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Progress towards halting the loss of biodiversity by 2010

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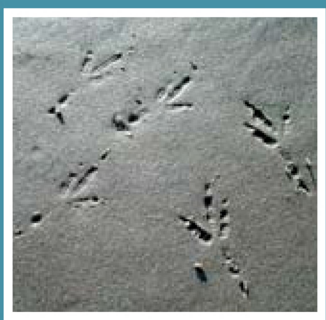

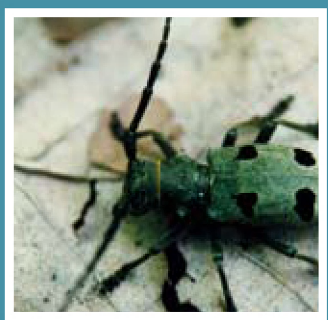

European Environment Agency

Progress towards halting the loss of biodiversity by 2010

European Environment Agency

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The project was managed by Tor-Björn Larsson and Rania S. Spyropoulou.

Acronyms used

Agenda 21	Agenda 21 addresses environment and development problems of today and also aims at attaining the long-term goals of sustainable development (UN Conference on Environment and Development in Rio de Janeiro, 1992)
BAPs	Biodiversity action plans
BirdLife	BirdLife International is a global partnership of conservation organisations that strives to conserve birds, their habitats and global biodiversity
BOD	The biochemical oxygen demand
CAP	EU's common agricultural policy
CBD	UN Convention on Biological Diversity
CFP	EU's common fisheries policy
ECBS	EC Biodiversity Conservation Strategy
EEA	European Environment Agency
ETC/BD	European Topic Centre on Biological Diversity (established in support of EEA)
ETC/W	European Topic Centre on Water (established in support of EEA)
ETC NPB	European Topic Centre on Nature Protection and Biodiversity, from 2004 onwards ETC/BD
EU-12	Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Spain, the Netherlands, the United Kingdom
EU-15	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden, the Netherlands, the United Kingdom
EU-25	Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, the Netherlands, the United Kingdom
FAO	UN Food and Agriculture Organisation
FSC	The Forest Stewardship Council
GMOs	Genetically modified organisms
HNV	High nature value (farmland)
ICP Forests	The International Co-operative Programme on the Assessment and Monitoring of Air Pollution Effects on Forests, established under the UNECE Convention on Long-range Transboundary Air Pollution
IMO	The International Maritime organizaton

IRENA	Indicator reporting on the integration of environmental concerns into agriculture policy (EU)
IUCN	The World Conservation Union
IWC	Wetlands International's Waterbird Census
LMEs	Large marine ecosystems
MCPFE	The Ministerial Conference for Protection of Forests in Europe
NAO	The North Atlantic Oscillation
Natura2000	A network of protected areas in the EU covering valuable natural habitats and species of particular importance for the conservation of biological diversity (EU birds and habitats directives)
NUTS	Nomenclature of territorial units for statistics
PEBLDS	Pan-European Biological and Landscape Diversity Strategy (Council of Europe)
PEFC	The Programme for the Endorsement of Forest Certification
pSCIs	Proposed sites of Community interest (EU habitats directive)
SACs	Special areas of conservation (EU habitats directive)
SCIs	Sites of community interest (EU habitats directive)
SEBI2010	Streamlining European 2010 Biodiversity Indicators
SPAs	Special protection areas (EU birds directive)
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFF	United Nations Forum on Forests
WFD	EU water framework directive

Executive summary

The continuing loss of biological diversity and its components, genes, species and ecosystems, is an issue of global concern. Research has shown that both the diversity and the identity of the various species have a fundamental influence on the magnitude and stability of the ecological processes that occur at the ecosystem level. There are significant interrelationships between the degradation of ecosystems, the loss of animal and plant species, market globalisation, and poverty. Europe's high per capita consumption and waste production means that its impact on ecosystems is felt well beyond its own borders. Biodiversity loss is inextricably linked to the degradation of the ecosystem services described by the 2005 Millennium Ecosystem Assessment.

The objective of 'managing natural resources more responsibly: to protect and restore habitats and natural systems and halt the loss of biodiversity by 2010' was first adopted by the EU in the EU Strategy for Sustainable Development (2001). As a consequence, the conservation of biodiversity is one of the four main issues to be tackled, together with climate change, environment and health and quality of life, and natural resources and waste, within the 6th environmental action programme 'Our Future, Our Choice', adopted in 2002.

In Europe, more than on any other continent, the influence of human activity has shaped biodiversity over time, with settled agriculture and animal husbandry spreading from the south-east to the north-west between 10 000 and 5 000 years ago. Landscapes in Europe were relatively stable until the agricultural and industrial revolutions of the past two centuries. Since then, and even more since the 1950s, dramatic changes in land use, intensification of agriculture, urbanisation, land abandonment and movement to towns and cities have led to the widespread collapse of the socio-economic systems that supported these diverse systems of land use.

While some species populations in Europe are increasing, many others are declining. The most vulnerable are the species at the top of food chains, such as large carnivores, endemic local species (species found only in one geographical area), species with chronically small populations, migratory species, and specialist species. However, several species that were considered threatened by extinction, such as the beaver, the otter, vultures and many raptors, are now showing stable or even positive trends in certain parts of their distribution, as a result of protection and restoration measures.

Land use in Europe continues to change, but not on the scale of recent decades. Land is becoming a scarcer resource: 800 000 ha of Europe's land cover was converted to artificial surfaces between 1990 and 2000, taking over agricultural and natural areas, in particular wetlands.

Responses in nature conservation policies are positive as the total area covered by nationally-designated areas by European countries has increased during recent years. The Natura2000 site designations have contributed to a direct increase in the total area designated for *in situ* conservation in EU-15 countries. The level of sufficiency in designating Natura2000 sites under the habitats directive is high for almost all EU-15 countries, but there have been significant delays in putting the network in place.

The generally low rate of implementation of both the EU Biodiversity Strategy and the action plans in Member States was recognised in 2004. The 'final message from Malahide' presented 18 priority objectives for halting the loss of biodiversity, many of which express the need for sectoral considerations and the integration of biodiversity issues in other policies.

This report assesses farmland, forests, freshwater ecosystems, marine and coastal systems, wetlands of international importance and mountain ecosystems in order to provide evidence of progress — or lack of progress — towards the 2010 target of halting the loss of biodiversity.

Farmland: Progress towards the 2010 target is not apparent and the target is unlikely to be reached without additional integrated policy efforts. In need of specific attention are the targeting and prioritising actions aimed both at the conservation of high nature value farmland and at improving the biodiversity value of intensively-managed farmland.

The most alarming signs of lack of progress are the continuing expansion of intensively-farmed areas at the expense of natural and semi-natural habitats, the reported declining trend in farmland-related species of birds and butterflies, the increasing rates of water utilisation, farm specialisation and intensification of farming practices, the increased presence of invasive alien species in farmland, and the high risk of abandonment of farmland in several parts of Europe.

Forests: There are clear signs of progress in reducing threats to and enhancing the biological diversity of Europe's forests. In most countries, forests are growing older and thus more valuable for biodiversity conservation, and a slightly decreased effect of air pollution has been observed. Conserving biodiversity has been gaining ground within the objectives of forest management, as has certification of the products of sustainably-managed forests.

Several persisting issues of concern include conservation of threatened species that occur in forests, control of increasing invasive alien species, addressing forest fragmentation due to changes in land use, and more efficient control of forest fires.

Freshwater ecosystems: The main sign of progress is the marked improvement in the water quality of many rivers and lakes in recent decades, which has made water again suitable for the potential return of some of the lost species. The 2010 target is unlikely to be reached without restoring riverine habitats and biological communities and reversing the trend of many freshwater species that are threatened or at risk of extinction. To this end, three issues are of outstanding importance: counteracting the loss, fragmentation and modification of habitats due to dams and canalization, minimizing the increased presence of invasive alien species, and ensuring the appropriate conservation and management of the few remaining natural freshwater systems.

Seas and coasts: The loss of biodiversity in all European seas and coasts is considerable and shows little sign of being reduced. The only area of progress, although not spectacular, is the improvement in the abiotic conditions of the Black sea, which was badly damaged in the past; conditions in the Mediterranean sea remain critical. Persisting evidence of the need for urgent action is the increasing depletion of fish stocks, the continuing pollution from land-based sources and oil spills, and the non-recovery of threatened and endangered marine species. Numbers of invasive alien species in the marine environment have been increasing and risks of pollution and genetic erosion induced by aquaculture have been identified. Continuing loss and fragmentation of natural habitat areas on the coastline as well as increased soil erosion, caused by urbanisation, tourism and infrastructure development, have been observed.

Wetlands of international importance: While the loss of wetland habitats in Europe is continuing, there is some progress in conserving the wetlands designated as of international importance (Ramsar sites). This is indicated by the steady increase in the area designated in the past decade, the stabilising populations of water birds, and the increased number of restoration and local community-awareness projects in many countries.

However, Ramsar sites are still facing important threats, and negative changes in ecological state have been reported in most of them. Pressures from water abstraction, drainage or damming, excessive hunting and fishing, and unspecified pollution sources have been identified in many countries. Urbanisation and transport development, as well as tourism and recreation have been signalled as drivers of deterioration of the sites.

Mountains: There is little evidence of progress in enhancing or reducing threats to the biological diversity of Europe's mountains, which are subject to rapid changes. The 2010 target may be partly met in areas where traditional uses and activities continue to shape the ecosystem structures. Evidence for progress is that the populations of some endangered large carnivores and herbivores are increasing due to successful management and that long-range pollution has stabilised while pollution from industry is a relatively local threat. The main challenges for reaching the target are minimising the high risk of local extinctions of several species and counteracting the already visible effects of habitat fragmentation and/or change due to changes in land use. The increasing effects of climate change should be also taken in account when addressing policy measures.

A number of issues continue to be of general concern in ecosystems across Europe. The effects of eutrophication and acidification often occur far from the sources of pollution, as a result of transfers through the atmosphere and water bodies. Marine, coastal and other aquatic ecosystems, grasslands and forests are all sensitive to eutrophication, which has become a widespread problem — globally and within Europe.

Climate change will impact biodiversity and ecosystems differently across Europe and it may well be the most powerful factor in shaping

Europe's future biodiversity, acting on top of habitat destruction, fragmentation and over-exploitation. Changes have been observed in the Arctic, with new incoming species of plants establishing in lakes, and in mountain regions like the Alps, with loss of endemic plants.

Potential risks to human health and the environment, including biodiversity, posed by living modified organisms, resulting from modern biotechnology, are recognised by global conventions and EU legislation. Continuous monitoring and assessment of impacts is necessary both at the European and global scales.

A range of general issues is in need of further consideration to help steer future action: the impacts of long-range transboundary pollution and climate change on biodiversity, the failure to break the common perception that conservation and economic development are incompatible, the continued abandonment of traditional wildlife-friendly extensive farming methods, and gaps between theory and practice in Europe's management of forests and fisheries.

With regard to improving the integration of biodiversity into economic sectors, there is a need to address next steps with respect to most actions laid down in policy documents, and a need for a clear sense of priority, broadly agreed by the key stakeholders.

Assessing the dependence of human health on responsible biodiversity management, the potential of spatial planning, the internalisation of external costs to biodiversity, and the distribution or sharing-out of competence between different levels of governance would assist in reaching further agreement on actions to be taken.

The development of integrated data sets throughout the continent as well as of a conceptual framework for indicators and their interpretation are essential for assessing progress towards the 2010 target and beyond it.

1 An issue of global concern

1.1 The biodiversity crisis

'Biological diversity' means the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Article 2 of the United Nations Convention on Biological Diversity, 1992).

Biological diversity (or biodiversity) can be described as the 'life insurance policy for life itself' (Pisupati and Warner, 2003).

The Earth's ecological systems are dynamic and reflect climatic conditions and geological, biochemical and biological processes over time. Five major biodiversity extinction events have been recorded since the earliest times in the planet's history. Each of them led to profound shifts in the life forms on earth. Scientists suggest that we might now be on the brink of a sixth biodiversity crisis as a result of human activities (Thomas *et al.*, 2004, American Museum of Natural History, 2005).

Our era is characterised by an unprecedented acceleration in species extinction — perhaps a thousand times more rapid than the estimated 'natural rate' of 1 out of 1 million species per year. Negative trends also continue to be noted in ecosystems and habitats, with the net global change in forest area between 1990 and 2000 estimated as – 9.4 million ha per year: the sum of – 14.6 million hectares of deforestation and 5.2 million hectares of gain in forest cover by plantations. The global change (– 0.22 percent per year) represents an area about the size of Portugal. The estimated net loss of forests for the 1990s as a whole was 94 million hectares — an area larger than Venezuela, FAO (2001).

Biological diversity is fundamental to agriculture and food production. A rich variety of cultivated plants and domesticated animals serve as the foundation for agricultural biodiversity. Yet people depend on just 14 mammal and bird species for 90 % of their food supply from animals, and on just four species — wheat, maize, rice and potato — from plants. But when food producers abandon diversity, species, varieties and breeds may die out — along with their specialised traits.

Biodiversity loss is one facet of the degradation of the ecosystem services assessed in the framework described by the Millennium Ecosystem Assessment (Reid *et al*., 2005), see Figure 1.1. This assessment revealed that approximately 60 % of the ecosystem services that support life on Earth — such as fresh water, capture fisheries, air and water regulation, and the regulation of regional climate, natural hazards and pests — are being degraded or used unsustainably.

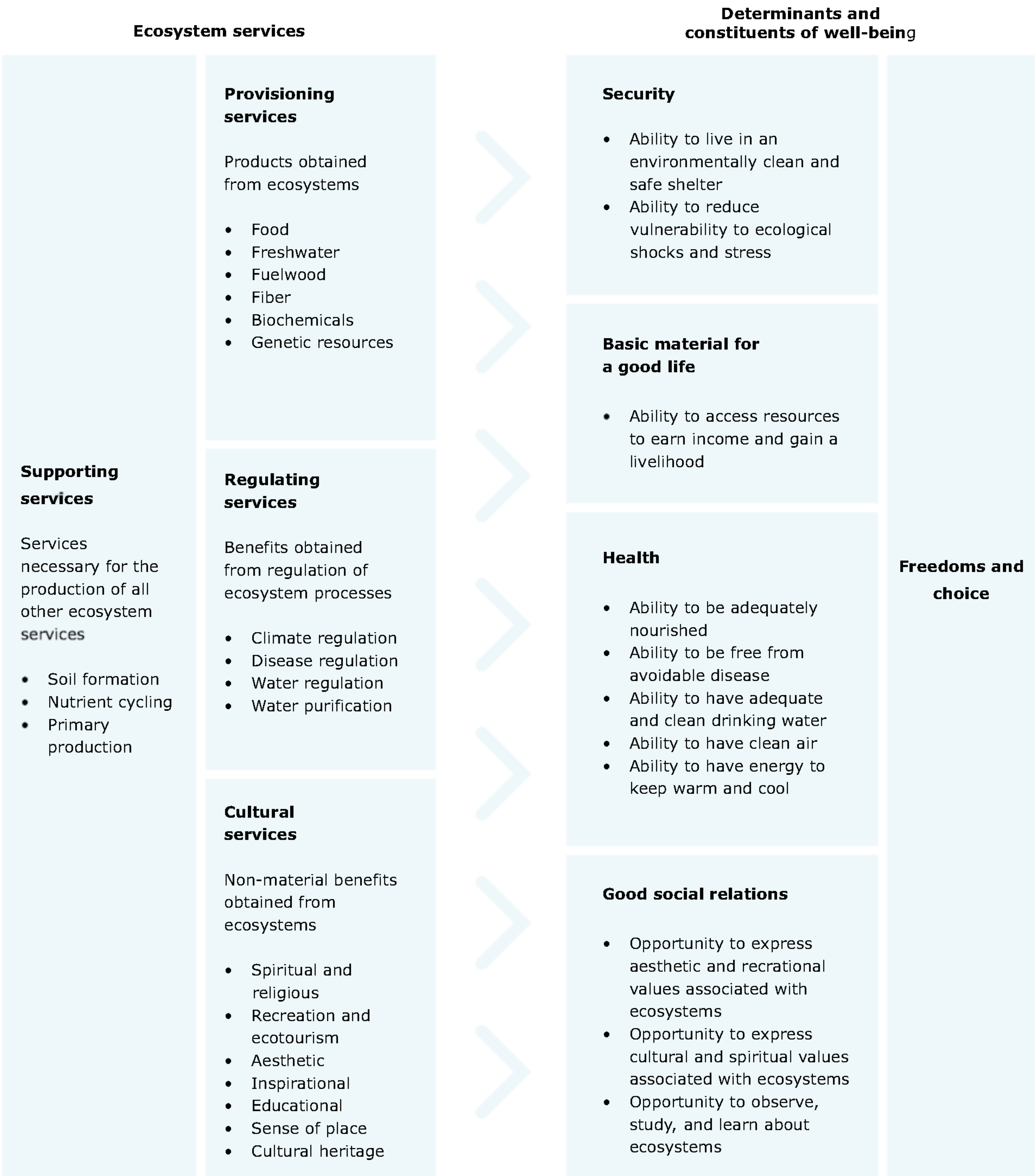
The main findings were:

- Humans have changed ecosystems more rapidly and extensively in the past 50 years than in any other period. This was done mainly to meet rapidly growing demands for food, fresh water, timber, fibre and fuel. More land has been converted to agriculture since 1945 than in the 18th and 19th centuries together. More than half of all synthetic nitrogen fertilisers, first made in 1913, ever used on the planet has been used since 1985. Experts say that together, these changes have resulted in a substantial and largely irreversible loss in diversity of life on Earth, with some 10 to 30 % of mammalian, bird and amphibian species currently threatened with extinction.

- Ecosystem changes that have contributed to substantial net gains in human well-being and economic development have been achieved at growing costs in the form of degradation of other services. Only four ecosystem services have been enhanced in the past 50 years: increases in crop, livestock and aquaculture production, and increased carbon sequestration for global climate regulation. Two services — capture fisheries and fresh water — are now well beyond levels that can sustain current, much less future, demands. Experts say that these problems will substantially diminish the short-term economic benefits of these two services for future generations.

- The degradation of ecosystem services could grow significantly worse during the first half of this century. This is a barrier to achieving the UN Millennium Development Goals which aim at the eradication of poverty and hunger, improvements in education, combating global epidemics such as HIV/AIDS, and ensuring environmental sustainability. In all the four plausible scenarios explored by the scientists in the Millennium Ecosystem Assessment, they project progress in eliminating hunger, but at far slower rates than needed to reach the Millennium Goal of halving the number of people suffering from hunger by 2015. Experts warn that changes in ecosystems such as deforestation may influence the abundance of human pathogens such as malaria and cholera, as well as the risk of emergence of new diseases. Malaria, for example, accounts for 11 % of the disease burden in Africa and had it been eliminated 35 years ago, the continent's gross domestic product over that period would have increased by USD 100 billion.

Figure 1.1 Ecosystem services and their links to human well-being



Source: Millennium Ecosystem Assessment, 2005.

- The challenge of reversing the degradation of ecosystems while meeting increasing demands can be met under some scenarios that involve significant policy and institutional changes. However, these changes would have to be large and are not currently under way. The report mentions options that exist to conserve or enhance ecosystem services that reduce negative trade-offs or that will positively impact other services. Protection of natural forests, for example, not only conserves wildlife but also sustains freshwater supplies and reduces carbon emissions.

Box 1.1 Ecosystem productivity declines as species diversity reduces

Major conclusions from research on grasslands across the world during the past decade provide clear evidence of the relationship between diversity loss and reduced ecosystem function for a wide range of ecosystem processes (Tilmann, 2005; Loreau, 2000):

Productivity: diversity loss leads to decreased productivity and decreased carbon sequestration.

