&5: >= 3 mg O_2/l) are found in Belgium, Bulgaria, and Romania.

Countries with more than 50 % of all river stations with the lowest **total ammonium** concentrations (class 1: < 0.04 mg N/l) for 2009 or the latest reported year are Spain, Austria, Cyprus, Croatia, Sweden, Bosnia and Herzegovina, Ireland, Slovenia, Finland, the United Kingdom, Iceland, Liechtenstein and Norway. Countries with 20 % or more stations with the highest total ammonium concentrations (class 5: >= 0.4 mg N/l) are FYR of Macedonia, Greece, Romania, Bulgaria, Luxembourg, Albania and Belgium.

Mean annual orthophosphate concentrations (PO4-P) exceed 0.2 mg/l in some river basins across Europe (see Figure 7.3C) and, whilst values vary with water body type, far lower concentrations are suggested as a threshold to prevent eutrophication (Dodds, 2006). Current concentrations in certain rivers therefore suggest that substantial improvements will be required for good ecological status to be achieved under the WFD.

Figure 7.3 Annual average river concentration of BOD (mg O_2/l), total ammonium and orthophosphate (mg/l as PO4-P) in 2008/09, by river basin district (BOD and PO_4) or country (NH_4)





7.1.4. **Case studies: trend in water and biological quality**

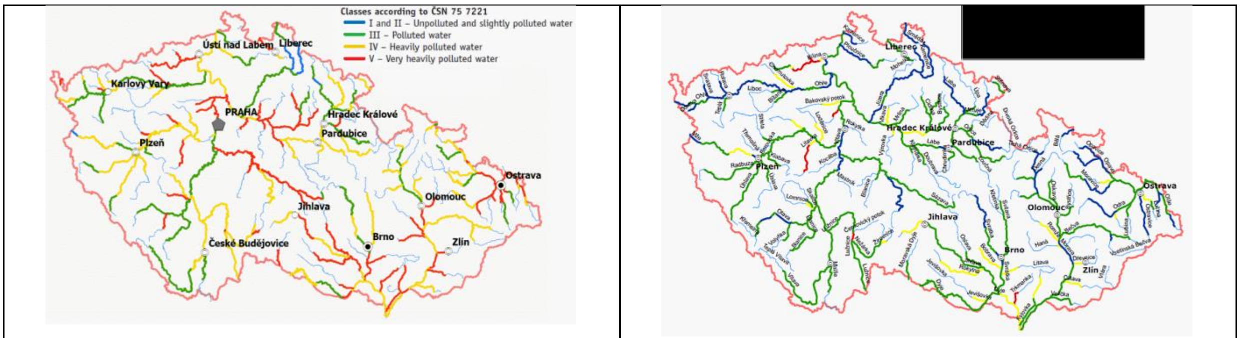
In Europe water quality has traditionally been measured and assessed using either basic physico-chemical (e.g. BOD, nutrients and oxygen level) or biological parameters or a combination of both – typically assessing organic pollution and eutrophication from point and diffuse sources. It is important to distinguish between water quality and ecological status or potential as the latter in addition to impact of pollution and water quality also include aspects such as hydromorphology and specific pollutants.

The previous section described major improvement on water quality over the last decades. This is also partly reflected in biological indicators related to water quality and pollution effects. In many countries there have during the last 20 years been significant improvements in river water and biological quality (See the following examples from the Czech Republic and the improvement in the Rhine and the Elbe).

Czech Republic

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.

Figure 7.4: A comparison of water quality in the rivers in the Czech Republic, 1991–1992 (left image) and 2007–2008 (right image)



Note: **Blue**: Unpolluted or slightly polluted waters; **Green**: polluted waters; **Yellow**: heavily polluted waters; and **Red**: Very heavily polluted waters

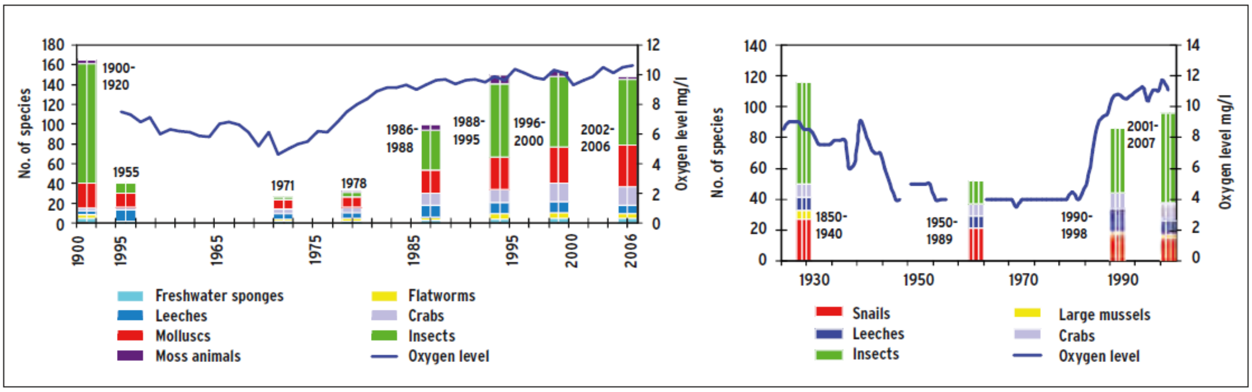
Methodology for the map: Traditionally, surface water quality is classified into 5 categories (shown in legend). The basic classification for the maps below is the aggregate of the following indicators: BOD_5, COD_{Cr}, $N\text{-}NH_4^+$, $N\text{-}NO_3^-$, Ptotal and the saprobic index of macroinvertebrate communities (the final class is the worst class of these indicators).
Source: http://issar.cenia.cz/issar/page.php?id=1775/The T.G. Masaryk Water Research Institute

Improved water quality in the Rhine and Elbe Rivers
Source: UBA 2010: Water resource management in Germany, part 1 fundamentals p. 54-57
The assessment of oxygen conditions in watercourses in Germany now occurs within the framework of ecological status monitoring. In the past, organic pressures were determined according to the Saprobic System, the results of which have been published every five years since 1975 by LAWA in the form of a biological water quality map. The Saprobic System uses macrozoobenthos (= invertebrates visible to the naked eye which live on or in the river bed) to describe the oxygen balance of a watercourse.