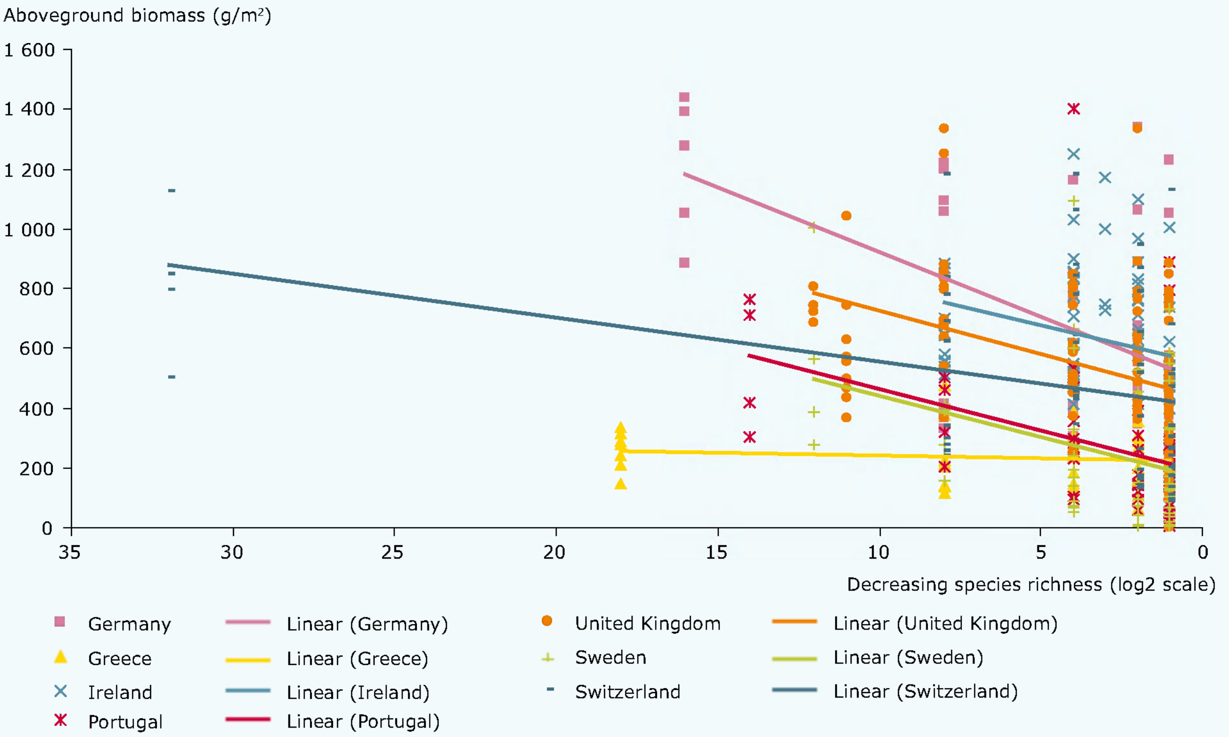
Water quality and soil fertility: diversity loss leads to less efficient resource use, greater loss of limiting nutrients to the groundwater, and loss of soil fertility.

Stability: diversity loss leads to lower ecosystem stability and less predictability (the 'insurance hypothesis' of Loreau).

Exotic invaders: decreased diversity leads to increased risk of species invasions.

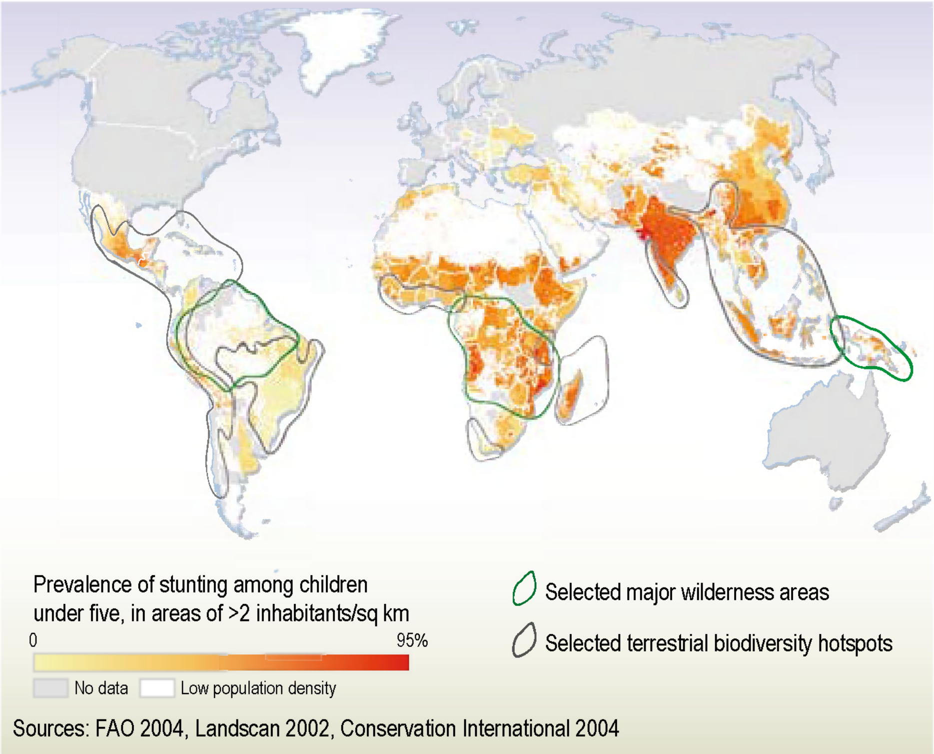
An example is provided in the experimental project BIODEPTH on a variety of grasslands across Europe. Although our general perception of high crop productivity is associated with large uniform stands, resulting from large fertiliser inputs, crop productivity in natural conditions, as expressed by hay yield, declines as plant diversity reduces (Figure 1.2).

Figure 1.2 Relation between plant diversity decline and plant productivity, expressed in hay yield, in various grassland types in Europe



Source: Hector, A. *et al.*, 1999.

Figure 1.3 Map showing overlap between areas with high poverty and high population density and areas with high biodiversity



Note: This may indicate areas in which people may have no other choice than to extract resources unsustainably, thus causing further biodiversity loss.

Source: UNEP/Grid Arendal, 2004.

Changes in species or habitat diversity affect the ability of ecosystems to supply services and recover from disturbances. In many cases it is the roles played by the species that are important, rather than their individual characteristics. Both the diversity and the identity of the various species have a fundamental influence on the magnitude and the stability of ecological processes that occur at the ecosystem level.

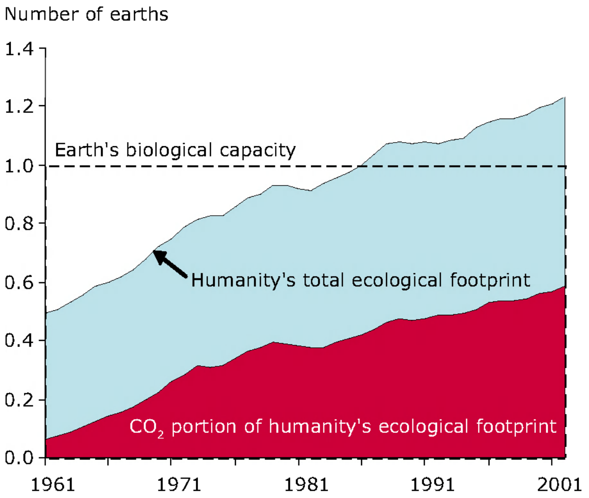
Human conflicts around the use and control of geographical locations and natural resources have been common since ancient times. In current times, significant interrelationships between degradation of ecosystems, loss of animal and plant species, market globalisation and poverty have been identified, thus proving that the loss of biological diversity is interwoven with the whole spectrum of human conditions on the planet.

One interesting aspect is the significant spatial overlap between areas with globally high biodiversity values and areas where human societies are hammered by poverty (see Figure 1.3). Around 1.3 billion people live in conditions of extreme poverty, generally in areas of high biodiversity, and depend on biodiversity for their food and health (IUCN, 2004a). In addition, a large part of the resources exploited in these regions are used for the benefit of richer countries.

Poverty often leads to unsustainable pressures on biological resources, and in turn, degradation of these resources and subsequent non-availability of food, non-timber forest produce and potable water can result. World poverty is inextricably linked to ecosystem deterioration and biodiversity loss (Ried *et al.*, 2005). Sufficient food to feed the world's population is now being produced, but many people still go hungry (IUCN, 2004a). Increased globalisation of food production is linked to increased dependency on very few species of crops cultivated as large-scale monoculture systems.

Europe's impact on biodiversity extends far beyond its own shores. Materials from across the globe are used for food, clothing, housing and transport in Europe. Waste produced in Europe is spread around the world — on the winds and via ocean currents. Europe's high per capita consumption and waste

Figure 1.4 Ecological overshoot 1961–2002



Source: Global Footprint Network, 2004.

production means that its impact on ecosystems is felt well beyond its own borders.

One attempt to capture that is the 'ecological footprint' — a measure of how much of the ecological capacity of the Earth we use up to grow our food and fibre, dispose of our waste, create room for our cities and infrastructure, and provide other ecological services such as sequestration of our carbon dioxide pollution. It has been developed by WWF, the global conservation organization, and the Global Footprint Network, among others.

Such calculations are inevitably crude, and not without controversy. Nonetheless, they can act as a warning about how we manage and share the planetary resources and ecological services on which we all depend.

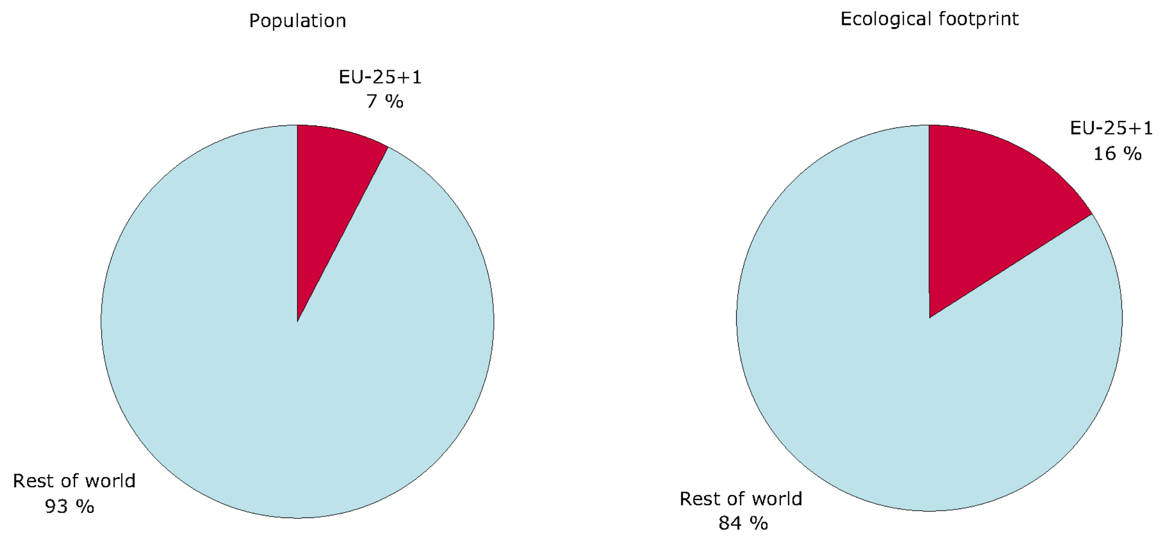
In 1961, the EU-25's global footprint was around three hectares per person, which was virtually the same as the continent's biocapacity (that is the effective area of land available on the continent for ecoservices). By 2001, Europe's global ecological footprint had risen to more than twice its internal biocapacity. Effectively it requires two continents of the size and biological productivity of modern-day Europe to maintain the continent in the style to which it has become accustomed.

1.2 Political recognition

With the signature of the UN Convention on Biological Diversity (CBD) in 1992, concerns for biodiversity and the many factors that may affect its multiple dimensions were raised to a high political profile and are since being debated even more systematically in different spheres of society all over the world, see Table 1.1.

Since 1992, work under the Convention has been initiated on seven thematic work programmes, addressing marine and coastal biodiversity, agricultural biodiversity, forest biodiversity, island biodiversity, the biodiversity of inland waters, dry and sub-humid lands and mountain biodiversity.

Figure 1.5 Ecological footprint versus population (EU-25 and Switzerland)



Source: Global Footprint Network, 2004.

Work has also been initiated on a number of key cross-cutting issues of relevance to all the thematic areas, such as access to genetic resources; traditional knowledge, innovations and practices; intellectual property rights; indicators; taxonomy; public education and awareness; incentives; and alien species. A strategic plan for the Convention was adopted in 2002 and a periodic review of the implementation of the work programmes has also been agreed.

The World Summit on Sustainable Development in 2002 stressed the importance of biodiversity for securing our foundations of existence and endorsed the target of reducing the rate of loss of biodiversity by 2010. It reiterated the central role of biodiversity in sustainable development and global poverty reduction and acknowledged the central role of the Convention in achieving this target in cooperation with other relevant international conventions. A specific goal is to stop the irretrievable loss of biodiversity by 2010.

The Cartagena Protocol on Biosafety, a supplementary agreement to the Convention, entered into force on 11 September 2003; it seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology.

The FAO International Treaty on Plant Genetic Resources for Food and Agriculture entered into force on 29 June 2004. The Treaty is vital to ensuring the continued availability of the plant genetic resources that countries will need to feed their people.

Table 1.1 Important recent political commitments related to the loss of biodiversity

At the global level	
6th conference of the parties to the Convention on Biological Diversity in the Hague 7–19 April 2002	Adoption of a Strategic Plan for the Convention on Biological Diversity (Decision VI/26) including the 2010 target 'to achieve a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth'.
World Summit on Sustainable Development in Johannesburg, 26 August–4 September 2002	Endorsement of the target for 'achievement by 2010 of a significant reduction in the current rate of loss of biological diversity' and recognition of the critical role played by biodiversity in sustainable development and poverty eradication.
7th conference of the parties to the Convention on Biological Diversity in Kuala-Lumpur, 9–27 February 2004	Adoption of a framework (Decision VII/30): — to facilitate the assessment of progress towards the 2010 target and communication of this assessment, — to promote coherence among the programmes of work of the Convention, — to provide a flexible framework within which national and regional targets may be set, and indicators identified.
At the pan-European level	
5th 'Environment for Europe' Ministerial Conference in Kiev, 21–23 May 2003	Endorsement of a resolution to 'halt the loss of biological diversity at all levels by the year 2010', according to seven key targets in the areas of: forests and biodiversity; agriculture and biodiversity; a pan-European ecological network; invasive alien species; financing biodiversity; biodiversity monitoring and indicators; public participation and awareness.
Third Intergovernmental Conference 'Biodiversity in Europe' in Madrid, 19–21 January 2004	European Union — pan-European partnership to implement actions towards halting biodiversity loss, in line with global concerns.
In the European Union	
6th environmental action programme (2001)	'Nature and Biodiversity' addressed as a priority area with the overall aim of 'protecting, conserving, restoring and developing the functioning of natural systems, natural habitats, wild flora and fauna with the aim of halting desertification and the loss of biodiversity (by 2010), including diversity of genetic resources, both in the European Union and on a global scale'.
European Council in Gothenburg, 15–16 June 2001	Adoption of the EU Strategy for Sustainable Development, which has as a headline objective 'managing natural resources more responsibly: to protect and restore habitats and natural systems and halt the loss of biodiversity by 2010'.
Conference 'Sustaining Livelihoods and Biodiversity: Attaining the 2010 Target in the European Biodiversity Strategy' in Malahide, 25–27 May 2004	A large consultation with various stakeholders was organised within the process for review of the EC Biodiversity Strategy and Biodiversity Action Plans which resulted in the 'Message from Malahide' identifying the need for further action under cross-cutting themes and major sectors influencing European biodiversity to halt its loss by 2010. The Malahide Conference also endorsed a first set of EU headline biodiversity indicators to assess progress towards the 2010 target.
European Council in Brussels 28 June 2004	Conclusions on 'Halting the loss of biodiversity by 2010'.
European Commission 2006	Preparation for the adoption of a communication on biodiversity.
At the national level	
Several countries have included the '2010 target' as part of their national biodiversity strategies.	

In the European Union, the EC Biodiversity Conservation Strategy (ECBS) was adopted in 1998, and provides a comprehensive response to the many requirements of the CBD. The four biodiversity action plans (BAPs for natural resources, agriculture, fisheries and development), adopted in 2001, lay out in detail what actions should be taken to implement the strategy. A review of the implementation of ECBS was initiated in 2004 and its outcome will be fundamental to halting the loss of biodiversity in Europe.

The objective of 'managing natural resources more responsibly: to protect and restore habitats and natural systems and halt the loss of biodiversity by 2010' was first adopted by the EU in its EU Strategy for Sustainable Development (2001). Following on this, the conservation of biodiversity is one of the four main issues to be tackled, together with climate change, environment and health and quality of life, and natural resources and waste, within the 6th environmental action programme 'Our future, our choice', adopted in 2002.

The 2010 target 'to achieve a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth' was consequently endorsed by the Convention of Biological Diversity in 2002 and the Johannesburg Summit on Sustainable development.

1.3 Streamlining European biodiversity indicators for 2010

In line with the target of halting or reducing the loss of biodiversity, countries have agreed on a global framework to monitor and report progress and to help achieve the 2010 target, as indicated in Table 1.1.

The framework for monitoring and reporting progress was defined by CBD and EU headline indicators that have been identified in relation to its seven focal areas. Table 1.2 shows the first set of EU headline biodiversity indicators endorsed in 2004.

In response to these developments, a pan-European cooperation on 'Streamlining European 2010 biodiversity indicators (SEBI2010)' is being coordinated by the European Environment Agency (with support from its Topic Centre on Biological Diversity), the European Centre for Nature Conservation and the UNEP World Conservation Monitoring Centre, in close cooperation with the European Commission (DG Environment), the PEBLDS Joint Secretariat and other appropriate organisations.

Table 1.2 A first set of EU headline biodiversity indicators to assess progress towards the 2010 target of halting biodiversity loss

Focal area	Indicators
Status and trends of the components of biological diversity	• Trends in extent of selected biomes (*), ecosystems and habitats • Trends in abundance and distribution of selected species • Change in status of threatened and/or protected species • Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socio-economic importance • Coverage of protected areas
Sustainable use	• Area of forest, agricultural, fishery and aquaculture ecosystems under sustainable management
Threats to biodiversity	• Nitrogen deposition • Numbers and costs of invasive alien species • Impact of climate change on biodiversity
Ecosystem integrity and ecosystem goods and services	• Marine trophic index • Connectivity/fragmentation of ecosystems • Water quality in aquatic ecosystems
Status of access and benefit sharing	• Patents
Status of resource transfers and use	• Funding of biodiversity
Public opinion	• Public awareness and participation

(*) Biomes are defined as 'the world's major communities, classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment' (Campbell).

The 'SEBI2010 process' ([1]) was launched in January 2005 and has called upon all European countries and stakeholders to contribute their expertise. The work plan of SEBI2010 has been endorsed and it aims to progressively develop biodiversity indicators, during the next years, which should be as consistent as possible at the national, EU, pan-European and global levels to track progress towards achieving the target of halting the loss of biodiversity by 2010.The first set of proposed indicators is to be finalised in 2006.

([1]) Documents and reports of the SEBI2010 process are posted on http://biodiversity-chm.eea.eu.int/information/indicator/F1090245995 — accessed 02/05/2006.

2 Setting the scene for Europe

2.1 An historical approach to Europe

The natural history of the European continent is marked by its geological past as well as by periods of extreme and relatively rapid climatic change, including repeated glaciations. It is estimated that the loss of species diversity during the past 2 million years has exceeded the rate of species creation by evolutionary processes. Thus the continent is relatively species-poor compared with equivalent regions in Asia and America.

There is a great contrast between the distribution of biomes during the last glacial maximum, when most of Europe was covered by ice, and today. These long-term, natural dynamics of habitats provide an important background to understanding present-day biodiversity status and trends. Forest species in particular had very restricted distributions for long periods during glaciations, which inevitably led to loss of species and genetic diversity. As the forest area increased in response to altering climate, the species characteristic of open habitats experienced habitat fragmentation and loss.

Not all species were able to follow the expansion of biomes after the glaciations. The remaining species diversity was maintained and concentrated in glacial refuges, such as islands and mountain chains with large topographic variation, which offered a variety of contrasting habitats within a small area. After the last glaciation, the rest of the land was re-colonised by plants and animals, however a high concentration of endemic species is still to be found on islands and mountains (EEA, 1999), Table 2.1.

The largest number of plant and animal species in Europe is hosted in the Mediterranean basin, which is also one of the 33 hot-spots in the world (Mittermeier, R. *et al.*, 2005). This area is nearer to the equator than the rest of the continent and combines mountainous reliefs with a very large number of islands and islets (almost 5 000) (Delanoe *et al.*, 1996). Some of the species with limited distribution in southern Europe are more widely spread in neighbouring parts of Asia and Africa.

In Europe, more than in any other continent, the influence of human activity has shaped biodiversity over time, with settled agriculture and animal husbandry spreading from the south-east to the north-west between 10 000 and 5 000 years ago. Its major consequences were clearing of the forest to create open habitats and massive population increases in species associated with agriculture, including crops, domestic animals, weeds, pests. Thus, Europe's biodiversity has historically been embedded in a rural environment, with complex interactions between species populations in open habitats and a dynamic landscape.