Observations of the biotic communities and oxygen balance in waterbodies have been recorded since at least the beginning of the last century. Figure 29 illustrates the conditions in the German sections of the Rhine and Elbe rivers. According to species lists from various authors, in the early 20th century the Rhine was inhabited by some 165 species of macrozoobenthos, while in around 1930 the Elbe was inhabited by around 120 species. As wastewater pollution increased and oxygen levels fell, the numbers of species have declined dramatically since the mid-1950s. The aquatic insect species (mayflies, stoneflies and caddis flies) have been particularly hard-hit by this development. By 1971, only 5 species out of a total of more than 100 remained in the Rhine, and in the Elbe only a few more. Improved oxygen conditions associated with the construction of industrial and municipal sewage treatment plants 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, no doubt partly due to the fact that their habitats no longer exist due to structural impoverishment. Additionally, large numbers of non-native and ubiquitous species (species with a high degree of adaptability) which are better able to withstand anthropogenic

Figure 7.5: Historical development of the biotic community and average oxygen levels of the River Rhine near Emmesrich and the Elbe near Magdeburg

Figure 29: Historical development of the biotic community (selected species groups) and average oxygen levels of the Rhine near Emmerich (left) and the German Elbe near Magdeburg (right)



Source: According to Schöll 2009a, 2009b

Source: Schöll, F. (2009a; 2009b)

7.2. Nutrient enrichment and diffuse source pollution

7.2.1. **Key messages**

- Despite improvements in some regions, diffuse pollution from agriculture remains a major cause of the poor water quality currently observed in parts of Europe. Agriculture contributes 50-80 % of the total nitrogen load observed in Europe’s freshwater.
- Cost-effective measures to tackle both sources exist and can be implemented through the river basin management plans of the Water Framework Directive. Full compliance with the Nitrates Directive is also required.

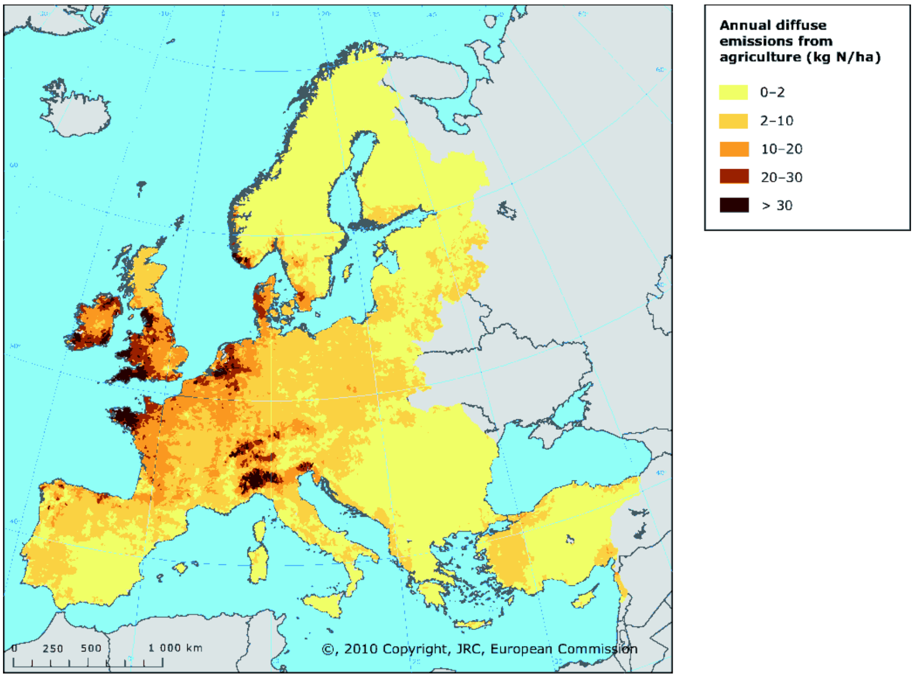
7.2.2. **European overview of diffuse nutrient pollution**

In many catchments, runoff from agricultural land is the principal source of nitrogen pollution. In case of phosphorus, households and industry tend to be the most significant sources, although with reduced point source discharges, the diffuse loss from agricultural soils can also be significant.

Modern-day agricultural practices often entail the high use of fertilisers and manure, leading to high nutrient surpluses that are transferred to water bodies through various processes. Here, excess nutrient affects the chemical status of water bodies and leads to eutrophication and changes in the ecological status. Important related environmental consequences include loss of plant and animal species, phytoplankton blooms and increased growth of macrophytes, with by-effects on the affected water bodies such as oxygen depletion, introduction of toxins or other compounds produced by the plants, reduced transparency and fish kills. Also, excess nutrient levels have negative impacts on the use of water for human consumption. Despite improvements in some regions, pollution from agriculture remains a major pressure on Europe's surface waters and groundwater.

Nutrient application to agricultural land mainly result from artificial, mineral fertilizers and manure from livestock production, but also other sources such as biological fixation and atmospheric deposition are relevant. In Europe, mineral fertilisers account for almost half of all nitrogen input into agricultural soils, while manure adds a further 40 % Today, the highest total fertiliser nutrient application rates — mineral and organic combined — generally, although not exclusively, occur in Western Europe. Ireland, England and Wales, the Netherlands, Belgium, Denmark, Luxembourg, north-western and southern Germany, the Brittany region of France and the Po valley in Italy all have high nutrient inputs (Grizzetti et al., 2007; Bouraoui et al., 2009). Inputs of nutrients to agricultural land across Europe are generally in excess of what is required by crops and grassland, resulting in nutrient surpluses (Grizzetti et al., 2007). The magnitude of these surpluses reflects the potential for detrimental impacts on the environment.

Figure 7.6: Annual diffuse agricultural emissions of nitrogen to freshwater (kg nitrogen per hectare of total land area)



Source: Bouraoui, F, Grizzetti, B and Aloe, A. 2009. Nutrient discharge from rivers and seas JRC EUR 24002 EN, 72 pp

7.2.3. **Nutrient concentrations and ecological effects in rivers, lakes and groundwater**

The average nitrate concentration in European rivers has decreased slightly since 1992, reflecting improved wastewater treatment, reduced atmospheric inputs and, in some regions, lower agricultural emissions. This trend information is based on Eionet data reported to the EEA (rather than the mandatory information required under Directives).

Nitrate-concentrations in groundwater exceeded the compliance threshold of 50 mg l^{-1} under the Nitrates, Groundwater and Drinking Water Directives in ca. 10 % of reported stations over the 2001-2008 period. Most of these stations are located in western and southern regions. High NO_3 concentrations in groundwater are found in particular in Spain, Belgium, Germany, Romania, Cyprus, Italy and Malta. The timeseries indicate increasing concentrations in the south-eastern region, possibly coupled to water scarcity and drought issues.

Phosphate concentrations in European rivers have decreased over the last two decades, by more than 30% from > 0.15 mg l^{-1} in the early 90-ies to ca. 0.08 mg l^{-1} in 2008. Most of the decrease occurred in the 1990s, reflecting the general improvement in wastewater treatment and reduced phosphate content of detergents over this period. High concentrations (> 0.1 mg l^{-1} P) are found in several regions with high population densities and intensive agriculture, including southeast UK, part of the Netherlands, Belgium, Southern Italy, central Spain and Portugal, western Poland, Hungary, Bulgaria, Macedonia, northern Greece. Given that phosphorus concentrations greater than 0.1 mg l^{-1} P are sufficiently high to promote freshwater eutrophication, the observed high values in some regions of Europe are of particular concern.

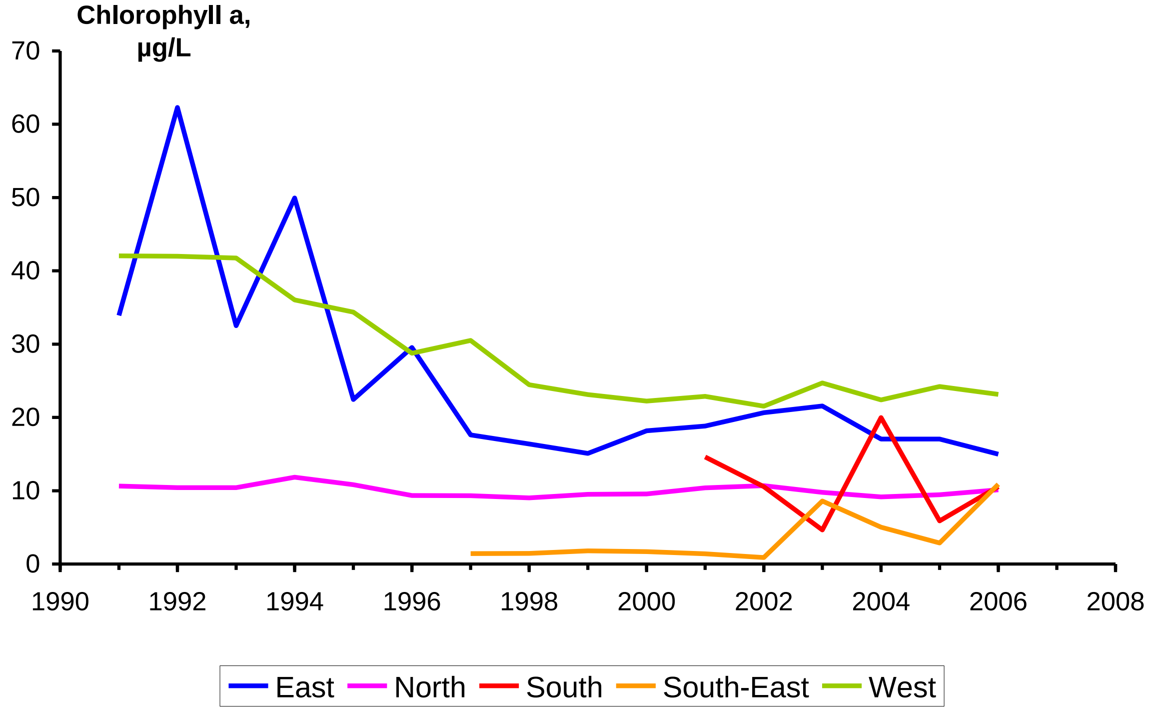
Total P in lakes has decreased only slightly since the early 1990s, and has been more or less stable since 2000. Lakes with high concentrations of total P (>0.05 mg l^{-1}) are found mainly in RBDs in England, Belgium, the Netherlands, northern Germany, Poland, Hungary, Romania, Bulgaria, Spain, Portugal. Concentrations reported under Eionet generally exceed draft WFD targets (0.01-0-05 mg l^{-1})

for many common lake types. Further reductions in diffuse emissions are needed to achieve WFD objectives.

Impacts of eutrophication on freshwater ecology and human health:
There are major biological impacts demonstrated in the large river basins of Europe (Danube, Rhine, Po) due to excessive nutrient levels.

For lakes there are reliable long-term trends for the Eastern and Western regions showing a decline in algal biomass up to the year 2000, but little change since then. For the northern region, no temporal trend is evident. The current chlorophyll levels are still too high to meet the WFD objective in most regions. As for total P, the WFD target for chlorophyll a is exceeded roughly by a factor of two for many common lake types.

Figure 7.7 - Development of algal biomass (chlorophyll a concentrations) in European lakes aggregated to geographic regions for the period 1991-2006. Should be updated with SoE data until 2009.



Notes: Countries included in the regions are: East (EE, HU, LT, LV, PL, SI, SK); West (AT, BE, CH, DE, DK, FR, GB, IE, NL); North (FI, IS, SE); South (CY, IT, PT); South-East (BA, BG, HR, MK, RS, TR).

Human health incidents involving toxic algal blooms (cyanotoxins) have been reported from at least 16 European countries. While no human deaths have been recorded, there are several instances of cattle, sheep and dog deaths, and numerous bird and fish kills have been ascribed to cyanotoxins after drinking untreated water. Hepatotoxic (liver) effects have been recorded more often than neurotoxic effects. WHO has developed guideline levels for cyanobacterial toxins in drinking water (Microcystin $< 1\ \mu g\ l^{-1}$) and bathing waters (Microcystin $< 10\ \mu g\ l^{-1}$).

7.2.4. Nutrient concentrations and ecological effects in transitional and coastal waters

Excess nutrients can create 'eutrophication', characterised by increased plant growth, problematic algal blooms, depletion of oxygen and loss of life in bottom waters and an undesirable disturbance to the balance of organisms present in the water.