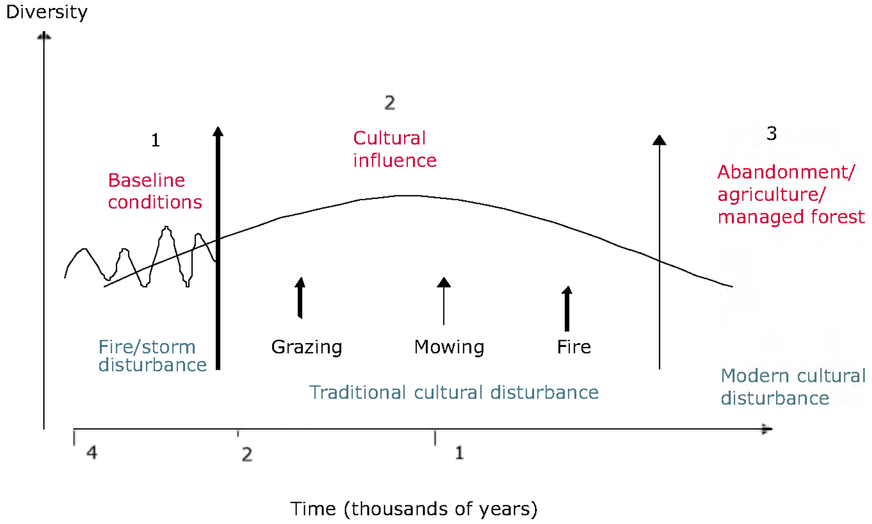
The landscapes that were created many millennia ago in Europe were relatively stable until the agricultural and industrial revolutions of the past two centuries. Since then, and even more since the 1950s, dramatic changes in land-use, intensification of agriculture, urbanisation, land abandonment and movement to towns and cities have led to the widespread collapse of the socio-economic systems that supported these diverse systems of land use.

Table 2.1 Concentration of plant diversity and endemism in European mountains as the result of repeated glaciations

Mountain range	Number of vascular plant species	Endemism
Baetic and Sub-Baetic Mountains (Spain)	3 000	80 % endemism in some habitats in the high mountains
Massifs of Gudar and Javalambre (Spain)	1 500	High level of endemism and many relic species
Pyrenees (France, Spain, Andorra)	3 500	200 endemic species
Alps (Austria, France, Germany, Italy, Liechtenstein, Slovenia, Switzerland)	5 500	7 % endemism
Balkan and Rhodope Massifs (Bulgaria, Greece, Serbia and Montenegro)	3 000	Important level of endemism
Mountains of southern and central Greece	4 000	35 % of montane species endemic to Greece
Crete (Greece)	1 600	10 % endemism
Troodos Mountains (Cyprus)	1 650	62 species

Source: Davis *et al.*, 1994–1997.

Figure 2.1 Model of changes in biodiversity associated with the development and abandonment of traditional agricultural methods



Source: Bradshaw and Hannon (unpublished).

Traditional agriculture during historic times varied in intensity in space and time, which was favourable for species that require occasional disturbance. Historical and palaeo-ecological records document periods of increased landscape exploitation, but also periods of landscape abandonment and forest re-growth, such as during the plague years of the 1300s. The onset of industrialisation during the 1800s broke this trend of variation and started the process of abandonment of traditional methods in favour of more intense and homogenous landscape management.

The current biodiversity crisis in western Europe results mainly from this drastic change in the long-term interactions between human activities and nature (Bradshaw R. and Emanuelsson U., 2004). In the new EU countries, where the share of extensively-used farming areas with valuable associated biodiversity is still relatively large compared with western Europe, we are likely to witness a similar process, with a rapid polarisation towards intensification of land-use on the one hand and abandonment on the other, both with negative effects on biodiversity (EEA, 2004a).

The biodiversity richness of European landscapes is essential to present and future ecosystem services, in particular in relation to potential adaptations to climate change (Figure 2.1). Maintaining ecosystems in terms of their abundance, health and connectivity is no longer a stand-alone target of nature conservation but a main challenge for society.

2.2 Species trends and movements

Species represent a very important component of biodiversity. Every species interacts in a complex way with other plant and animal species within communities, having one or more roles as a prey, a parasite, a pollinator, a producer of food and energy, a decomposer, a nutrient recycling, or a competitor.

During the past decade we have witnessed positive trends in the populations and distributions of several wild-life species, such as geese, wild boar, reindeer, cormorant and wolf, favoured by current land-use and management practices.

It has been shown that the numbers of plant species on alpine summits are increasing (Figure 3.49), as they are in arctic lakes, as a result of shorter periods under ice and snow, a sign of climate change. In fact, an increase in the abundance of some species or expansion of their distribution area is not always a good sign. Some species are opportunistic and benefit from changes in management practices towards more intensification and therefore more availability of food (crops, fish farms, large un-watched sheep flocks).

Similarly, an increase in the number of plant species in grasslands and heathlands may indicate an expansion of more robust and generalist plant species, due to increasing nitrogen deposition. This, in turn, can affect the presence or abundance of the insect species that the plant species are able to support.

Some commercial species have been intentionally released into nature or have escaped their controlled environments and have expanded in an uncontrolled way; others have been transferred by ballast water or channels and have become pests in nature by competing with other wild species.

In general, only a few introduced species survive in their new environment and eventually get naturalised without creating any problems. However, some are highly successful competitors for space and food and may become a threat to indigenous species or to a whole ecosystem by disrupting the food chain or altering the habitat. Such disruptions may become even more effective as a result of climate change.

While some species populations are increasing, many others are declining, the most vulnerable being species at the top of food chains, such as large carnivores, endemic local species (species found only in one geographical area) with a very limited distribution, species with chronically small populations, migratory species, and specialist species.

Several species that were considered threatened by extinction, such as the beaver, the otter, vultures and many raptors, are now showing stable or even positive trends in certain parts of their distribution, as a result of protection and restoration measures.

Box 2.1 Genetically modified organisms (GMOs)

The use of genetically modified organisms (GMOs) in the food production chain is one of the many applications of modern biotechnology. GMOs are plants, animals and micro-organisms (bacteria, viruses, etc.), the genetic characteristics of which have been modified artificially in order to give them a new property, useful to humans. They may also pose threats to their naturally-occurring relatives.

The local genetic stock or gene pool of a given wild species may face extinction by mixing with the genes of their commercial relatives or GMOs, when these are introduced into nature or escape from controlled environments. The same danger is faced by varieties and races of cultivated plants and animals.

The recovery of threatened species and their long-term survival can only be achieved through the effective removal of threats and the restoration of the composition, structure and functions of their natural habitats.

Facts and figures on species trends:

- 42 % of European mammals are threatened at the global level, including the Iberian Lynx and the Mediterranean Monk Seal, both with very few individuals left (IUCN, 2004b; ETC/BD, 2005);
- 43 % of the European avifauna has an unfavourable conservation status in Europe (Birdlife, 2004);
- most fish stocks of commercial importance in European waters appear to be outside safe biological limits (EEA-ETC/Water);
- 12 % of the 576 butterfly species resident in Europe are very rare or declining seriously on the continent (Van Sway, 1999);
- up to 600 European plant species are considered by International Union for Conservation of Nature to be extinct, extinct in the wild or critically rare. Of these, only half are cultivated in botanical gardens which ensure *ex situ* conservation (Buord, Lesouef and Richard in press);
- 26.8 % of the world's domestic mammalian breeds and 57.6 % of poultry breeds currently at risk of extinction occur in Europe;
- 22 % of the 2 238 European breeds registered by FAO have approached a critical population size, 34 % are classified as endangered and 44 % are considered not to be at risk of being lost (FAO, 2000).

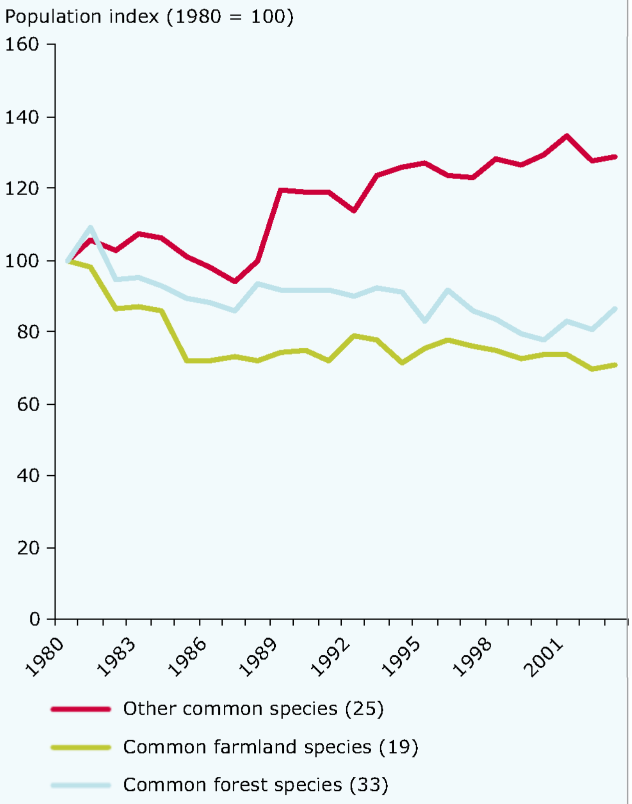
What we have been able to measure as trends of species seems to have resulted from the long-term changes in land-use and resource management practices introduced in Europe during the past century. These changes are not homogeneous in space or time and introduce a degree of uncertainty for the future. Climate change impacts are likely to be a main driver of biodiversity change in the near future, exceeding other impacts from habitat destruction, pollution and over-harvesting (EEA, 2004). The use of genetically modified organisms (GMOs) has expanded, but their impact has not so far been adequately assessed.

Box 2.2 Common European birds tell us what is happening in the wider countryside

Common birds are good environmental indicators of what is happening in the wider countryside. A pan-European monitoring scheme has been set up by the European Bird Census Council, the Royal Society for the Protection of Birds, BirdLife International and Statistics Netherlands. The results show a mixed picture of how the environment around us is changing. Over the past twenty-five years, the indicator shows that on average common farmland birds have declined sharply in number and common forest birds have declined moderately. In contrast, common generalist birds have increased. Evidence from other sources has shown that changing agricultural methods, especially increased specialisation and intensification, has driven the decline in farmland birds. With expected large-scale land abandonment in marginal agricultural lands, it is likely that other birds species linked to extensive agricultural practices will decline. The factors causing the decline of forest birds are less well known, as are the reasons for population increases in some species.

Overall, these results confirm earlier studies by showing that while some generalist species have responded positively to human-induced change in the environment, many specialist species have responded negatively. This is a process know as 'biotic homogenisation'.

Figure 2.2 Trends in common bird species populations in EU countries since 1980



Source: EBCC/RSPB/Birdlife/Statistics, the Netherlands.

2.3 Land-cover changes between 1990 and 2000 in Europe

Land use in Europe continues to change, but not on the scale of recent decades. Recent analyses by the European Environment Agency (Weber and Hazeu, 2005) show that land is becoming a scarcer resource: 800 000 ha of Europe's land cover was converted to artificial surfaces between 1990 and 2000, taking over agricultural and natural areas, in particular wetlands (see Figure 2.4 and Figure 2.5).

Most of the population of Europe now lives in urban areas. Urban development, while continuing around large towns, is extending in a scattered way all over the countryside (Figure 2.6). Urbanisation of the coasts continues to accelerate, as a consequence of mass tourism as well as the increase in the number of second homes.

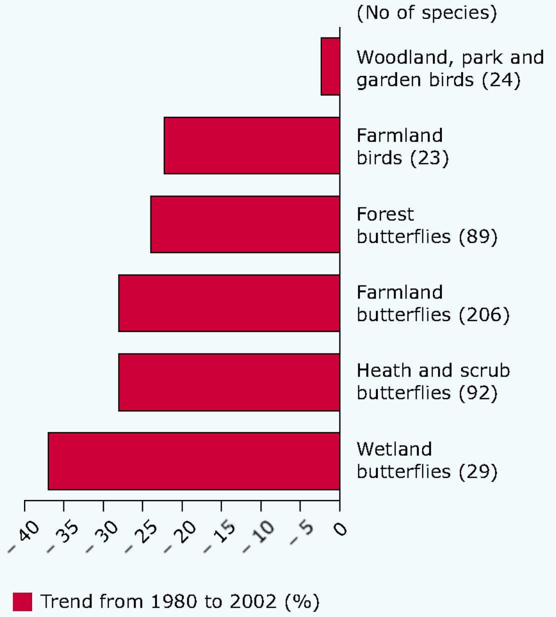
Agricultural land patterns and their functions in the countryside have been evolving in order to ensure that cities are fed and rural populations maintained. Pastures and semi-natural grasslands continue to be converted to arable land, with subsequent use of fertilisers and pesticides as well as destruction of hedgerows, walls, lanes and ponds that have historically supplied niches for a wide range of species.

On the other hand, farmland abandonment is occurring in many regions as a result of socio-economic marginalisation and the ageing of local populations. On the European scale, farmland abandonment is exceeding the formation of new agricultural land. Although abandonment of previously intensively-managed fields or forests may benefit biodiversity locally, the impacts when they occur on a large scale are generally negative. The most vulnerable areas are those where farming is small-scale or extensive, i.e. with low use of fertiliser, pesticides and concentrated feedstuff (as in the south of Portugal and large parts of Italy and Spain). Intensification of agriculture and farmland abandonment may be two faces of the same coin,

Box 2.3 Trends in species diversity

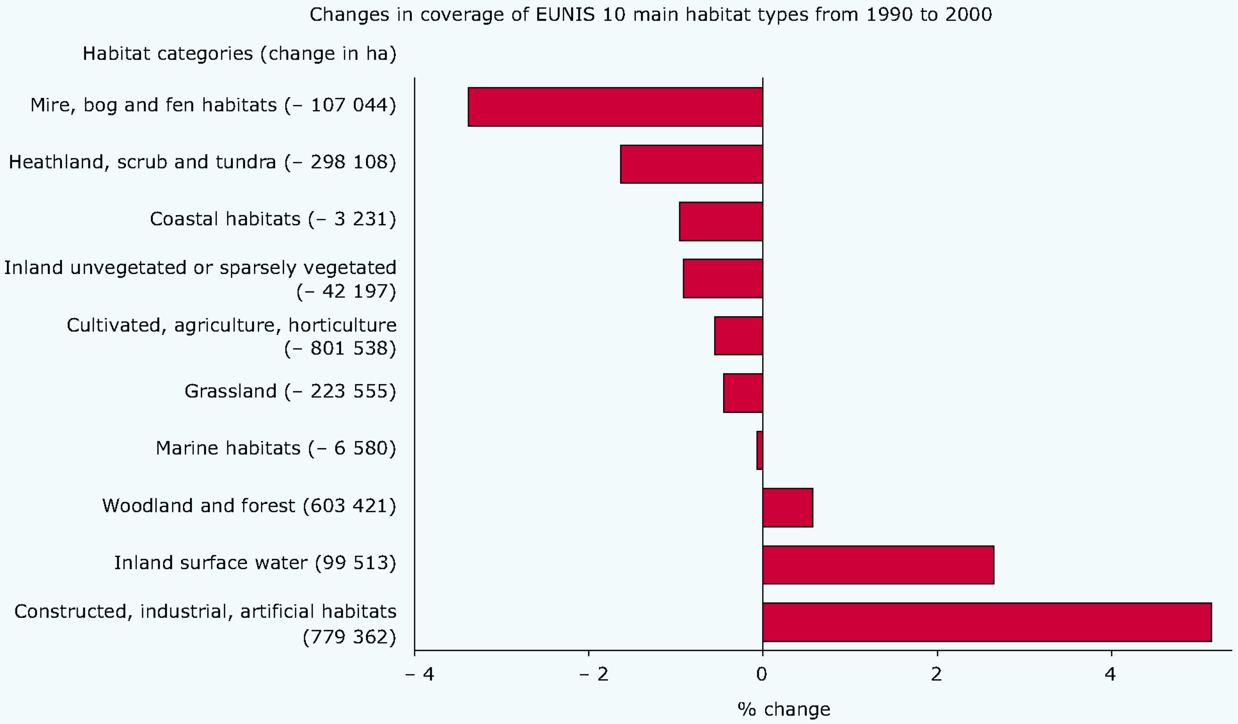
Butterfly and bird species occurring in different habitat types across Europe show population declines of between 2 % and 37 % since the early 1970s. Similar trends can be observed in the land-cover change for related habitats between 1990 and 2000, especially for heaths and scrubs as well as mires, bogs and fens, which are specific wetland habitats.

Figure 2.3 Trends in birds and butterfly populations in EU-25 (% decline) (Version 1.00)



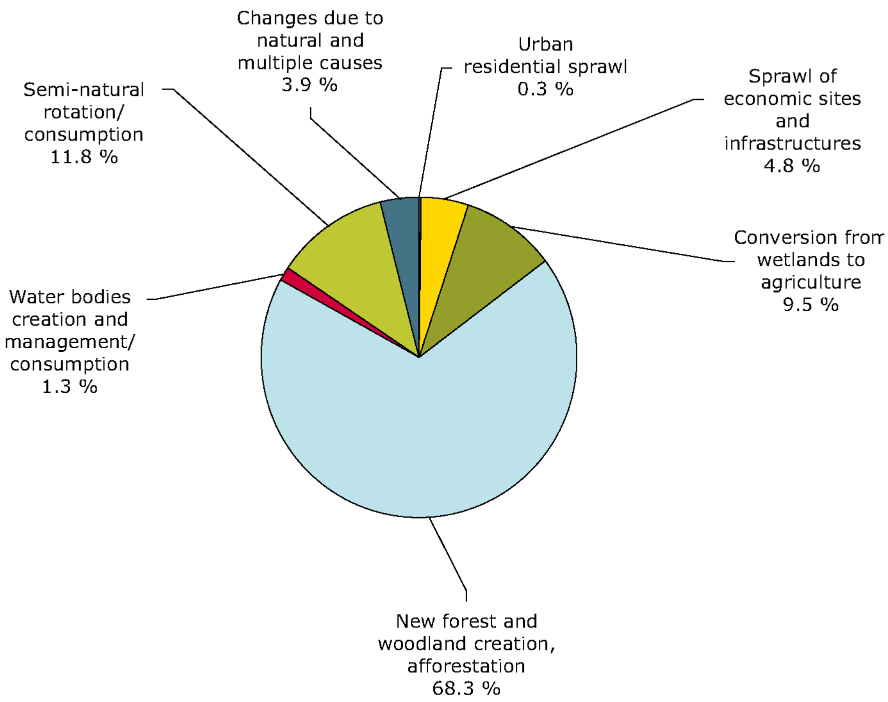
Source: EEA core set of indicators — CSI 09, May 2005.

Figure 2.4 Land cover change from 1990 to 2000 expressed as % of the 1990 level, aggregated into EUNIS habitat level 1 categories (Version 1.00)



Source: EEA core set of indicators — CSI 08, May 2005.

Figure 2.5 Wetland habitat consumption by other land-cover categories (from 1990–2000)



Sources: EEA Corine land cover 1990–2000 (23 countries).

with both often occurring simultaneously in the same region (Figure 2.7).

Overall, forest area in Europe has been increasing over recent decades, largely through afforestation of agricultural land as part of the set-aside strategy of the EU common agricultural policy (Van Brusselen *et al.*, 2005) but also as a result of natural vegetation dynamics in regions where land is being abandoned. However, depending on the type of management, such increase in forest quantity does not ensure an increase in the quality of habitats for biodiversity.

Transport infrastructures fragment ecosystems in physical terms, and their traffic generates noise and pollution. The fragmentation results in small-scale land conversion and piecemeal encroachment.

Dams on rivers, for electricity production, water abstraction and flood control, block the circulation of species, in particular migratory fish, and block the flows of sediments that restore beaches, thereby resulting in coastal erosion. There are only limited provisions available for mitigating these barrier effects.