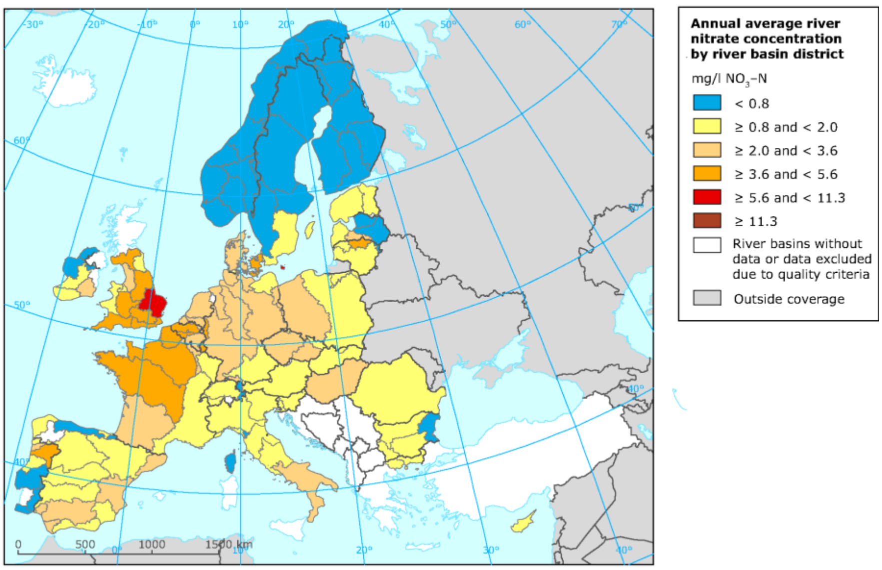
In spite of measures to reduce nutrient input, concentrations in European seas at 85 % of measurement stations show no change in nitrogen concentrations and 80 % show no change in phosphorous concentrations. Oxygen depletion is particularly serious in the Baltic and Black seas.

Pollution of transitional, coastal and marine waters in many cases directly impacts the lower levels of the marine food-web: phytoplankton, zooplankton and animals living on the sea floor but impacts are moved upwards in the food chain with the many different feeding habits of marine organisms. In some cases severe pollution fundamentally alters ecosystem functioning.

There are numerous pollutants impacting the marine environment, arising from many sources. These come from land-based activities such as agriculture, industry and wastewater treatment that emit or discharge pollutants to freshwater and, therefore, ultimately to coastal waters, whilst atmospheric deposition of certain pollutants to marine waters can also be a key source.

Excessive use of the fertilizers nitrogen and phosphorous create eutrophication of marine waters which is the accelerated, enhanced growth of phytoplankton and higher plant forms and an undesirable disturbance of the balance of organisms in the water. Land-based sources of nutrients both diffuse sources — from artificial fertilisers used in agriculture and from animal manure — and point sources from urban wastewater treatment plants, whilst reducing, are still the main sources of nutrients to waterways. Nitrogen is also released into the atmosphere and later deposited on the sea surface. Where estimates are available, they show that approximately 25 % of the nitrogen load to the sea surface is contributed as atmospheric deposition (HELCOM, 2009a).

Figure 7.8: Annual average river nitrate concentration (mg/l NO3-N) in 2008, averaged by river basin district



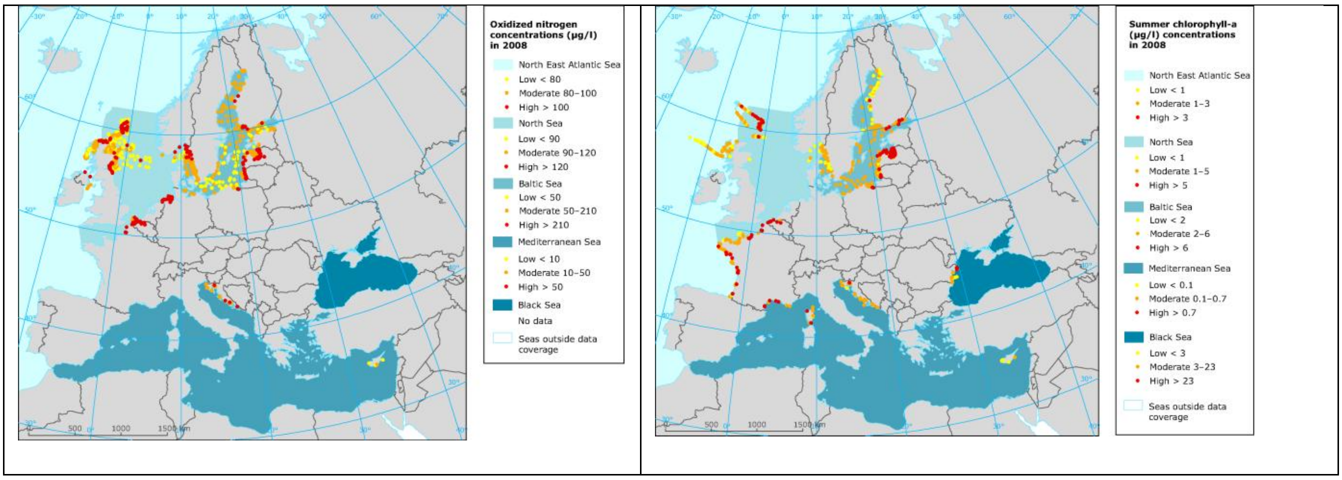
Note: This map shows the mean annual concentrations of Nitrate (NO3) as mg/l NO3-N measured at Eionet-Water River monitoring stations during 2008. All data are annual means.

The EEA indicators on nitrogen, phosphorous and chlorophyll-a show the concentration levels of these substances and their change over time. Winter nutrient concentrations in transitional, coastal and marine waters respond to inputs from land and atmospheric sources. Algae are most abundant in the summer and their abundance is linked to the concentration of both the plant pigment chlorophyll-a in the water and nutrients. Based on the EEA indicators of nutrients (EEA, 2010d) and chlorophyll-a

(EEA, 2010e) in transitional, coastal and marine waters (Maps 4.1, 4.2 and 4.3), there is clear evidence of nutrient enrichment:

- within the coastal zones, bays and estuarine areas of some parts of the North East Atlantic region, particularly those near major European river deltas;
- in the Baltic Proper and the Gulf of Finland as well as coastal areas of the Baltic Sea;
- in areas close to river deltas or large urban agglomerations in the Mediterranean Sea;
- in the Black Sea, although improvement has been significant since 1990 (Oguz et al., 2008).

Figure 7.9: Nitrate (left panel) and chlorophyll a (right panel) in coastal waters



Source: EEA CSI21 and CSI23.

In spite of measures to reduce nutrient concentrations in European seas, 85 % of measurement stations show no change in nitrogen concentrations, 80 % show no change in phosphorous concentrations (see Fig. 7.2b), and 89 % show no change in chlorophyll-a concentrations.