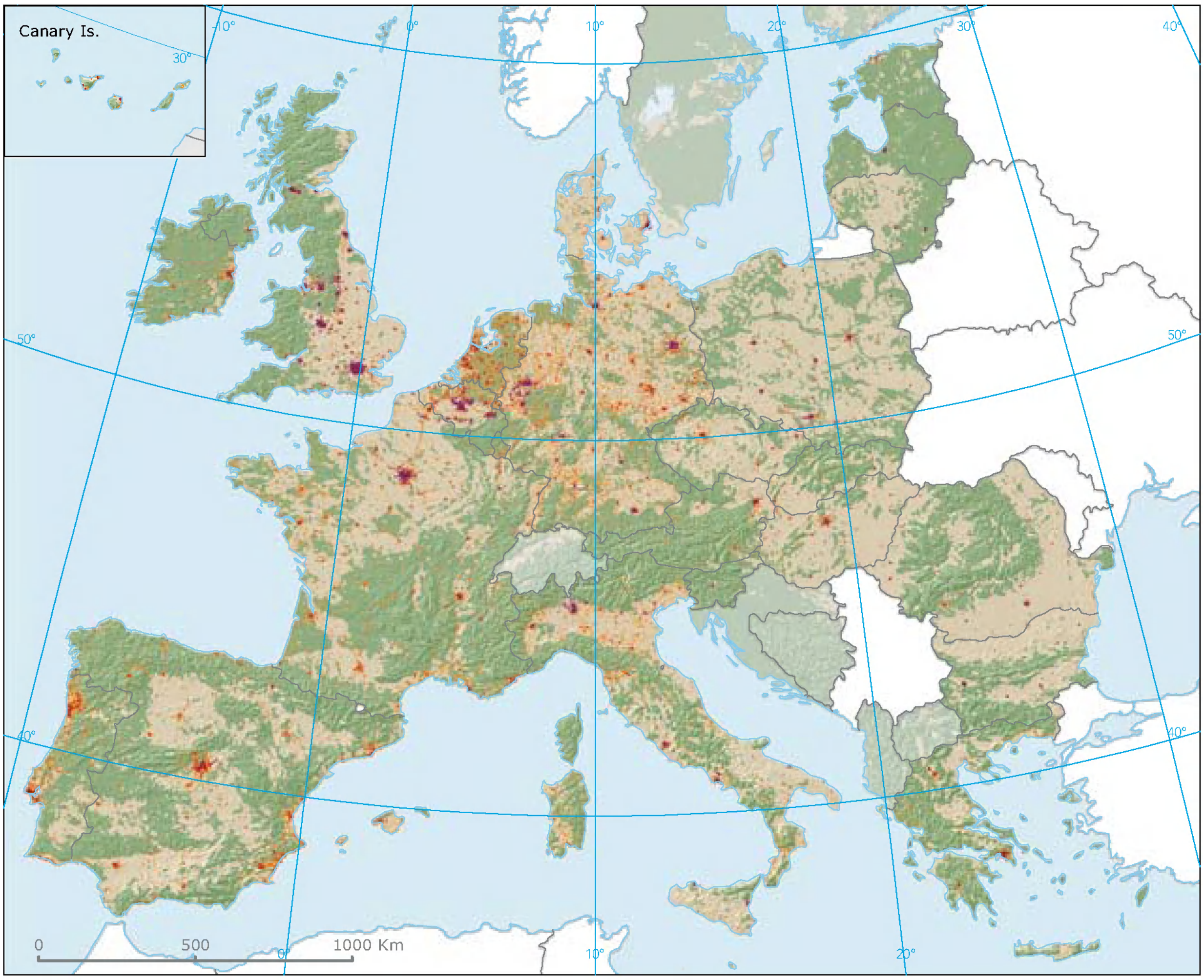
As result of all these changes, most protected areas are near to or influenced by infrastructures. It will be increasingly difficult to designate new areas for protection which are not influenced by transport infrastructure, urbanisation or tourism.

In our modified landscapes, the habitats and the connectivity between habitats where wild-living species can survive is steadily decreasing and becoming more and more fragmented, making viable species populations more difficult. Equally worrying, the regional identity of European landscapes as a testimony of a combined natural and cultural heritage is at risk (Council of Europe, 2001; 2002)

2.4 Nature conservation in the EU

Nature conservation policies remain a key instrument for achieving the goal of halting biodiversity loss by 2010. In addition to national nature conservation policies, European countries have made international commitments to protect nature through signing up of the following conventions: Ramsar Convention on the Conservation of Wetlands (1971); Helsinki Convention on the Baltic Sea (1974); Barcelona Convention on the Mediterranean (1976); Bonn Convention on Migratory Species (1979); Bern Convention on European Wildlife and Natural Habitats (1979); Convention on the Protection of the Alps (1991).

Figure 2.6 Extension of urban sprawl between 1990 and 2000



Urban and infrastructure development
- 1 to 5 %
- 5 to 10 %
- More than 10 %

Urban zones 1990
- > 50 000 people

Green background index (%)
- 0–60
- 61–100

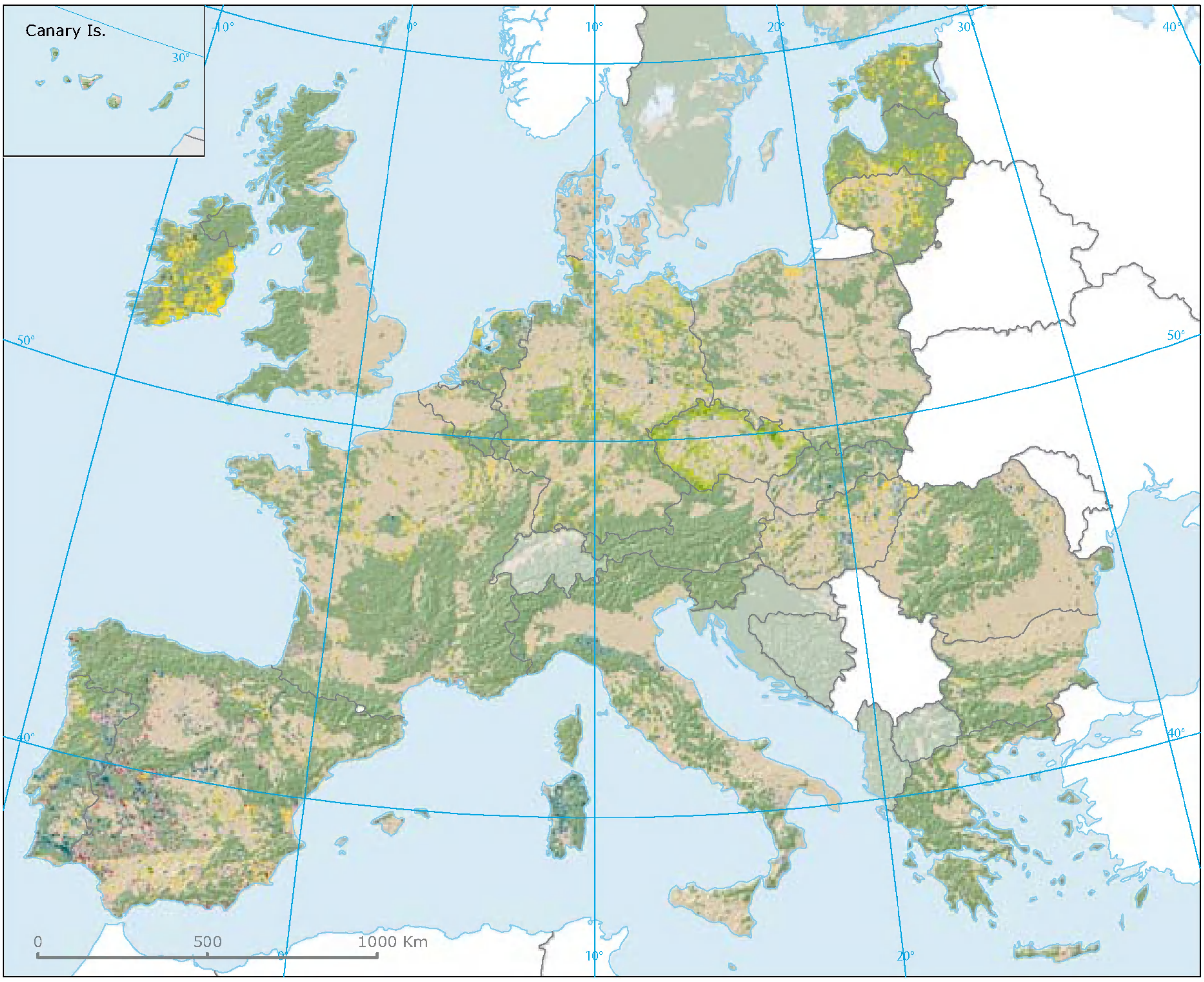
Source: EEA, 2005.

At the EU level, policy on nature conservation is essentially made up of Directive 79/409/EEC on the protection of wild birds (known as the 'birds directive') and Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora (known as the 'habitats directive'). Together, they establish a legislative framework for protecting and conserving the EU's wildlife and habitats.

Both directives are a contribution of the European Community to some of the international conventions listed above. They are also a key component of the Biodiversity Action Plan on Nature Resources (2001), in support of the EC Biodiversity Strategy (1999), currently under review (see Section 1.2)

At the centre of the birds and habitats directives is the creation of a coherent ecological network of designated areas across the EU — known as Natura2000 (see Figure 2.9). Its purpose is to maintain or restore the habitats and species of European concern at a favourable conservation status in their natural range. The network is made up of:

Figure 2.7 Conversion processes in farmland in selected European countries between 1990 and 2000



Net conversion of pasture to crop land

- Net increase of set aside/fallow land > 30 %
- Net increase of set aside/fallow land 5 % to 30 %
- Net conversion of pasture to arable 5 % to 30 %
- Net conversion of pasture to arable > 30 %

Withdrawal of farming (total)

- 2 % to 10 %
- More than 10 %

Conversion of land to agriculture

- 2 % to 10 %
- More than 10 %

Green background index (%)

- 0–60
- 61–100

Source: EEA, 2005.

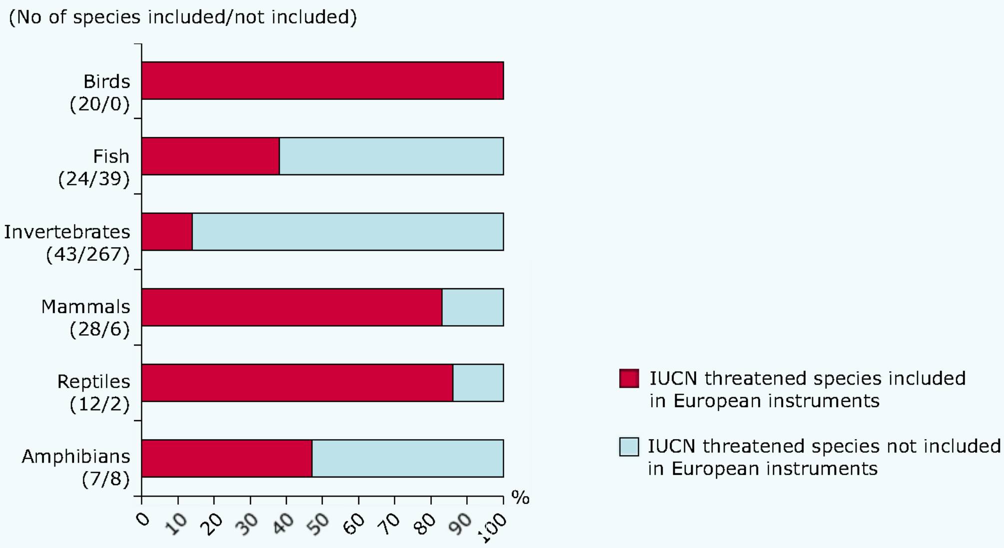
- 'Special protection areas (SPAs) to conserve the 194 bird species and sub-species listed in Annex I of the birds directive as well as migratory birds;
- 'Sites of Community interest (SCIs) which will consequently be designated as 'Special areas of conservation (SACs) to conserve the 273 habitat types, 200 animal and 724 plant species listed under the habitats directive.

The birds directive provides a general protection regime for all wild bird species and a set of provisions for protecting and managing special protection areas (SPAs). Member States classify SPA sites for conservation of the bird species and sub-species listed in Annex I as well as for all other migratory species not listed in Annex I. In February 2005, 4 169 SPAs, covering near 382 000 km^2 had been classified in the EU-25 of which 325 000 km^2

Box 2.4 Threatened and protected species

Some, but not all, of the globally endangered species of wild fauna occurring in Europe in 2004 are currently under European protection. The responsibility of the EU towards the global community for the conservation of these listed species is high (Figure 2.8).

Figure 2.8 Percentage of inclusion of globally threatened species occurring in EU-25 in protected species lists of EU directives and the Bern Convention (Version. 1.00)



Source: EEA 2005, Assessment of core set of indicators — CSI 07.

are terrestrial (approximately 8 % of the total EU-25 land area) and 56 000 km^2 marine area, Figure 2.10.

Although no agreed indicator to demonstrate the sufficiency of SPA designation by Member States is yet available, it is obvious that some countries are still failing to complete the network, Figure 2.11.

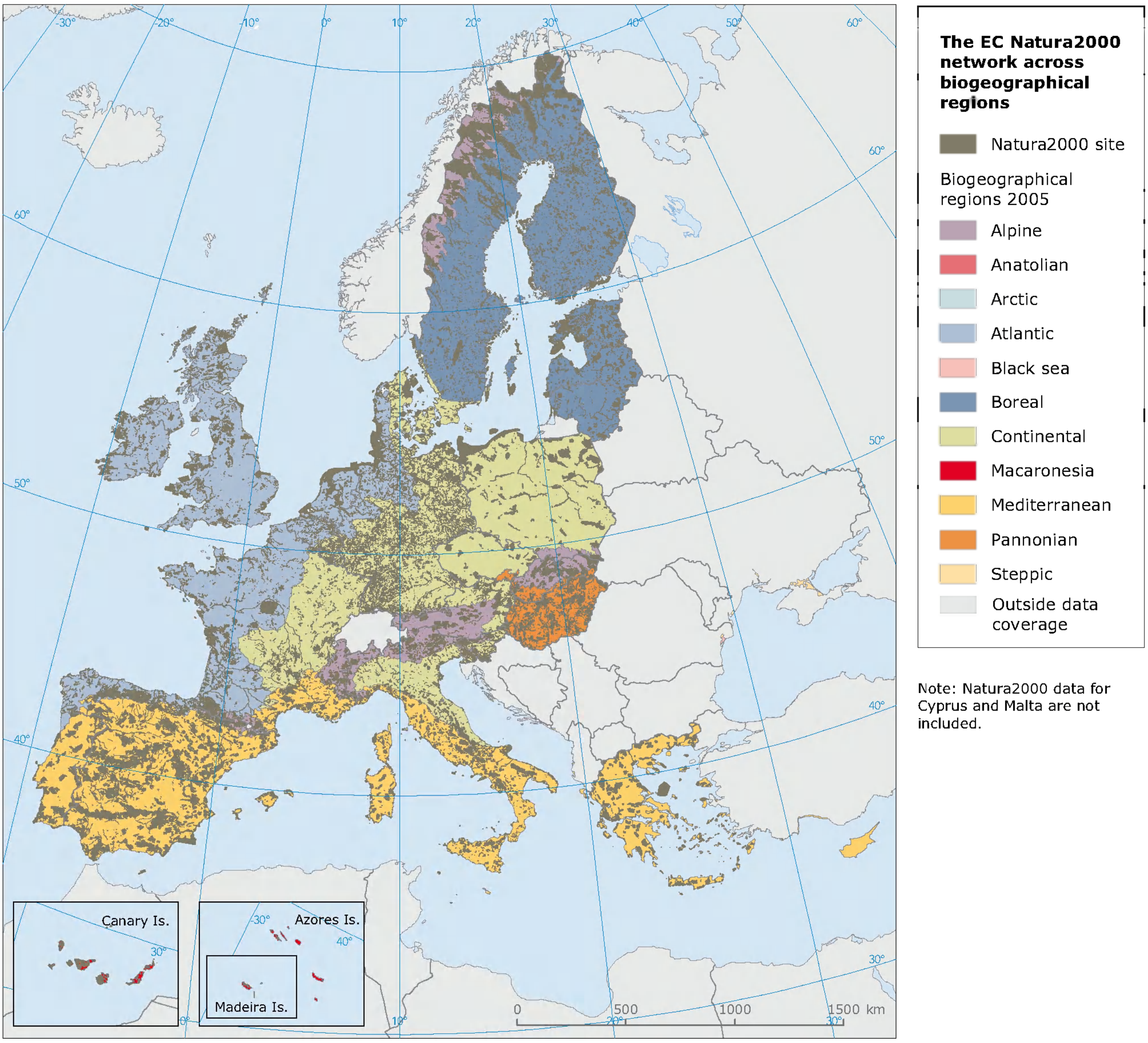
The habitats directive provides for the conservation of selected species and habitat types in the whole territory of Member States and within the Natura2000 sites. It includes procedures for preventing ecological damage to the species and habitats concerned, providing financial support to countries, and assessing and reporting on the effectiveness of the implementation.

The identification of sites for the Natura2000 network is based on the biogeographical regions of Europe, Figure 2.12. Establishment of the lists of sites in each of these regions is a 3-stage process: Phase 1 — proposals of national lists (proposed sites of Community interest), Phase 2 — establishment of Community lists (sites of Community interest), Phase 3 — enforcement of appropriate measures in the formally classified special areas for conservation (SACs).

The component of Natura2000 site selection on the basis of the habitats directive has been substantially delayed and Phase 2 is still under development in the old EU-15 Member States. On 31 December 2004, the completion of the network had been fulfilled for four out of the six biogeographic regions. The four Community lists of sites of Community importance (SCIs) have been finalised as follows:

- Macaronesian list of SCIs: 208 individual sites with an area of 3 487 km^2 of land and 1 848 km^2 of marine area. This represents 34 % of the total land area of these Atlantic islands;
- Alpine list of SCIs: 959 sites proposed by the seven Alpine Member States, covering about 37 % of the Alpine region and about 3 % of the EU territory (the Alpine region includes the Alps, the Pyrenees, the Apennines, the Fennoscandian mountains as well as the Carpathians);
- Atlantic list of SCIs: 2 419 sites proposed by the nine Atlantic Member States, covering about 8 %

Figure 2.9 The EU Natura2000 network of designated areas (both SPAs and SCIs) across biogeographic regions



Note: Natura2000 data for Cyprus and Malta are not included.

Source: EEA-ETC/Biological Diversity, Natura2000 database, 2005.
Note: Natura2000 data for Cyprus and Malta are not included.

of the total land area of the Atlantic region and 3 % of the EU territory. 28 585 km^2 are marine areas;

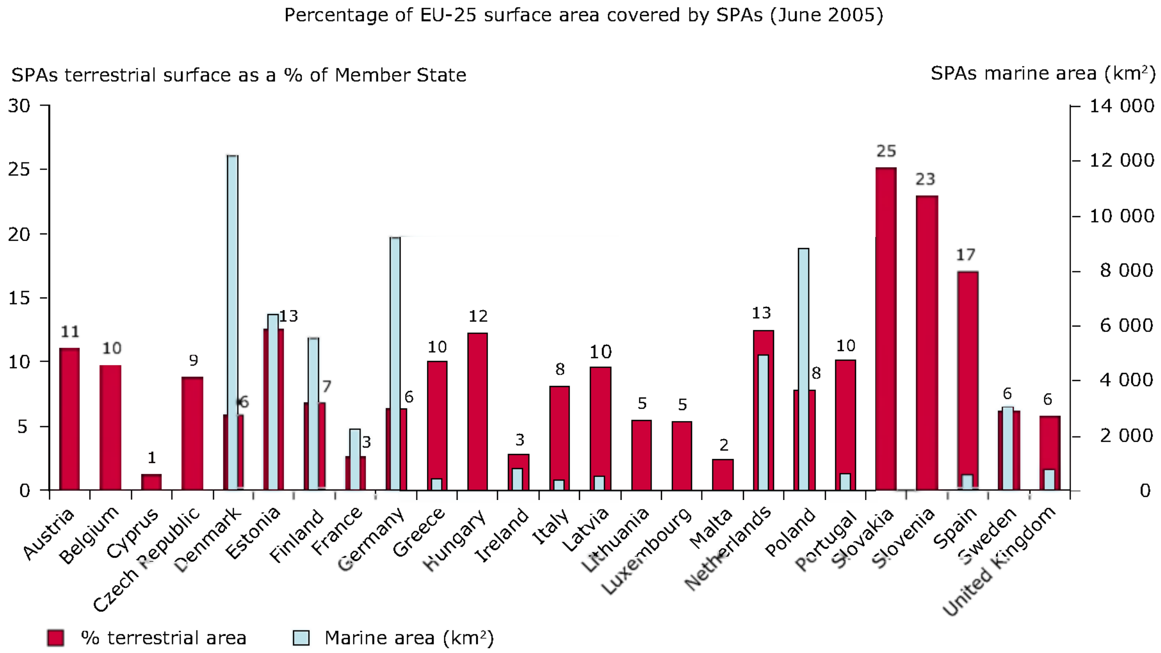
- Continental list of SCIs: 4 958 sites proposed by the eight Continental Member States, covering about 6 % of the total land area of the Continental region and 2 % of the EU territory. 8 356 km^2 are marine areas.