Winter oxidized nitrogen concentrations have fallen significantly at 21 % of 268 stations in the Baltic Sea and at 8 % of stations in the North Sea. The stations with decreasing trends are in Denmark, Finland, Germany, the Netherlands, Norway and Sweden, and in the open parts of the Baltic Sea (Figure 4.1). Little improvement is seen in other seas (EEA, 2010d).

In 2008, the highest chlorophyll-a concentrations were observed in the Gulf of Riga, along the coast of Lithuania influenced by the Nemunas River, the Scheldt estuary in Belgium, and at the mouth of the Seine and Loire rivers in France (Map 4.3).

7.3. Relationship between ecological status and water quality

EEA have had first attempts to link the information reported on water quality in rivers and lakes via WISE-SoE to the information reported via the WISE-WFD reporting on status and pressures at water bodies. Some preliminary results are presented in the following. These analysis will updated during the coming month be further enhanced will be distributed before the Eionet Stakeholder workshop ultimo March.

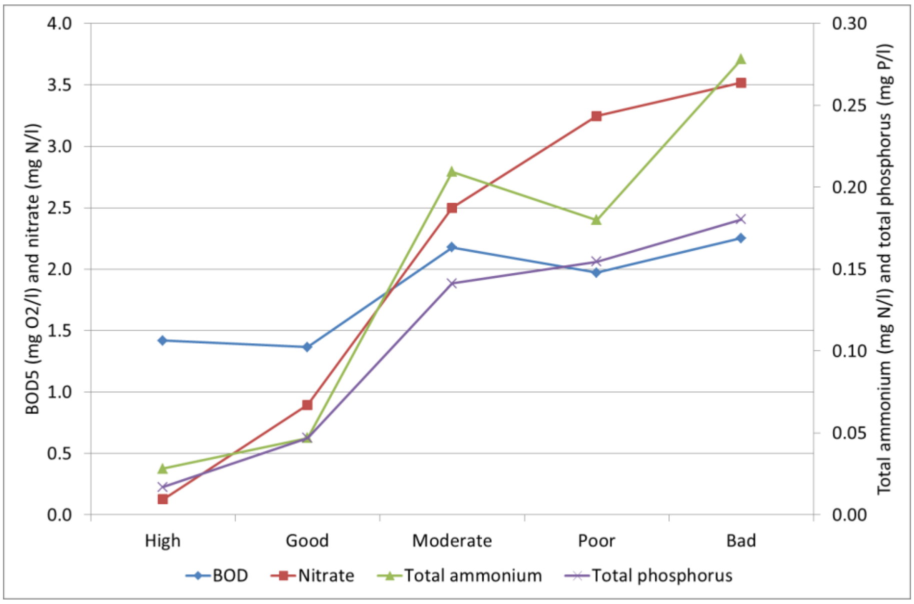
River water bodies being classified as having high or good ecological status generally have much lower concentration of pollutants (BOD5, total ammonium, total phosphorus, and nitrate) and better water quality than WBs classified as having moderate to poor ecological status (Figure 7.10 and Figure 7.11).

- River water bodies classified as having high ecological status also have generally low concentration of pollutants with nitrate, total phosphorus, and total ammonium being lower than 0.1 mg NO3-N/l, 0.02 mg P/l and 0.04 mg NH4-N/l..

- There is a marked shift in water quality from water bodies having good ecological status or potential to water bodies having moderate of worse ecological status. Generally the water bodies with good status only have one-third of the concentration levels of the water bodies in worse status.
- There is a general trend in increasing nutrient pollutant concentrations going from moderate to poor and bad ecological status or potential.

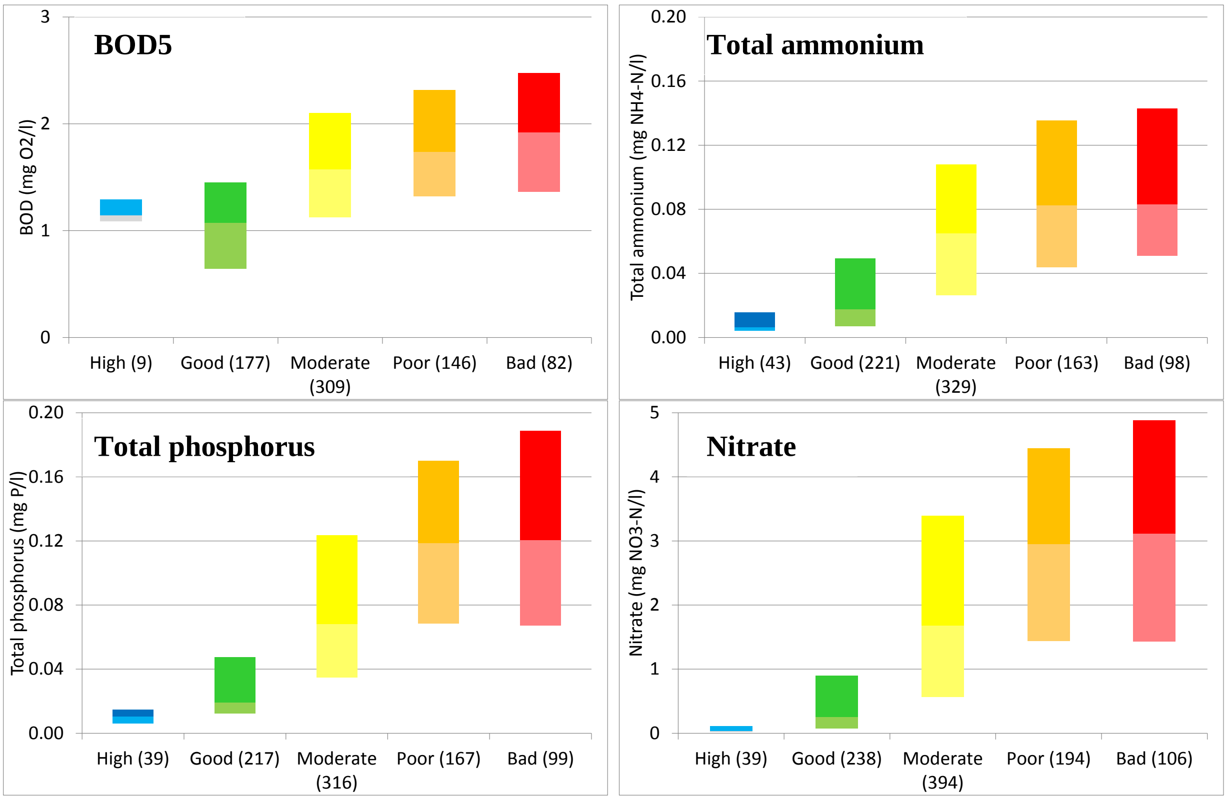
The preliminary diagrams presented in figure 7.10 and 7.11 may indicate that in many rivers it is necessary to reduce the pollutant levels by 70 % to achieve the good ecological status objective of the WFD.