Progress in the sufficiency of Member State proposals for the EU-15 is shown in Figure 2.12. It is noted that only two countries have achieved full sufficiency.

The overall situation of site proposals for the EU-25 is shown in Figure 2.13. This brings the total to 19 516 sites, covering nearly 523 000 km^2 proposed as sites of Community importance for the whole EU-25, of which 458 000 km^2 are terrestrial (almost 14 % of the total EU-25 land area) and 65 000 km^2 marine area.

Figures 2.14 and 2.15 demonstrate the extent to which nationally-designated sites that already exist fulfil the criteria of the European directives. They also provide a snapshot of the significance of

Figure 2.10 Special protection areas established under the EU birds directive (EU-25)



Source: EEA-ETC/Biological Diversity, Natura2000 database, 2005.

the contribution of European legislation to *in situ* conservation in Europe.

The coherence of the Natura2000 network is important in order to achieve or maintain favourable conservation status of species and habitats in the face of climate change, including the promotion of cross-border ecological corridors between the EU and neighbouring states.

2.5 Biodiversity integration in sectoral policies

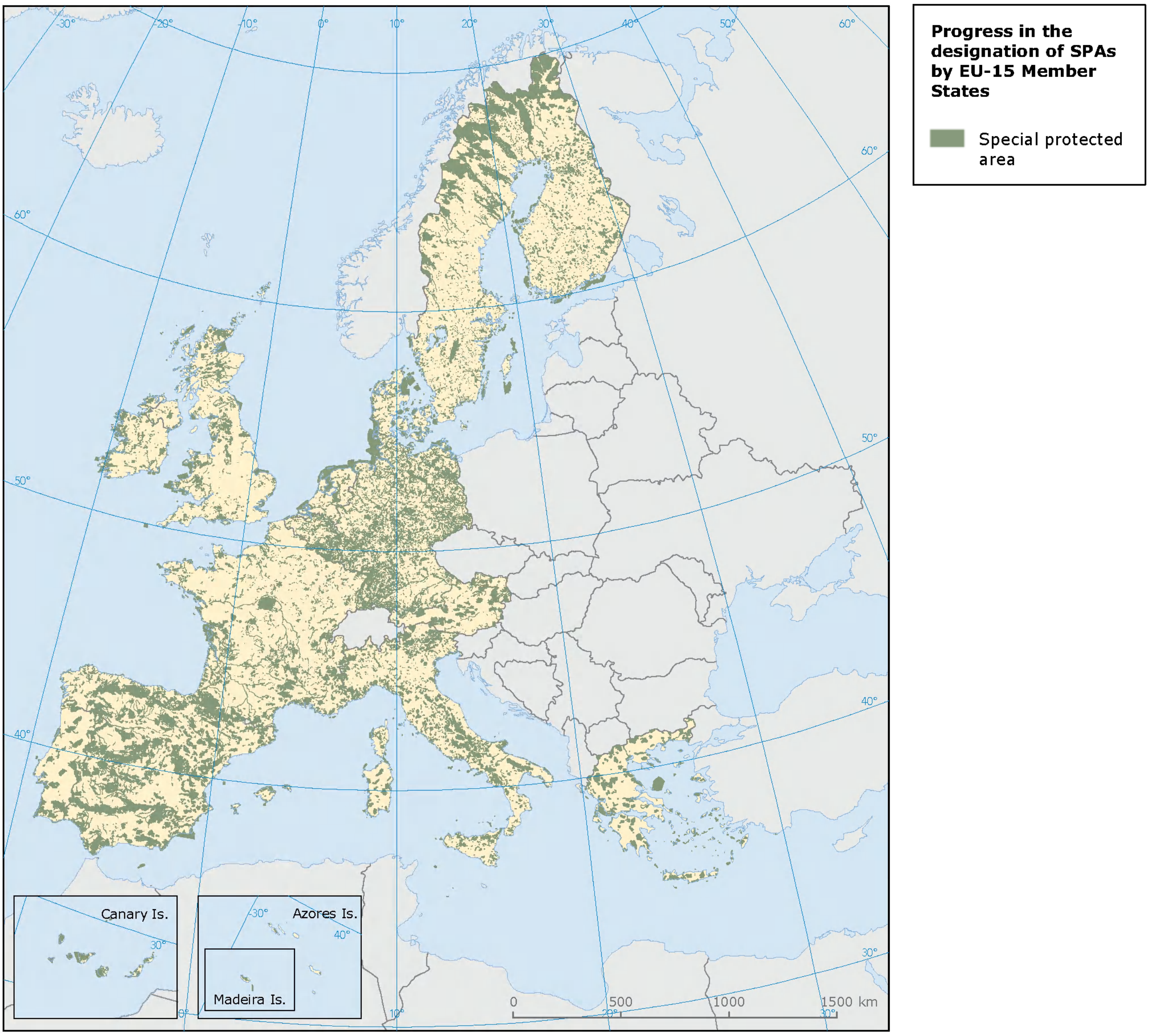
The challenge of the 2010 target requires integration of biodiversity concerns into sectoral policies, an approach that builds on designated areas and the wider countryside and landscapes. This is the approach that the EU has taken for the implementation of the Convention on Biological Diversity (CBD).

The generally low rate of implementation of both the strategy and the action plans in Member States, and the continuous loss of natural habitat outside protected areas were discussed during the review of the EU Biodiversity Strategy in 2004. The 'Final Message from Malahide' presented 18 priority objectives for halting the loss of biodiversity, many of which express the need for sector considerations and integration of biodiversity issues in other policies, see Table 2.2.

There are various existing EU instruments and policies to be used in order to achieve these objectives in the field of EU responsibility as well in the shared responsibility between the EU and the Member States. Integrating sectoral biodiversity concerns for energy, industry, transport, tourism and recreation, health, education and defence remains very much in the hands of the countries. An analysis of policy responses has yet to be undertaken.

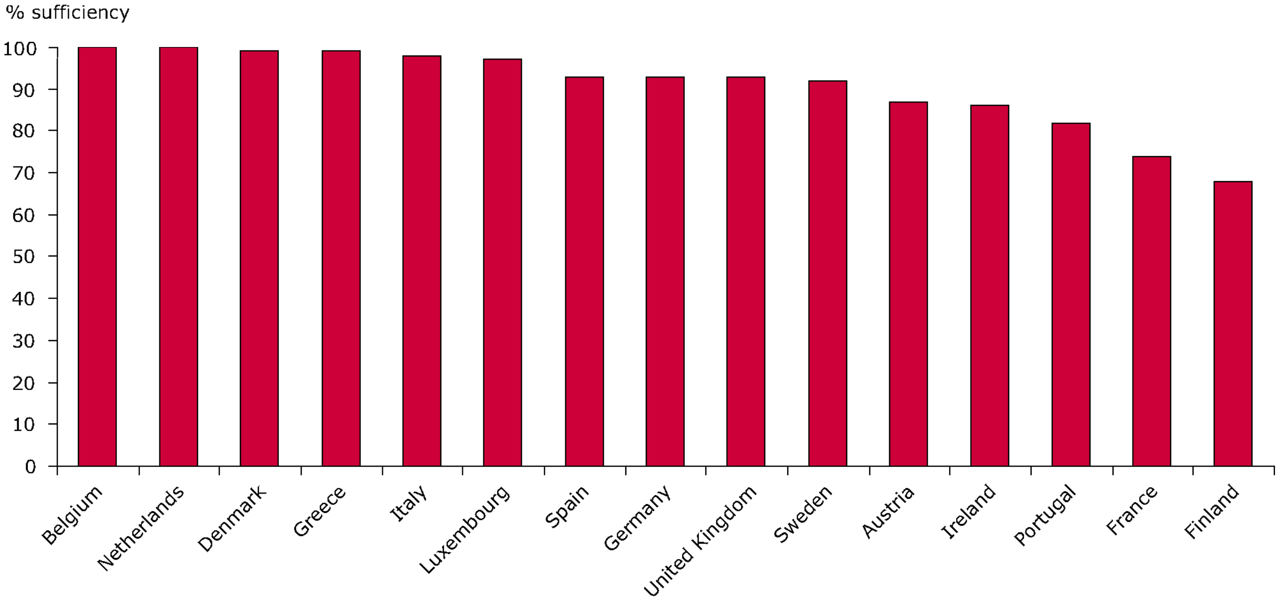
The broad objectives, set at the Community level, to protect nature and manage natural resources according to principles of sustainability could benefit from getting closer to local practice. In part, this points to opportunities to improve the coherence of governance between different levels of administration in countries and at the EU level. Subsidies that encourage landowners to undermine ecological goods and services remain, although recent reforms to the common agricultural policy point the way forward. Most importantly, the external costs to biodiversity have not yet been fully internalised in the sectors that have most impact.

Figure 2.11 Progress in the designation of SPAs by EU-15 Member States (November 2004)



Source: EEA, 2004.

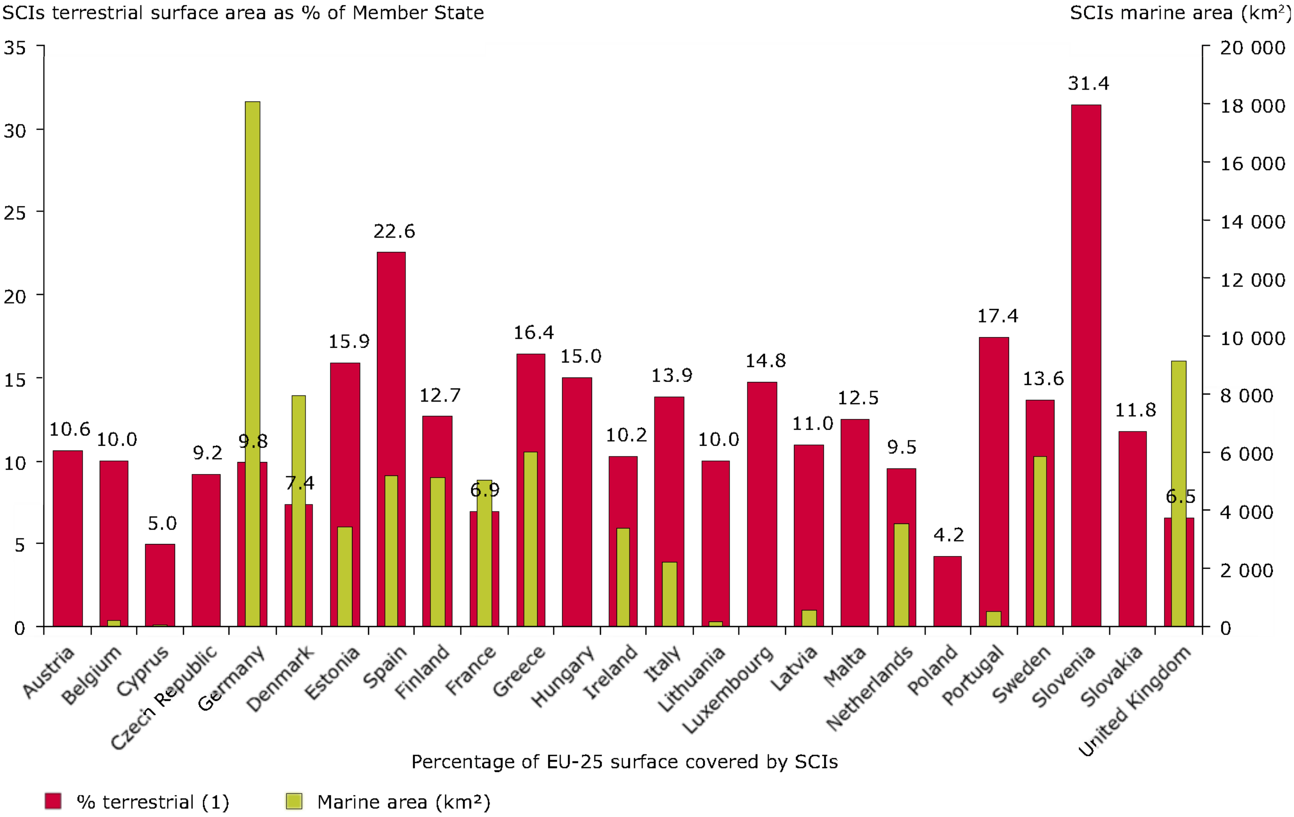
Figure 2.12 EU habitats directive: sufficiency of Member State proposals for designated sites (EU-15, September 2004)



Note: Bars show the degree to which Member States have proposed sites that are considered sufficient to protect the habitats and species mentioned in habitats directive Annex I and II (situation of December 2005). Marine species and habitats are not considered.

Source: EEA-ETC/Biological Diversity, Natura2000 database.

Figure 2.13 Proposed sites of Community importance according to the habitats directive (EU-25)



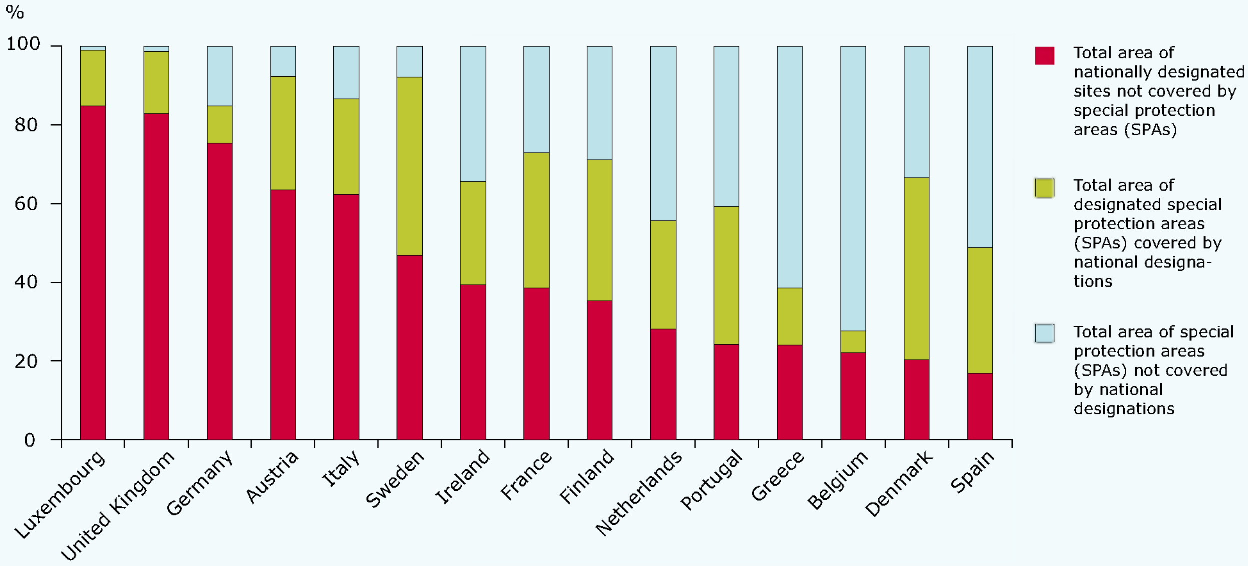
Note: pSCIs on land as percentage of country area and in marine as absolute area.

Source: EEA-ETC/Biological Diversity, Natura2000 database, 2005.

Box 2.5 Designated areas

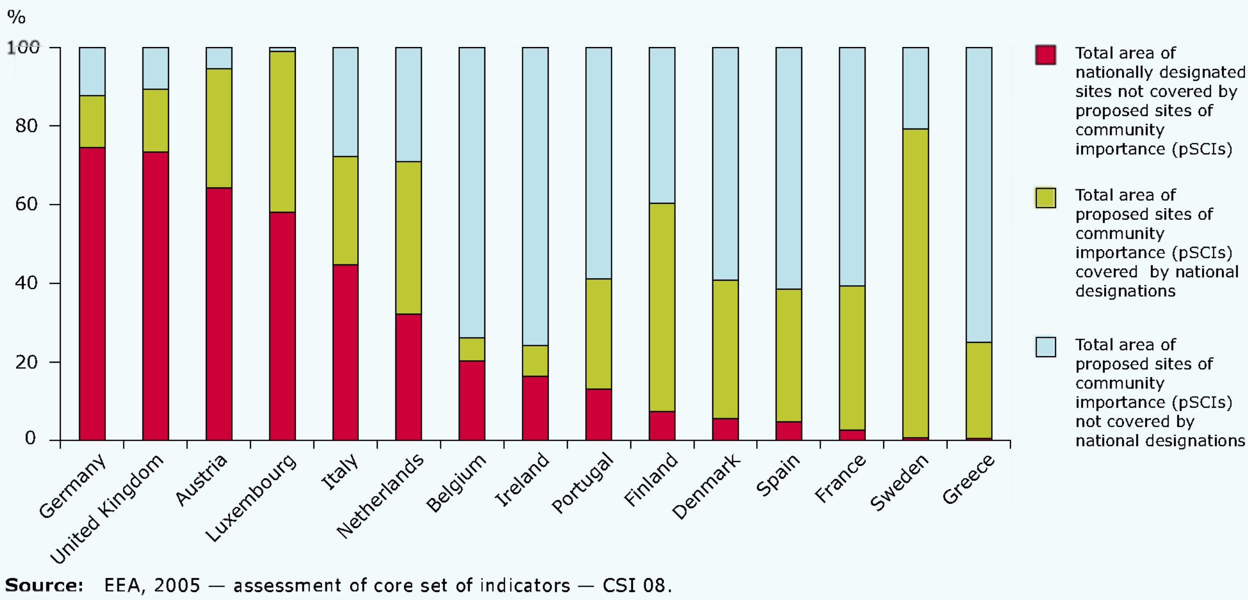
In situ conservation of species, habitats, and ecosystems entails the establishment of protected areas. Good signs of commitment to the conservation of biodiversity by European countries are shown by the increase in the total surface cover of nationally-designated areas over time. There has also been an increase in the cumulative area of sites comprising the European Natura2000 network during the past ten years. The level of sufficiency in designating Natura2000 sites for the habitats directive is high for almost all EU-15 countries. Some of the Natura2000 sites include areas that have not already been designated under national laws, thus contributing to a direct increase in the total area designated for in situ conservation of biodiversity components in Europe.

Figure 2.14 Proportion of total surface area designated under the birds directive, protected only by national instruments and covered by both (special protection areas — SPAs) (Version 1.00)



Source: EEA, 2005 — assessment of core set of indicators — CSI 08.

Figure 2.15 Proportion of total surface area designated only for the habitats directive, protected only by national instruments, and covered by both (sites of Community importance — SCIs) (Version 1.00)



Source: EEA, 2005 — assessment of core set of indicators — CSI 08.

Table 2.2 Sectors and objectives considered by the Malahide stakeholder conference

Main area		Priority objective	
Sector 1:	Conservation and sustainable use of natural resources	Objective 1:	To ensure conservation of Europe's most important wildlife habitats and species within a thriving wider environment.
		Objective 2:	To ensure that biodiversity concerns are fully recognised in the conception and implementation of community legislation and instruments in both environment and other sectors.
		Objective 3:	To develop and implement measures for the prevention and control of invasive alien species and alien genotypes.
		Objective 4:	To prevent or minimise the negative impacts on biodiversity and optimise opportunities to benefit biodiversity, in relation to climate change adaptation and mitigation.
Sector 2:	Agriculture	Objective 5:	To further integrate biodiversity issues into the common agricultural policy in order that the agricultural sector can fulfil its contribution to the 2010 biodiversity target
Sector 3:	Forestry	Objective 6:	To conserve and enhance biodiversity through sustainable forest management at national, regional and global levels.
Sector 4:	Fisheries	Objective 7:	To further promote conservation and sustainable use of commercial stocks and to continue to reduce the adverse impacts of fishing and aquaculture on species and habitats, making full use in particular of the CFP instruments.
Sector 5:	Regional policy and spatial planning	Objective 8:	To ensure that cohesion policy and spatial planning support conservation and sustainable use of biodiversity.
Sector 6:	Energy and transport, construction and extractive industries	Objective 9:	To prevent, minimise and mitigate negative impacts on biodiversity of construction, infrastructure and extractive industries, or related to the use of infrastructure.
Sector 7:	Tourism	Objective 10:	To make all tourism sustainable.

Source: Final message of the Stakeholders' Conference Biodiversity and the EU — Sustaining Life, Sustaining Livelihoods, Malahide, Ireland, 25–27 May 2004.

3 Assessing progress in selected ecosystems

This chapter is a first approach to assessing trends and highlighting issues related to halting biodiversity loss in Europe. It uses six specific types of ecosystems as 'gates' in order to assess evidence of progress — or lack of progress — towards the 2010 target in all three components of biodiversity: genes, species and habitat types.

How can measurable targets be set or how can the ecosystem health be assessed? A simple and flexible approach is needed where some knowledge of the 'natural state' of ecosystems, their history and/or 'traditional' land use and their acceptable ecological quality and/or resilience could be used.

The 'natural state' is the way physical and biological processes would operate without direct human intervention. The natural state may be a useful operational baseline, for example the northernmost and/or mountain taiga forest and mire landscape. It may be used for setting measurable targets to some extent but hardly ever fully. It may also be used to measure and understand changes in the extent of several ecosystems and habitats.

Historical or 'traditional' land-use information is the result of the influence of past human practices such as farming, felling, grazing and fishing on ecosystems, species and habitats. A traditional land-use baseline should be related to a defined time-period but this may not always be necessary since the traditional land-use systems have been fairly stable during historical times. In many parts of Europe, traditionally-managed landscapes have long vanished or are now vanishing rapidly and, from a biodiversity point of view, fragmentation of the traditional landscape, and succession habitats, may be very important, but probably only from a short-term perspective.

Acceptable ecological quality and/or resilience baselines are expected to provide information on whether ecosystems, habitats or species can cope with the observed and predicted changes as well as whether it is possible to reverse negative impacts. Such information is definitely needed in heavily-impacted areas — such as regulated rivers, intensively-used agricultural areas, large forest plantations, reclamation areas after mining, and built-up areas. From a wider perspective, managing for ecosystem and landscape quality may be the most appropriate target for a large part of Europe

While setting targets is a political process, it also needs to be based on objective, transparent and comprehensive assessment of biodiversity components and ecosystem services. The design and proposal of indicators for assessing progress in halting the loss of biodiversity is the objective of the SEBI2010 process (see Section 1.3) and the result of this work will be made available in the next two years. At least two assessments of these indicators, one before and one after 2010 will be needed.

3.1 Agricultural ecosystems

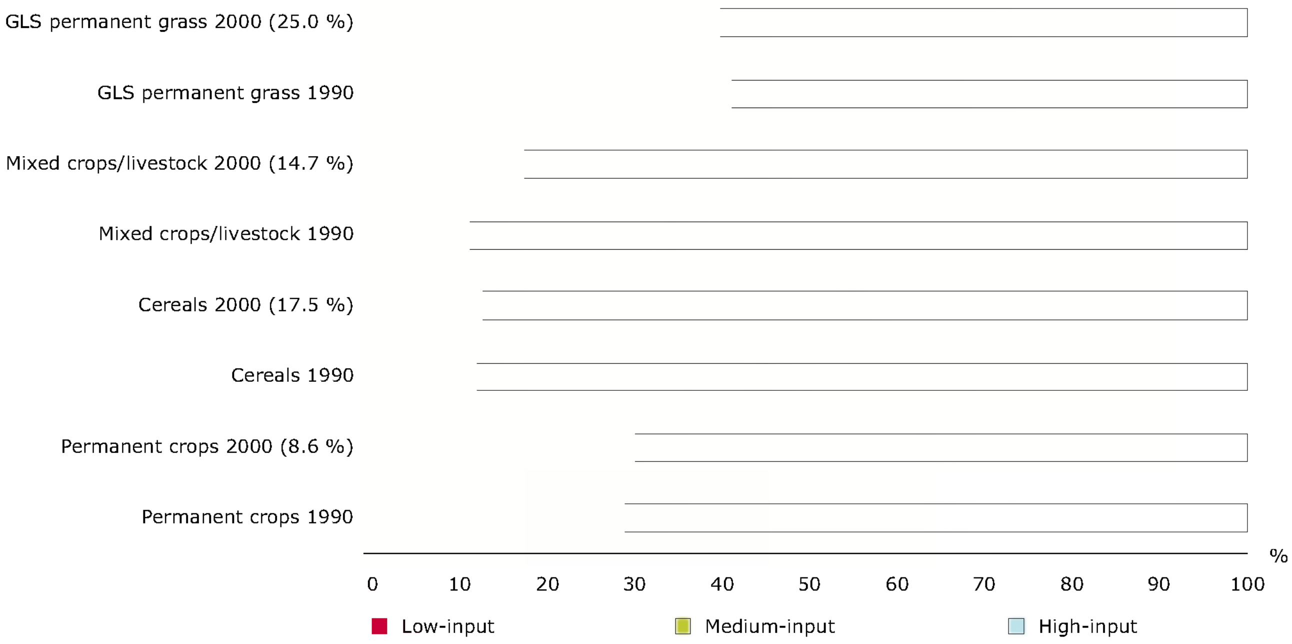
Farmland, including arable land and permanent grassland, is one of the dominant land uses in Europe, covering more than 45 % (180 million ha) of the EU-25.

Varying farming traditions, combined with specific soil and climate conditions, have resulted in diverse and highly characteristic agricultural landscapes. Approximately 50 % of the species occurring in Europe have been estimated as depending on agricultural habitats (Kristensen, 2003). Nevertheless, the loss of biodiversity in these habitats during the past few decades has been high.

Agricultural practices and organisation are still quite diverse at the European level, ranging from large and specialised commercial holdings to part-time farming using mainly traditional practices. The most favourable conditions for farmland species diversity are considered to occur under extensive and/or traditional agricultural management. The major pressures on biodiversity on agricultural land result from changes in the type and intensity of farming (see Figure 3.1) which generate changes in agricultural landscapes. Such changes can result either from intensification or abandonment, both of which can be detrimental to biodiversity, Figure 3.1.

The EU's common agricultural policy (CAP) and associated national agricultural policies initially aimed to increase productivity and provide more food at a lower cost for EU countries, while also

Figure 3.1 Trends in intensity of farming for selected types of farms (derived typology) between 1990 and 2000 in EU-12



Note: The numbers in brackets indicate the area share of each farm type in total utilised agricultural area in 2000.
Source: FADN-DG Agriculture and Rural Development, adaptation LEI.

achieving a fair standard of living for farmers. However, the negative consequences of the intensification of farming were recognised by the 1980s, and in 1985 the CAP experienced changes, with the introduction of agro-environmental support to farmers. In 1998, the Agenda 2000 reform introduced elements of environmental cross-compliance and the opportunity for farmers to obtain support (under the rural development regulation) for activities other than farming itself.

The 'mid-term' review in 2003 placed environmental concerns at the heart of the CAP. Consequently, from 2005 farmers will receive a single farm payment based on their historic level of CAP support, provided they undertake to comply with a suite of EU directives (including the birds and habitats directives) and keep their land in 'good agricultural and environmental condition'. Although a wide suite of measures can be funded under the rural development heading, it is anticipated that this change in the CAP will release funds to encourage more farmers to join agri-environment schemes.

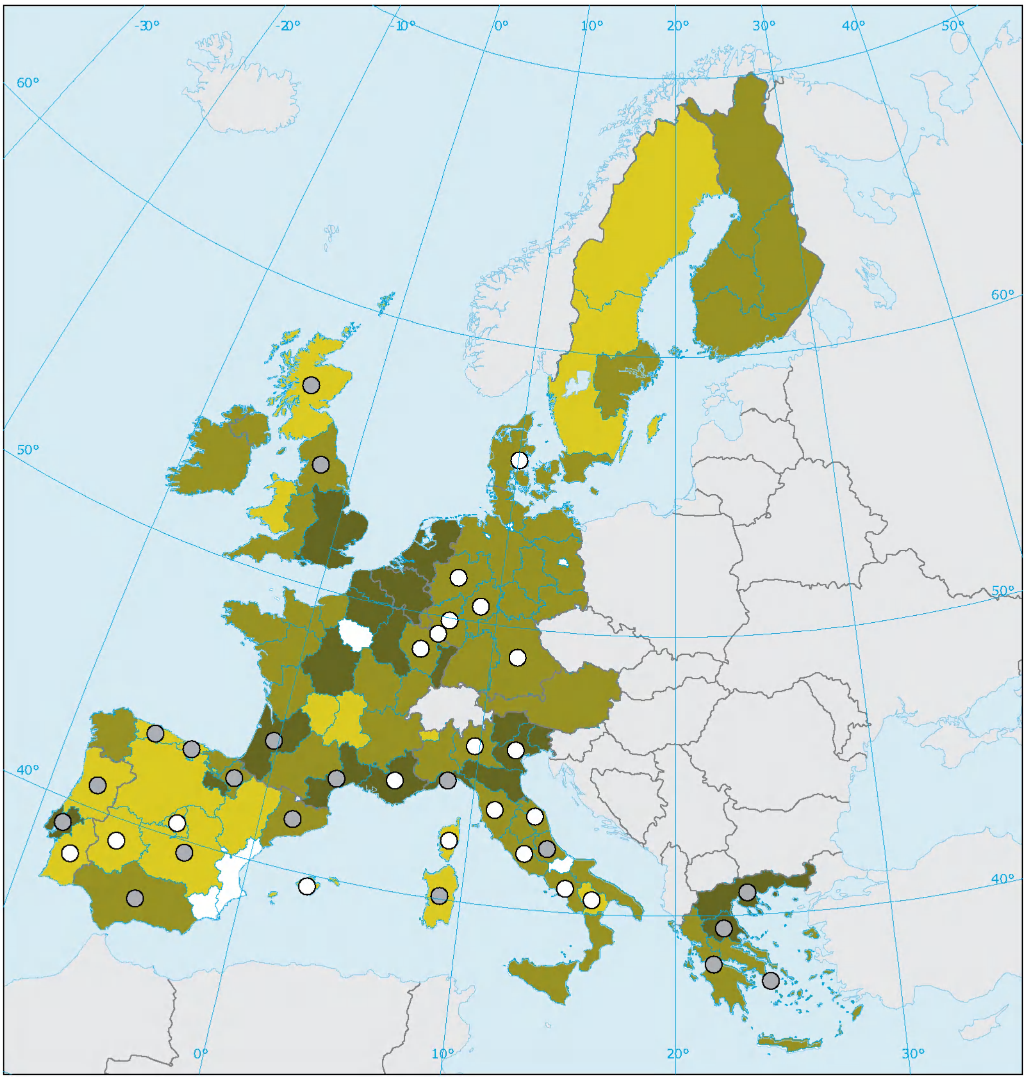
3.1.1 Habitats and areas of high-value nature farmland

Agricultural land-use in the more productive lowland areas of the EU-15 has intensified considerably during recent decades; see Figure 3.2. The mechanisation of agriculture has facilitated the elimination of many landscape features such as hedgerows, the drainage of wetlands and the ploughing of semi-natural grasslands. Species richness and habitat diversity have declined due to increased pesticide and fertiliser use and the simplification of crop rotations.

Improvements in agricultural productivity often result in pressure on natural resources. For example, the increase in the area of irrigated farmland in southern Europe during 1990–2000 has put additional pressure on water resources, see Figure 3.3.

Farm abandonment is a medium-term consequence of the marginalisation of agriculture due to low agricultural profitability, often linked to physical or climatic handicaps and wider socio-economic trends. Although the available data can hide significant intra-regional differences, it appears that marginalisation is occurring in Ireland, the south of

Figure 3.2 Regional importance of low-input, medium-input and high-input farming and the trend 1990–2000



Intensity at the regional level in 2000 and change from 1990–2000

Intensity type

- Low input
- Medium input
- High input

Change 1990–2000

- > 15 % decrease
- > 15 % increase
- No data
- Non EU-15
- HARM1 (*)

(*) HARM1 = Regional division, which gives the opportunity to compare farm structure survey NUTS 2 regions with the Farm Accountancy Data Network regions.

Note: The low-input regions are the 20 regions with the lowest average expenditure on inputs, high-input are the 22 with the highest average expenditure, and medium-input constitute the remainder.
Information on trends in Finland, Sweden, Austria and in the New Bundesländer in Germany is not available.

Source: FADN-DG Agriculture and Rural Development, adaptation LEI.

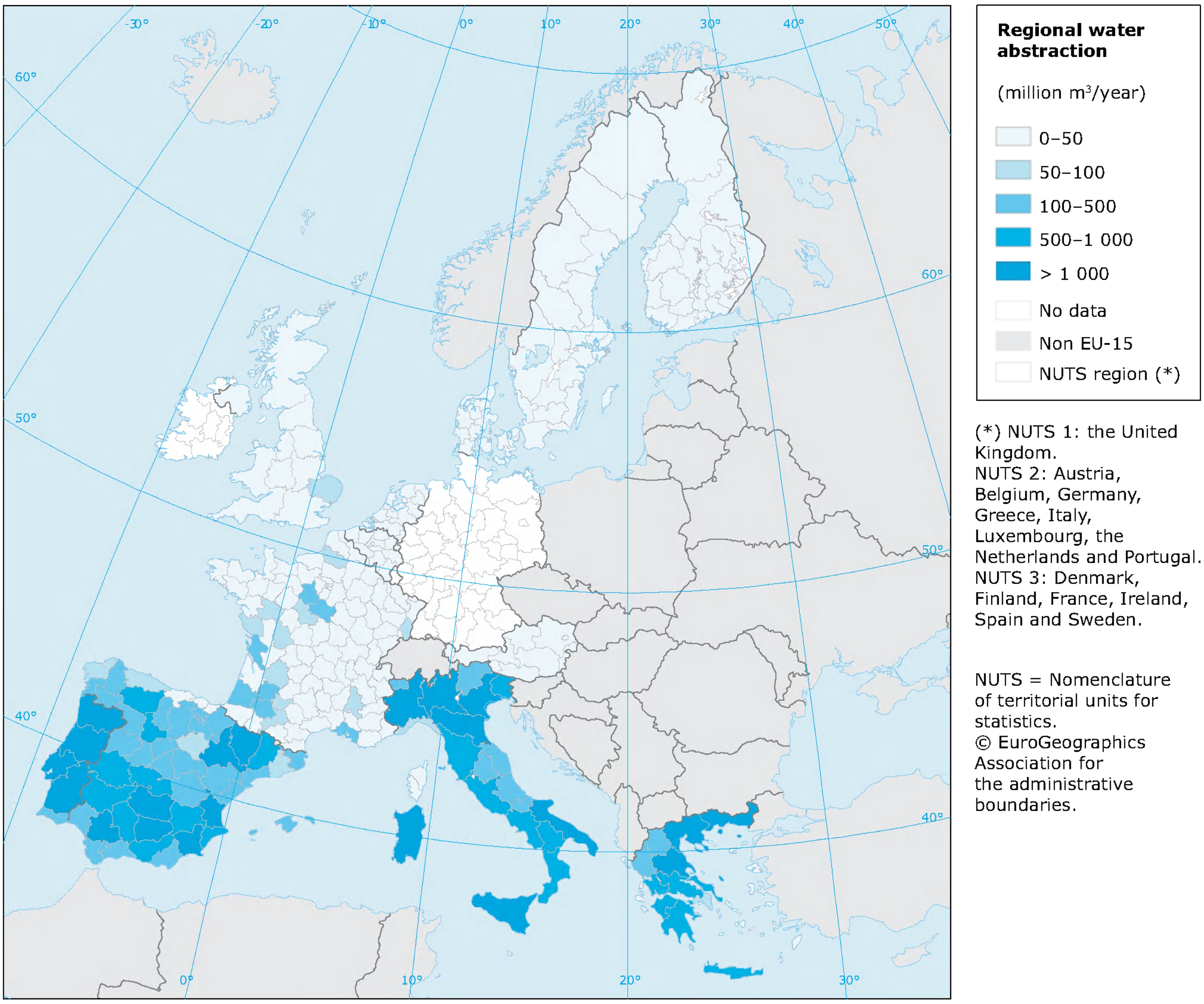
Portugal, Northern Ireland, large parts of Italy, and in parts of Spain and France. A loss of biodiversity and heritage landscapes is almost always associated with farm abandonment.

In between the intensively-managed agricultural land and the abandoned farmland are areas which generally contain more of a patchwork of semi-natural and natural habitats and varied farmland. These areas are subject to a greater range of intensities of management, host a higher diversity of species and have a high nature value (HNV). Such farmland occurs in association with traditional cropping systems in southern Europe as well as with livestock grazing systems on semi-natural habitats

Box 3.1 Many habitats which we now value depend on low-intensity agro-ecosystems

The decline in traditional livestock breeds has negative implications for the management of semi-natural habitats that have been shaped by agricultural practices. Figure 3.5 shows that on average, 18 % of all land in Natura2000 sites belongs to habitat categories which depend on a continuation of extensive agricultural practices. Such practices can be supported via agri-environment schemes and other agricultural policy instruments.

Figure 3.3 Regional water abstraction rates for agriculture (million m³/year) during 2000



(*) NUTS 1: the United Kingdom.
NUTS 2: Austria, Belgium, Germany, Greece, Italy, Luxembourg, the Netherlands and Portugal.
NUTS 3: Denmark, Finland, France, Ireland, Spain and Sweden.

NUTS = Nomenclature of territorial units for statistics.
© EuroGeographics Association for the administrative boundaries.

Note: United Kingdom estimates are based on 1997 data for irrigable area and reported water abstraction rates. Ireland, Luxemburg and Germany do not provide data on irrigable area for NUTS regions.

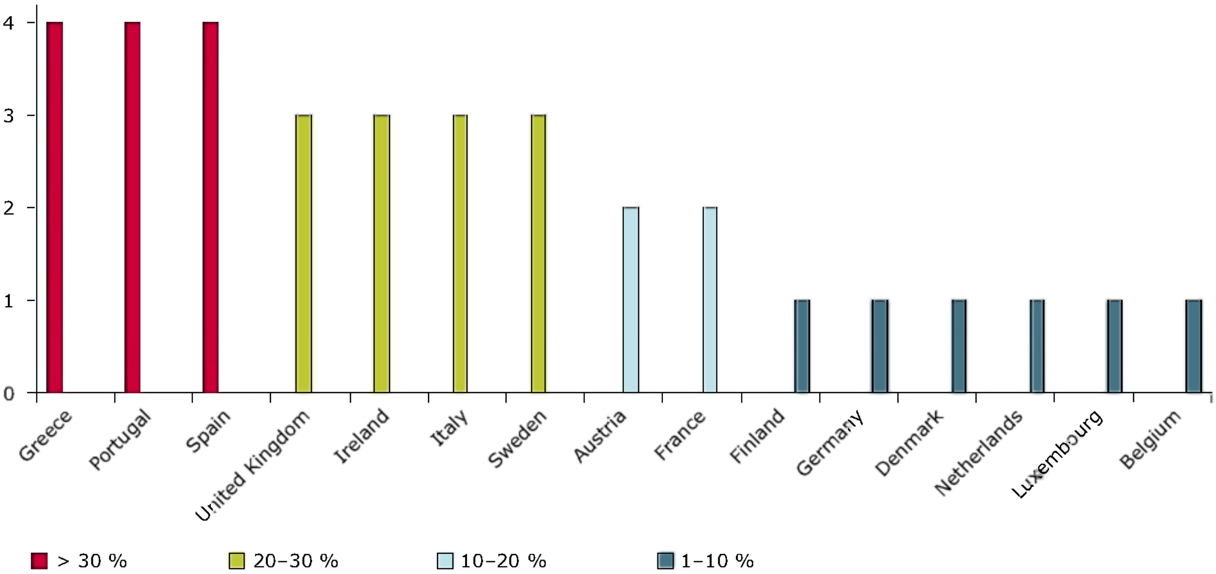
Source: Community survey on the structure of agricultural holdings (FSS). Eurostat combined with information from OECD/Eurostat questioner.

in the mountains and other remote areas of Europe, see Figure 3.4.

Due to the relatively small remaining area of undisturbed natural habitats, so-called 'semi-natural farmland habitats' and in particular semi-natural grasslands, have become critically important as a European biodiversity resource (EEA, 1999; McCracken, 2004). Depending on the biogeographic context or the local situation, these habitat types may well have higher levels of biodiversity than undisturbed areas, as is the case for vascular plants in semi-natural grasslands in Sweden.