Figure 7.10: Comparison of mean annual average BOD and nutrient concentrations at river water bodies by ecological status or potential.



Note: Preliminary results based on 800-1000 river water bodies with annual average water quality concentration values (average of the years 2005 to 2009) compared with the ecological status/potential at water body level.
Based on results from 10 Member States.

Figure 7.11: Concentration range (1st quartile, median and 3rd quartile) of annual average nutrient and organic matter pollutant concentrations in river water bodies in different classes of ecological status or potential (high to bad).



Note: Preliminary results based on 800-1000 river water bodies with annual average water quality concentration values (average of the years 2005 to 2009) compared with the ecological status/potential at water body level.
Based on results from 10 Member States.

7.4. Measures on point sources and diffuse sources

Section 7.4 has to be improved and updated and will be based on results from DG Environment evaluation of pressures and measures in the RBMPs.

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

7.4.1. **Key messages**

- EU water legislation, including the Water Framework Directive (WFD), Urban Waste Water Treatment Directive and Nitrates Directive, will help to improve the quality of freshwater (e.g. by reducing nutrient and chemical pollution) before it enters waters.
- Wastewater treatment needs to 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.

- While compliance with the UWWTD is already relatively high in the most of the northern and central European Member States, there is a need to improve both connection rates and treatment levels in other countries, to ensure improved water quality so the objectives of good ecological status are met.
- Cost-effective measures exist to tackle agricultural pollution and need to be implemented through the WFD, while full compliance with the Nitrates Directive is also required.
- The forthcoming reform of the Common Agricultural Policy provides an opportunity to further strengthen water protection.

7.4.2. **Measures point sources**

Continuing improvement in the level of pollutant removal from urban wastewater discharges is anticipated, driven by requirements under the UWWTD and non-EU legislation. While compliance with the UWWTD is already relatively high in the older Member States, country-specific deadlines for each of the newer Member States, established in the Accession Treaties, range between 2010 and 2018. As a consequence, improvements in both connection rates and treatment levels are likely to be realised for these countries over the coming years, provided that the directive is complied with.

Wastewater treatment needs to continue to play a critical role in the protection of Europe's freshwater 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 through co-financing improvements to wastewater treatment (EC, 2009). The overall burden on the treatment process can, however, be reduced through a greater control of pollutants at source, an approach that is not only beneficial environmentally, particularly with respect to pollutants for which the treatment process was not specifically designed, but also in terms of cost-effectiveness (EEA, 2005a). 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. The availability of alternative cleaning agents has enabled the use of phosphate-free industrial and domestic detergents, for example, significantly reducing phosphate levels received by wastewater treatment plants. A number of countries have either implemented legislation or established voluntary agreements with detergent manufacturers at the national level. Significant potential remains, however, for a greater use of phosphate-free detergents across many parts of Europe and the establishment of Europe-wide legislation in this respect would ensure that this potential is realised.

Table 7.1. German catalogue of point source measures

Urban Waste Water treatment	Building and adapting urban WWT plants Extension of urban WWT plants to reduce phosphorus or/and nitrogen input Extension of urban WWT plants to reduce point source input of other pollutants Optimizing the operational mode of urban WWT plants Inter-municipal consolidation of WWT plant Building or rebuilding small WWT plants Connecting the remaining non-connected areas to existing WWT plants Reducing point source pollution from other urban waste water sources
Combined WW and rainwater	Building and adapting facilities for diversion, treatment and retention of combined WW and rainwater Optimizing the operational mode of facilities for diversion, treatment and retention of combined WW and rainwater Other measures to reduce the input of pollutants from facilities for diversion, treatment and retention of combined WW and rainwater
Industrial wastewater	Building and adapting industrial WWT plants

	Optimizing the operational mode of industrial WWT plants Reducing point source pollution from other industrial waste water sources
Other point sources	Reducing point source pollution from mining Reducing thermal pollution Reducing pollution from other point sources

Based on Kail and Wolter, 2011.

7.4.3. **Measures (NiD etc.)**

While clear improvements in the nutrient content of water over recent years are evident in some agricultural catchments across Europe, for others the situation is worsening or has stabilised but with concentrations at a high level. These findings reflect the fact that while some action has been taken in certain locations, compliance with the environmental objectives of the WFD is not required until 2015. Furthermore, appropriate measures under the ND have only recently been implemented in many countries and, in others, full compliance is yet to be achieved.

Cost-effective measures exist to tackle agricultural pollution and 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 one or more action programmes on their territory, with almost all such programmes incorporating the manure nitrogen application threshold of 170 kg/ha/year (EC, 2010). However, implementation of the ND is still incomplete and, even where full compliance has occurred, sufficient improvement in nitrate water quality will take some time because of transport processes in soils and groundwater.

The achievement of good status in agricultural catchments will depend not only on the implementation of measures to address emissions of nitrogen, but also those of other pollutants, particularly phosphorus and pesticides. In this respect, the RBMPs of the WFD have a critical role to play in identifying cost-effective measures to tackle all sources of agricultural pollution. It is worth noting, however, that some national initiatives have already had clear positive impacts.

Recent reforms of the Common Agricultural Policy (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 address the environment. There are options for a range of measures for the improvement of water quality, including improving manure storage, the use of cover crops, riparian buffer strips and wetland restoration. They 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 Common Agricultural Policy provides an opportunity to further strengthen water protection.

Table 7.2. German catalogue of diffuse source measures

Agricultural nutrient and sediment input	Reducing the direct input of nutrients from agricultural activities Developing buffer strips to reduce nutrient input Other measures to reduce nutrient and sediment input from erosion (agricultural areas) Reducing nutrient leaching from agricultural areas Reducing nutrient input from drainage Reducing pesticide input from agricultural areas
Other diffuse sources	Reducing diffuse source pollution from mining Reducing diffuse source pollution from contaminated sites Reducing diffuse source pollution from paved areas Measures in drinking water protection areas

	Reducing pressures from acidification Avoiding input from accidents Reducing pressures from other diffuse sources

Based on Kail and Wolter, 2011.