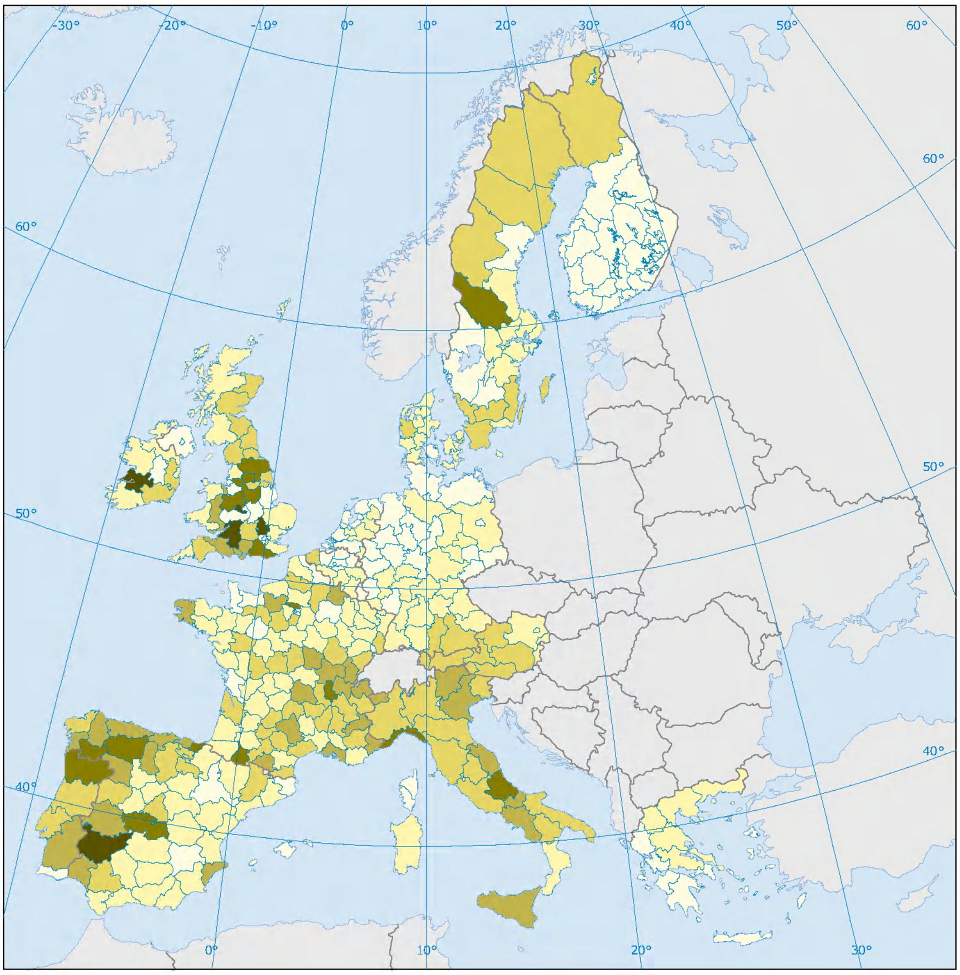
Figure 3.6 provides an example from a relatively intensively-managed part of Sweden and illustrates the scale of simplification of agricultural landscapes that has occurred there and elsewhere across Europe. From comparison of the three maps, it can be seen that many small habitats such as rows of trees and grasslands have disappeared and been replaced by arable fields (light areas) or forests (green areas).

Figure 3.4 Share of HNV farmland areas in total utilised agricultural area, EU-15



Source: EEA, 2004 c.

Figure 3.5 Share of targeted agricultural habitat types (Annex I habitats dependent on extensive farming practices) within Natura2000 sites



Habitats directive Annex I: targeted agricultural habitat types in Natura2000 sites

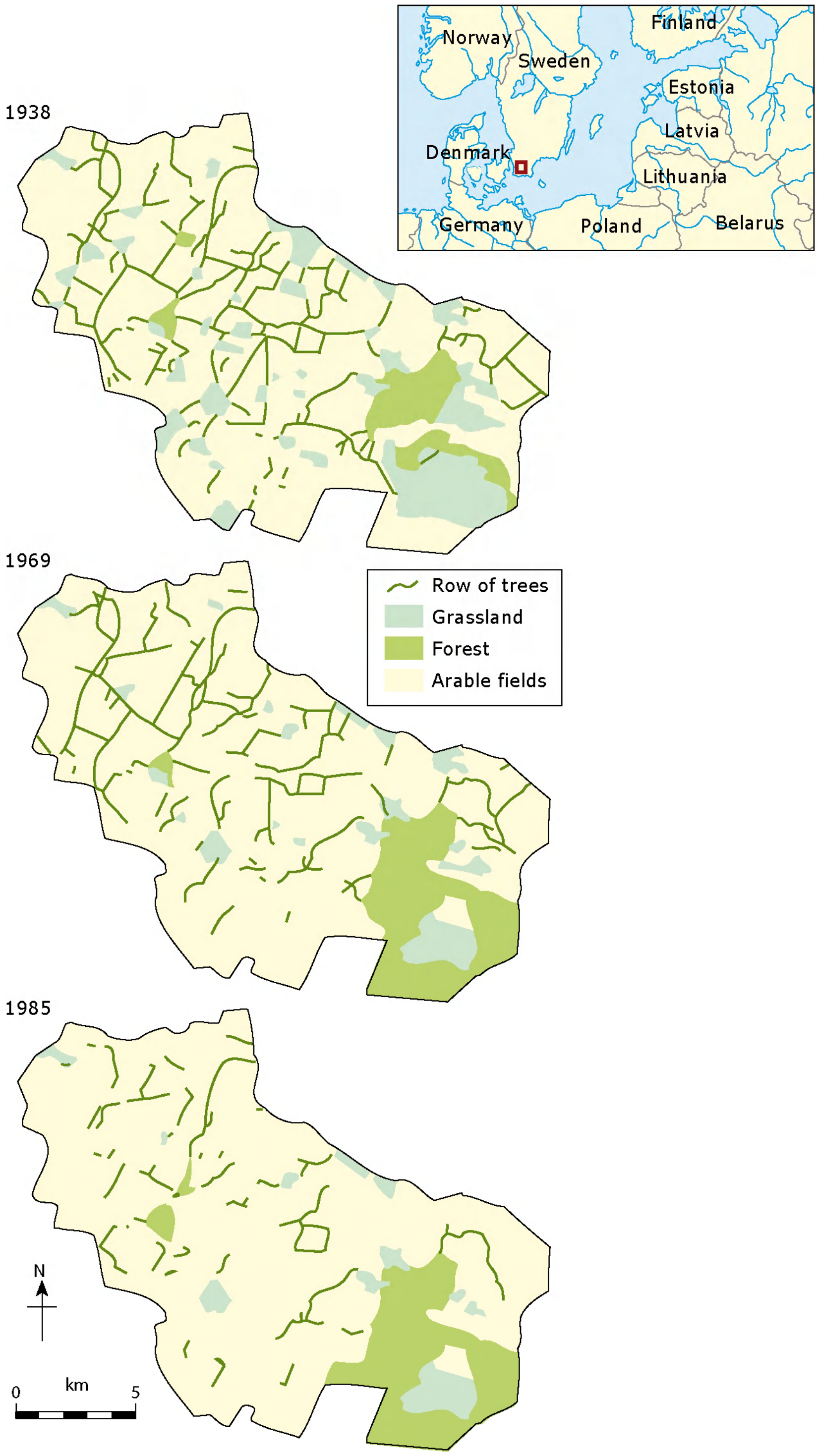
- 0–5 %
- 5–15 %
- 15–25 %
- 25–35 %
- 35–50 %
- > 50 %
- NUTS region (*)
- Non EU-15

NUTS = Nomenclature of territorial units for statistics.
© EuroGeographics Association for the administrative boundaries.

(*) NUTS 2: Austria, Belgium, Germany, Greece, Italy, Luxembourg, the Netherlands, Portugal, and the United Kingdom NUTS 3: Denmark, Finland, France, Ireland, Spain and Sweden

Source: EEA-ETC/Biological Diversity, Natura2000 database, July 2004.

Figure 3.6 Loss of landscape elements in Beden, Sweden between 1938 and 1985



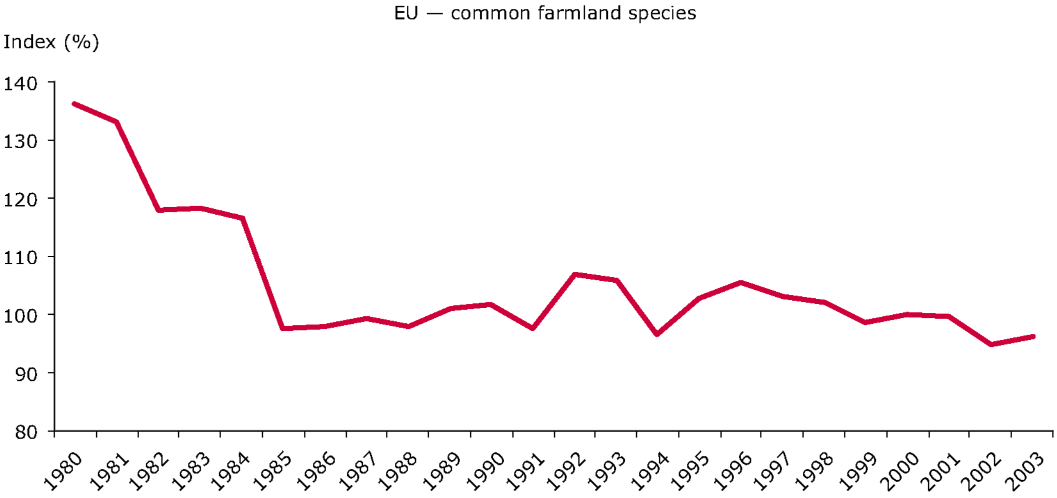
Source: EEA, 1995.

3.1.2 Trends in species

Common species

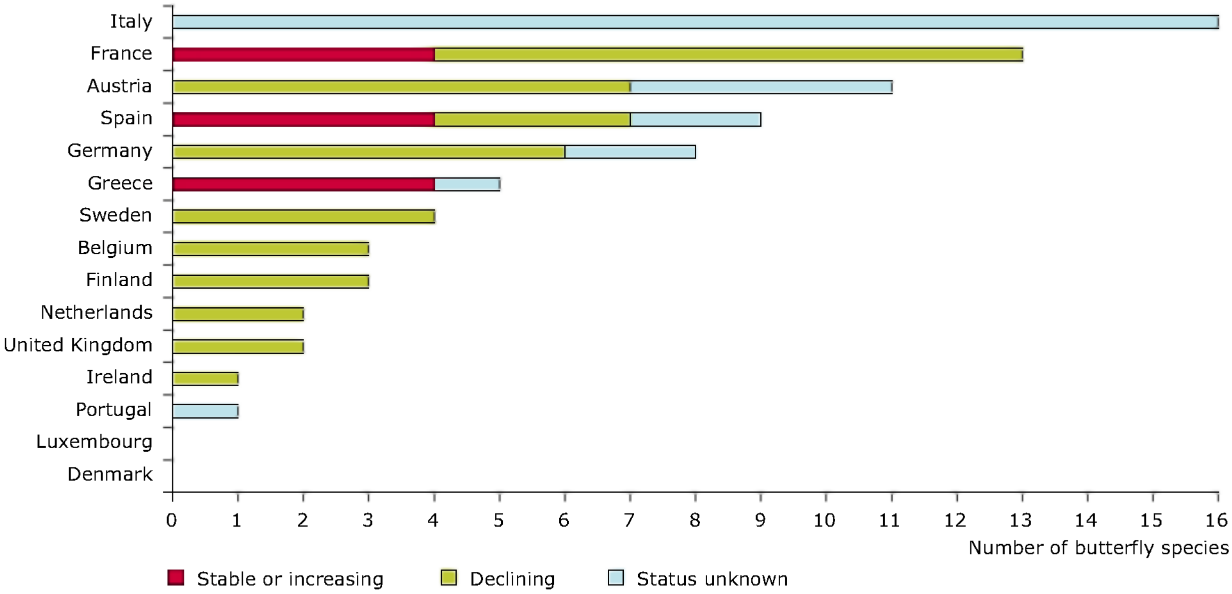
Farmland birds are one of the few species groups for which trend information is available across a number of European countries. Farmland bird populations give an indication of the general state of farmland biodiversity, since the diversity and abundance of plant and insect species on farmland directly affects the availability of food for birds. In addition, features such as hedgerows, uncultivated field margins, small woodlands and patches of scrub are important for many species of birds. Figure 3.7 illustrates trends in farmland bird populations

Figure 3.7 Trends in farmland bird populations between 1980 and 2002, based on 24 characteristic bird species



Source: ETC/NPB based on data from BirdLife International.

Figure 3.8 Population trends of agriculture-related butterfly species in prime butterfly areas



Note: Denmark and Luxemburg do not retain key butterfly species that rely on agricultural habitats.
Source: Van Swaay and Warren, 2003.

across the 11 EU countries for which data were available. On average, farmland bird populations declined by more than a third between 1980 and 2002. The countries most affected are Belgium, France, the Netherlands, Sweden and the United Kingdom.

The declines in farmland birds are being mirrored by other groups, for example as shown for butterfly species in Figure 3.8. Butterflies have declined markedly in some of the habitats (such as grassland and heathland) associated with farmland across Europe.

Threatened species
A wide range of species that depend on farmland habitats have been affected by the increasing intensification of farming, thus becoming threatened. For example, more than 400 species of vascular plants in Germany have declined because

of habitat loss or fragmentation due to agricultural intensification, while in the United Kingdom there has been a greater decrease in plant diversity in arable habitats than in any other habitat. Farmland invertebrates have also suffered, with total abundance of insects, including moths, butterflies, sawflies, spiders, parasitoid wasps, and aphids, decreasing.

Changes in the populations of individual farmland bird species have been particularly well documented. For example, the red-backed shrike (*Lanius collurio*) has shown a widespread decline in Europe and its conservation status in the EU is 'unfavourable' (BirdLife International, 2004). It is thought that the application of inorganic nitrogen fertiliser and the use of insecticides reduce the abundance of insect food. A large proportion of the European population breeds in eastern Europe, and key populations in Romania and Bulgaria have remained stable despite a large fall in numbers observed in the whole of Europe between 1970 and 1999.

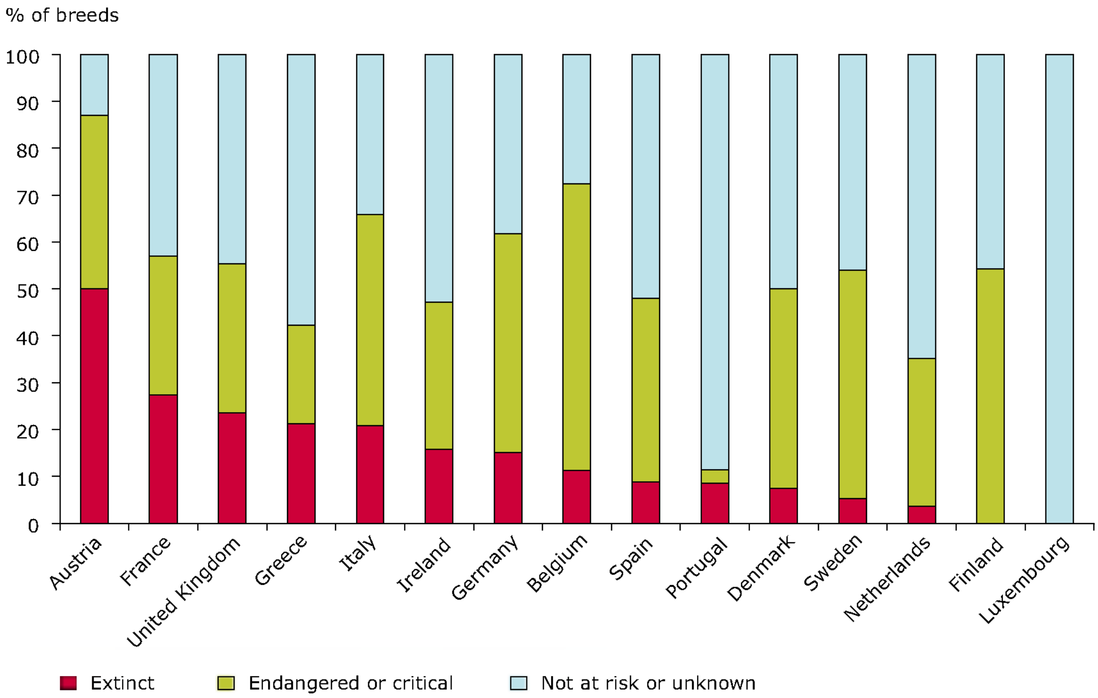
In contrast, the marsh fritillary butterfly (*Euphydryas aurinia*) is declining in almost every European country. The United Kingdom and Ireland are believed to be major remaining strongholds for the species, but even here it has declined substantially over the past 150 years. This butterfly breeds in two main habitats, damp neutral or acid grasslands and dry chalk and limestone grasslands. The main factors contributing to the decline are agricultural improvement of marshy and chalk/limestone grasslands, afforestation and development of habitats, changes in livestock grazing practices and the increasing fragmentation and isolation of habitats (Anonymous, 1995).

Varieties and races

Europe is home to a large proportion of the world's domestic livestock diversity, with more than 2 500 breeds registered in the Food and Agriculture Organisation (FAO) breeds database. A large number of European breeds are threatened because of their perceived lack of economic competitiveness. In nearly all EU-15 countries, about 50 % of all livestock breeds have extinct, endangered or critical status, Figure 3.9. Although some old breeds still survive in marginal areas, most traditional breeds nowadays are maintained by rare-breed societies and hobby breeders.

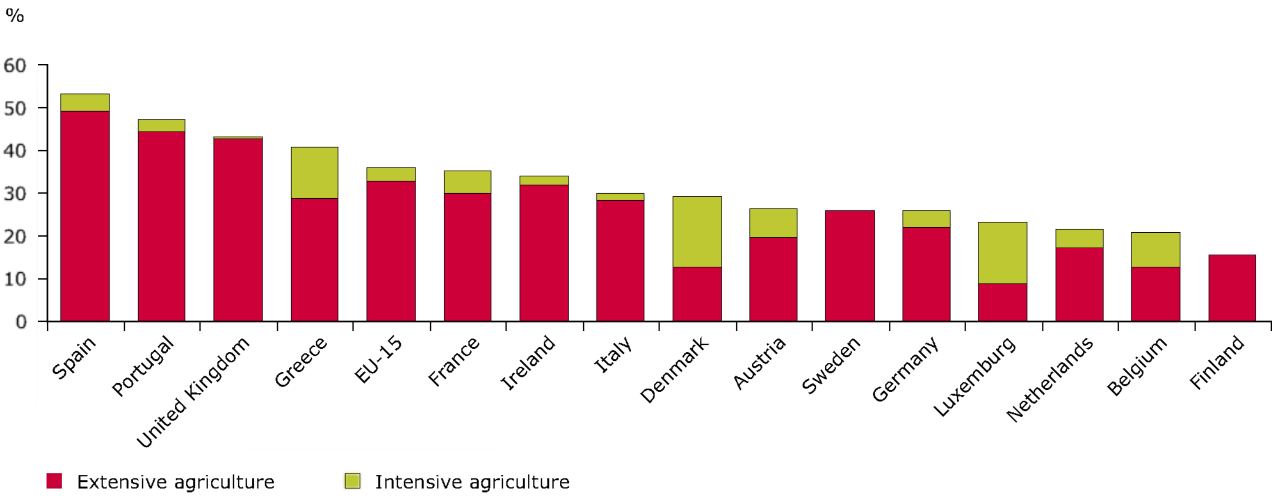
High nature value (HNV) pastoral grazing systems depend on hardy old livestock breeds adapted to natural conditions and practices such as transhumance (the seasonal movement of livestock between grazing habitats). For example, Avileña

Figure 3.9 Distribution of the endangered risk status of main national livestock breeds (cattle, pig, sheep, goat and poultry) in the EU-15



Source: EEA(2005), prepared by IRENA from data within FAO's Domestic Animal Diversity Information System.

Figure 3.10 Agricultural land in proposed sites of Community interest (pSCIs) under the habitats directive, as a proportion of the total area designated as pSCI sites



Source: EEA ETC/NPB, June 2004.

negra cattle in central Spain can walk 20–40 km a day on the journey to their summer mountain pastures. Modern breeds — which can produce a lot of milk and meat — need large quantities of rich grass and supplementary feeds and cannot cope with the harsh conditions of HNV pastoralism. The switch to modern breeds has therefore led to the abandonment of remote pastures in many areas and the loss of biodiversity that depends on grazing.

Invasive alien species
Invasive alien species cause conflicts with biodiversity in a wide variety of farmland habitats throughout Europe, especially in central and eastern Europe. For example, in Hungary, the most susceptible habitats to invasives have been identified as mis-managed agricultural and rural areas and wetland ecosystems. According to recent estimates, about 45 000 ha of grassland in nationally designated sites are affected by invasive plants such as *Solidago spp.*, *Ailanthus altissima*, *Elaeagnus angustifolia* and *Asclepias syriaca*. The government has initiated several programmes for the mechanical control of invasive plant species in protected areas, with limited success (Anonymous, 2002).