7.5. Acidification

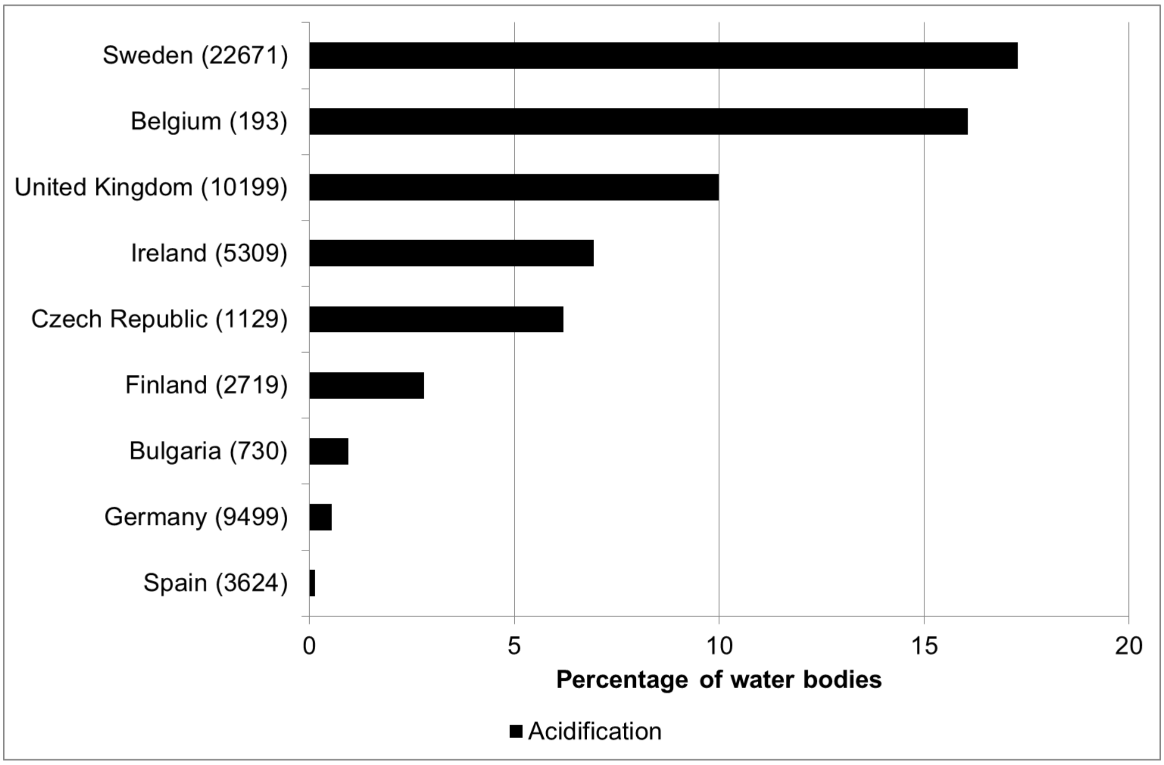
7.5.1. **Key messages**

- Acidification has been reported to affect 15% of lake WBs and 9% of river WBs in altogether nine Member States
- Sweden, United Kingdom, Ireland, the Czech Republic and Belgium Flanders* are the member states that report the largest impact of acidification in rivers and lakes.
- Acidification has been largely reduced over the past decades and biological recovery has started in most areas, although full recovery will not be achieved without further reductions in sulphate and nitrate deposition.

7.5.2. **Assessment**

More than 3500 river and 1650 lake water bodies have been reported as being affected by acidification in nine member states, accounting for 9 % and 15% of the river and lake WBs, respectively.

Figure 7.12. Proportion of total number of classified lake and river water bodies reported to have significant impact from acidification.



Sweden, United Kingdom, Ireland, the Czech Republic and Belgium (Flanders) have reported 6-17% of their river and lake WBs being affected by acidification. It is likely that the Belgium data represent erroneous reporting, and not antropogenic acidification (should be clarified by Belgian authorities).

Focus on RBD with acidification problem – *Is it possible for Sweden or other Member States having water bodies being affected by acidification to write a brief case on the affected RBDs and the impacts and measures?*

7.5.3. **Case studies**

Trends in European acidification of surface water bodies
Source: Skjelkvåle, B.L., and de Wit, H. A. 2011

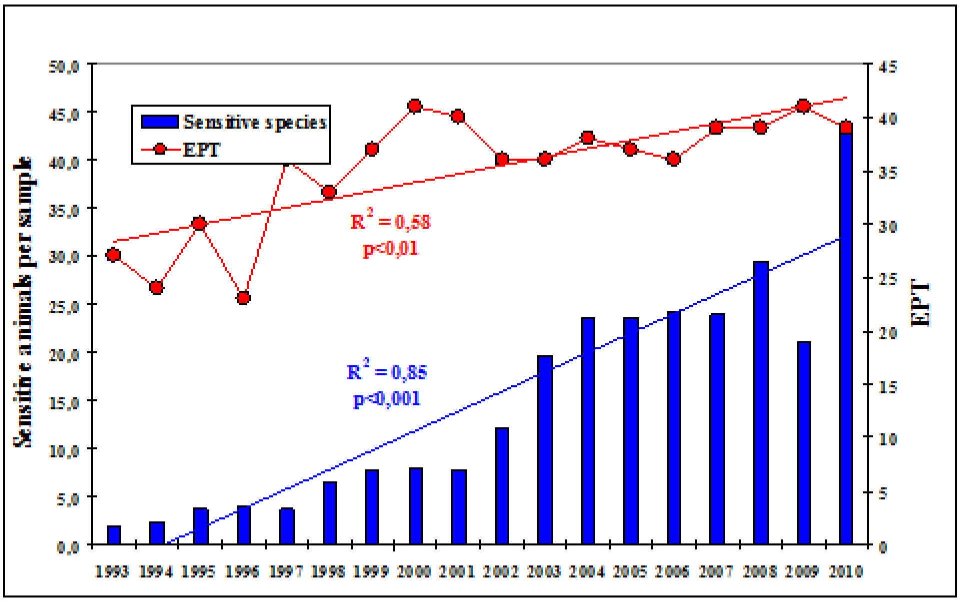
From 1990 to 2008 the concentrations of sulphate and nitrate in precipitation have decreased in large areas in Europe and North America due to emission reductions. The reductions were larger from 1990 to 1999 than from 1999 to 2008. The same pattern can also be seen for sulphate in surface water. Nitrate, in contrast to sulphate, does not show uniform decreasing trends despite the decrease in nitrogen deposition.

Biological recovery is under way in Europe, but full recovery is still far ahead.
The acidity of lakes and rivers has decreased due to the decrease in sulphate and many places there are good conditions for recovery of aquatic biological communities that have been damaged due to acidification (see figure 7.13). Six countries (Czech Republic, Finland, Germany, Norway, Sweden and Switzerland) reported on biological recovery from national monitoring programmes. Most contributions focused on recovery of zoobenthos (small organisms that live on the bottom of rivers and lakes such as aquatic insects, worms and snails), but status of fish populations, algae and macrophytes (water plants) were also given. Zoobenthos have a short life cycle and are therefore able to respond more quickly to improved water chemistry than fish, which makes these organisms suitable as early indicators of biological recovery.

Almost all contributions reported evidence of biological recovery which was attributed to improved water quality, although other factors such as climate also contributed to explaining temporal variations. Higher species diversity was observed while species composition in many places has become more similar to non-acidified communities.

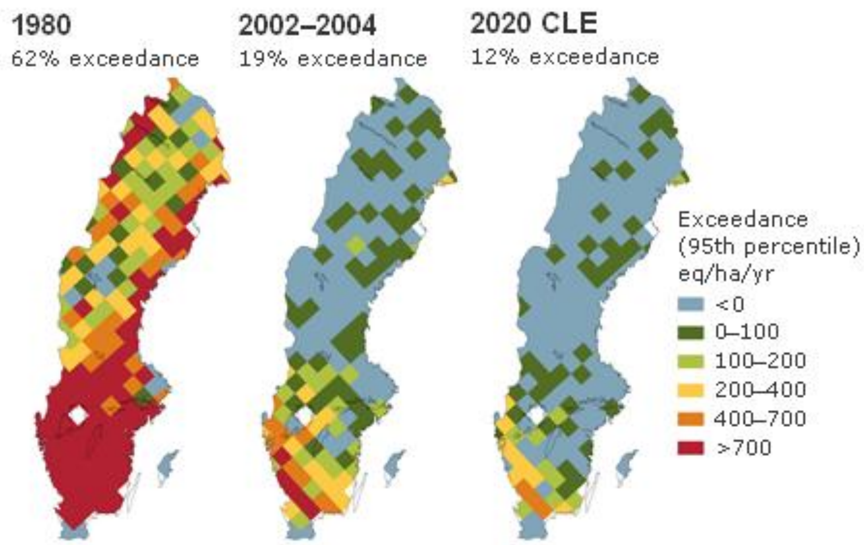
Full biological recovery is not documented anywhere. A return to pre-industrial biodiversity is unlikely in most cases, because original species are extinct, new species have been introduced and biological processes are often non-reversible. Several areas in Europe will never achieve good (non-acidified) water quality with current legislation of emissions of acidifying components. Future reductions of both S and N deposition are necessary to achieve biological recovery.

Figure 7.12. Number of sensitive benthic animals per sample and taxa richness of EPT taxa in the upper unlimed part of River Vikedal in the period 1993 - 2010. Fjellheim and Anker Halvorsen in chapter 4.5 of Skjelkvåle and de Wit 2011.



Sweden Acidification varies between areas
Source: SOER2010 Sweden Freshwater assessment
http://www.eea.europa.eu/soer/countries/se/soertopic_view?topic=freshwater

Acidification is caused by national and international anthropogenic loads. Acid fallout has decreased by more than 90 % during the past ten years. One source of acidifying pollutants that is becoming increasingly important is shipping. Differences within Sweden are large. This is clearly shown in the figure.

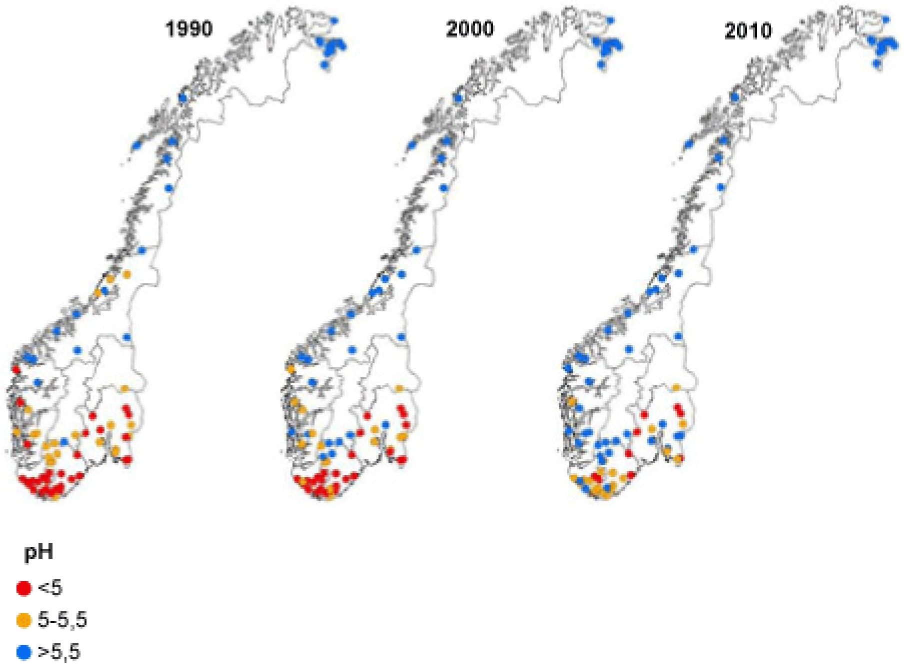


Norway
Source: Environment.no - Acid rain http://www.environment.no/Topics/Air-pollution/Acid-rain/
A great deal has been done to reduce sulphur emissions in Norway and the rest of Europe, and pollution has been substantially reduced as a result. Nevertheless, much of the southern half of Norway is still suffering from damage caused by acid rain.

State Southern half of Norway still suffering from damage
Impact Acid rain kills fish
Driving forces Trends determined by energy use

Pressure Industry and transport the main sources
Response International agreements are vital

→ **pH trends in lakes**



SOURCE: Norwegian Institute for Water Research, 2011 / www.environment.no

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8. Missing chapters

It is the intention to add some chapters on environmental objectives (status in 2015) and on measures. These chapters will be developed on basis of the analysis done by EU Commission DG ENV.

The missing chapters will compare the observed status and pressures presented in chapter 4 to 6 in the present report with the list of measures and the environmental objectives (status 2015). The content of the chapters are depicted in the below diagram. The chapters will aim at answering the following questions:

- Are the proposed measures (PoM) tackling the right pressures?
- What will be the status in 2015/21/27 if the PoMs are implemented?