3.1.3 Key management issues

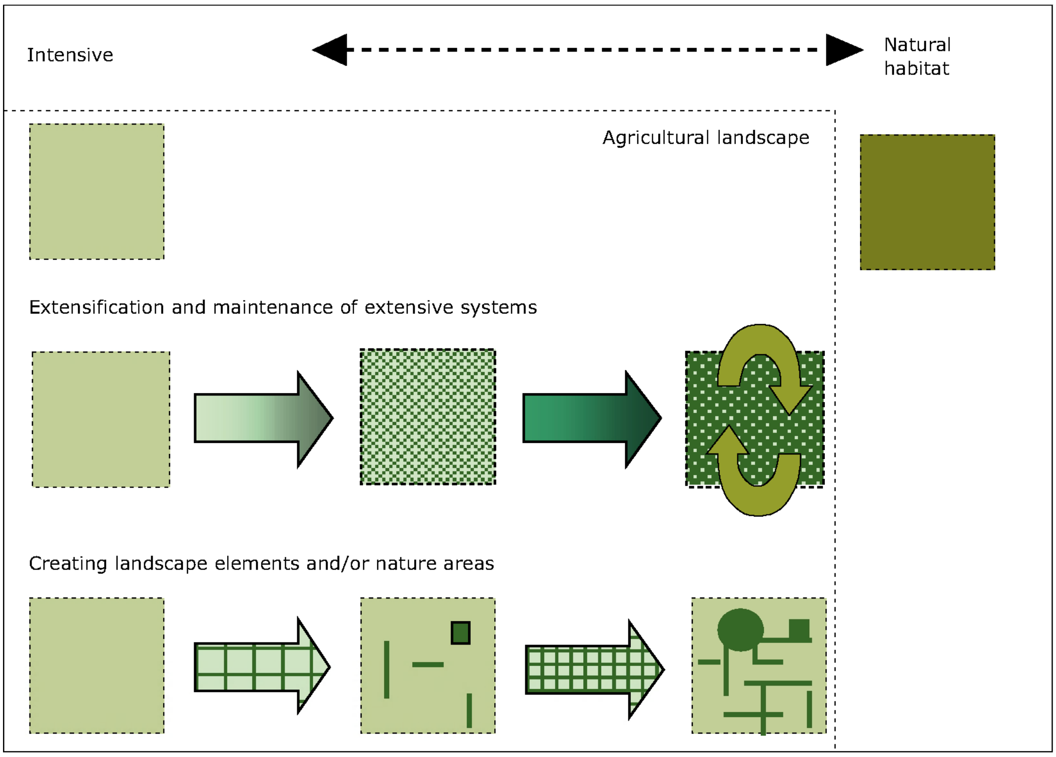
The Natura2000 network is building on sites of Community interest (SCIs) that will safeguard the 198 natural and semi-natural habitat types that must be maintained in a favourable conservation status, listed in Annex I of the directive (see also Section 2.4). Of these 198 habitat types, 65 have been shown to be threatened by the intensification of agriculture, while 26 grazed pasture habitats and 6 mown grassland habitats are threatened by the abandonment of pastoral management practices (Osterman, 1998).

Agricultural habitats form about 35 % of the total area proposed for the Natura2000 network under the habitats directive in the EU-15. Only Greece, Portugal and Spain have a higher proportion of such habitats within the pSCIs they have listed (Figure 3.10).

As already indicated, the current reform of the CAP represents a radical change in the system of farm support within the EU, i.e. decoupling of support from production, and mandatory environmental cross-compliance for all supported sectors. There is, however, concern that things may not work out as planned. The possible effects on farming and land-use patterns are largely unknown, and hence the likely impacts on farmland biodiversity are currently unclear. Some environmental benefits (possible reductions in input use, stricter controls on impacts and increased effectiveness of agri-environment payments) are anticipated, particularly on farmland that was previously managed intensively.

Organic farming and codes of good farming practice are of benefit for habitat diversity and common farmland species. Sensitive or rare farmland species require additional targeted measures for their survival.

Figure 3.11 Schematic representation of the agricultural landscape and options to maintain and enhance its biodiversity value.



Source: Hoogeveen *et al.*, 2001.

For most intensively-managed areas of farmland, an improvement in biodiversity value can be achieved either by lowering inputs across the agricultural landscape as a whole or by reintroducing a greater range and mixture of habitats into the landscape (Figure 3.11).

For most high nature value farmland, the issues revolve around maintaining the diversity that currently exists in habitats and farming practices. It is essential that policies recognise that specific approaches need to be taken to maintain the socially and economically-fragile farming systems of high nature value. The socio-economic sustainability of the farming systems appears to have received little attention.

The increased use of agri-environment schemes in rural development measures is good in principle. However, the reforms to date have done little to address the question of whether or not the programmes themselves have been effective in achieving their biodiversity objectives.

As a result, many schemes tend to be over-prescriptive, are targeted too closely on specific production objectives or conspicuous species and some may have been over-ambitious in their objectives. The ecological complexity of farmland and the fact that no two farms are the same has been difficult to address, as has been making clear the distinction between high nature value farmland and the more impoverished systems of management and production associated with intensively-managed areas (Bignal and McCracken, 2001).

There also needs to be a recognition that CAP measures are not the only factors that influence land management decisions on farms across Europe. There needs to be more integration of policies aimed at addressing all the agricultural, economic and socio-economic issues that drive biodiversity changes on farmland. In particular, there need to be closer linkages between the development of Structural Fund and CAP measures to ensure that the local infrastructure required by the farmers is maintained, especially in HNV farmland areas.

Development support is needed to exploit the market potential of locally distinctive crops and products. Structural fund priorities and rural development regulation needs should be sufficiently well integrated with one another to promote farmland biodiversity (Hindmarch and McCracken, 2004). It will be difficult to promote farm management that is more favourable for preserving biodiversity components unless local infrastructure like slaughterhouses and milk processing plants can be reinstated, enhanced and adapted to future needs.

3.1.4 Conclusions

Overall, progress towards the 2010 target to halt biodiversity loss on farmland in Europe is not visible and unlikely to be reached without additional integrated policy efforts. Specific attention needs to be paid to targeting and prioritising actions aimed both at the conservation of HNV farmland and at improving the biodiversity value of intensively-managed farmland.

The most alarming signs of lack of progress are:

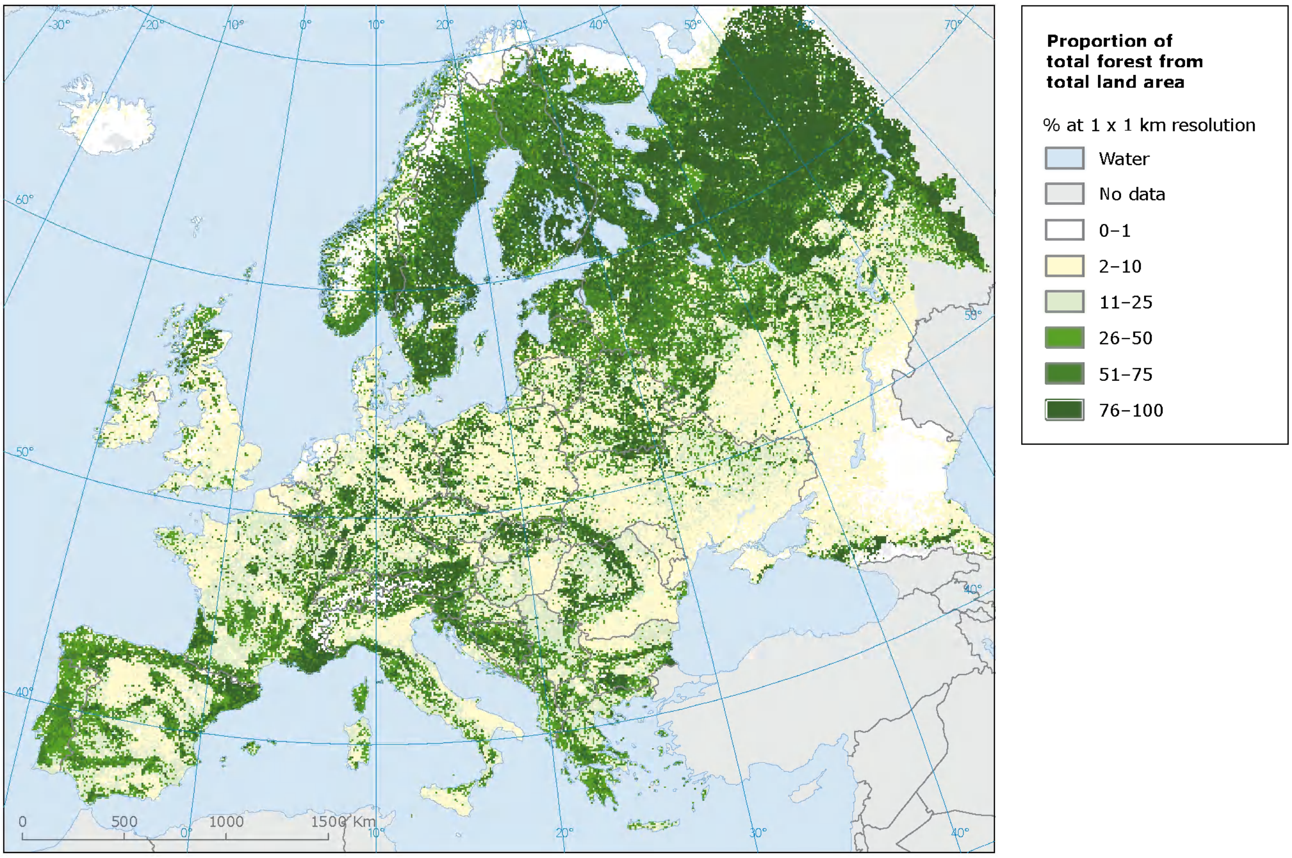
- the continuing expansion of intensively-farmed areas at the expense of natural and semi-natural habitats;
- the declining trend in farmland-related species of birds and butterflies;
- the increasing rates of water utilisation, farm specialisation and intensification of farming practices;
- the increased presence of invasive alien species in farmland;
- the high risk of abandonment of farmland in several parts of Europe.

The contribution of policy measures such as agri-environment schemes and the effective management of the Natura2000 sites cannot currently be assessed, but it should receive high priority in the near future.

3.2 Forest ecosystems

Most of Europe would be covered by forest, were there no human interference. Still, with an overall cover of roughly 30 % of the land area, forests remain a key repository of biological diversity. The increasing industrial exploitation of forests in the late 1800s for timber (and later also pulp) created a general concern in many European countries about the sustainability of the use of the wood resource. This resulted in a number of national forest laws,

Figure 3.12 Forest map of Europe



Source: European Forest Institute, 2002.

mainly in the early decades of the 1900s, aimed at protecting the productive function of the forests.

In the late 1900s, increased attention to the development of the forests and debate about forest management led to the development of national forest legislation and global agreements aimed at multi-functionality, which also gave place to biological diversity. The United Nations Forum on Forests (UNFF), established in response to the Forest Principles of the Rio meeting in 1992, is currently the global body on forests. Regarding biodiversity, the Convention on Biological Diversity has established a Forest thematic area with a work programme harmonised with UNFF.

The Ministerial Conference for Protection of Forests in Europe (MCPFE) was launched in 1990, and now comprises 44 participating countries and the European Community. MCPFE recognises the multifunctional role of forests, provides general guidelines for the conservation of the biodiversity of European forests, and, since 1993, has established an indicator set related to sustainable forest management in the participating countries.

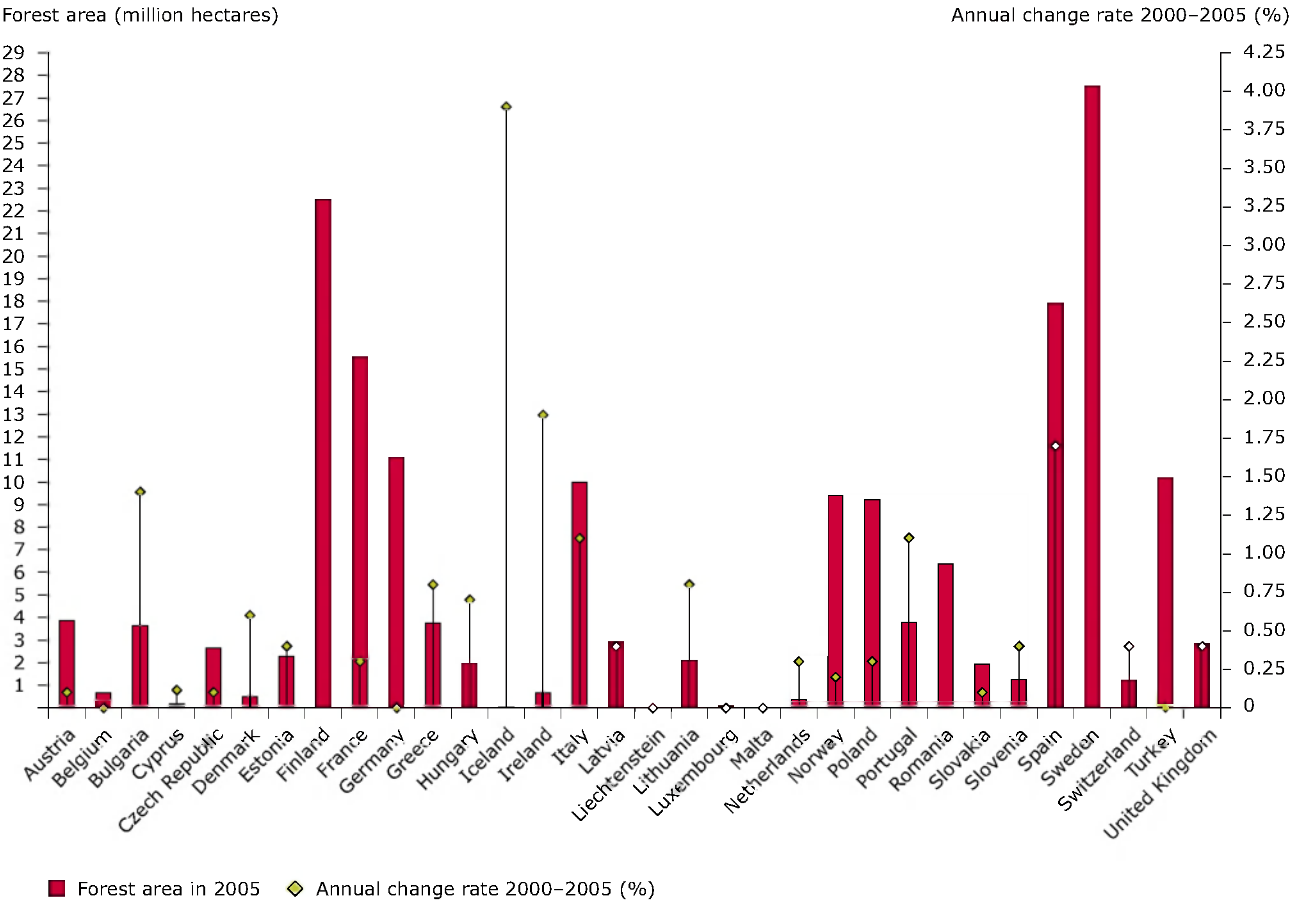
Forest management certification is a market-based, non-governmental response from the forestry sector fed by public concern and demand for environmentally-adapted forest products. In Europe the certification is carried out by independent organisations in a number of different schemes. This process has led to an increasing number of public and private forests having been certified in Europe over the past decade.

The new EU Regulation (EC) 2152/2003 (Forest Focus) is an important step forward in forest monitoring. This Regulation will continue to monitor the effects of air pollution on forests, and forest fires, and will promote the development of new monitoring instruments for new environmental issues of political relevance, including biodiversity.

3.2.1 *Forest habitats and species*

Recent estimates by UNECE/FAO (2000) and MCPFE/UNECE/FAO (2003) show a current slight increase (at most 0.5 % per year) in forest area for most countries in Europe, see Figure 3.13.

Figure 3.13 Annual change in total forest area

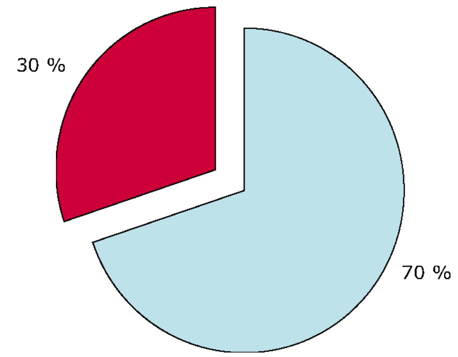


Source: FAO, 2005; Global Forest Resources Assessment 2005.

The abandonment of agricultural land (see Section 3.1), brings about opportunities for both planted afforestations and spontaneous regrowth of forests. Most of the recent afforestations in the EU-15 have been supported by the Community, e.g. through Regulation 2080/92 on afforestation of agricultural lands. However, on the whole spontaneous regrowth has taken up an area of about the same magnitude as plantations. Of all European countries, Ireland, Iceland and the Mediterranean countries, in particular Spain, France, Portugal, Turkey, Greece and Italy, show relatively higher afforestation rates.

Forests undisturbed by man provide habitats for a large number of species. The bulk of these forests are concentrated in a few, mainly northern, boreal regions, however scattered relicts of undisturbed forests also remain in the mountainous areas of the Balkan, Alpine and Carpathian regions (Diaci and Frank, 2001). A decrease in the forest area available for wood supply in a number of countries (Finland, Bulgaria, Latvia, Poland, Romania, Sweden and Turkey) is shown by UNECE/FAO (2000), suggesting, amongst other things, a possibly higher level of protection of forest naturalness.

Figure 3.14 Forest bird species with 'unfavourable conservation status'



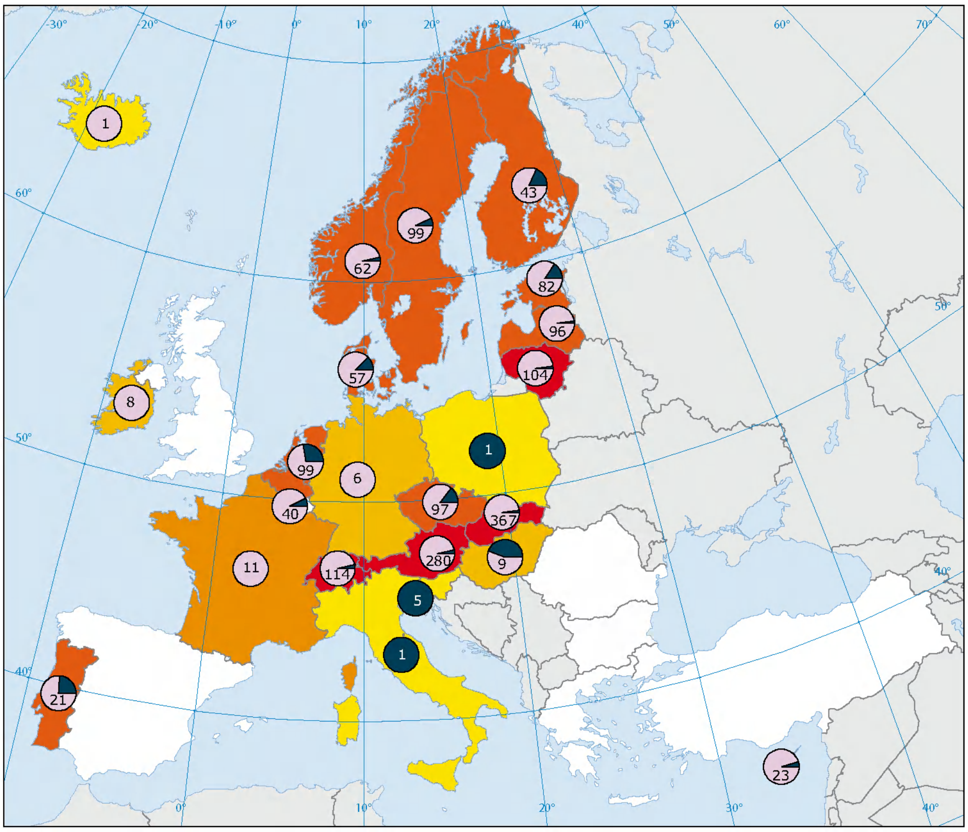
Bird species with unfavourable conservation status not related to forests

Bird species with unfavourable conservation status related to forests

Source: ETC/NPB, 2004 and BirdLife International, 2004.

Forest habitats in Europe present a high diversity in terms of plant composition due to their various abiotic conditions. These are recognised by more

Figure 3.15 Map showing total number of endangered vascular plant species and the share of endangered tree species and other endangered vascular plant species in forests



Endangered forests species

Total endangered vascular plant species

1–5

6–10

11–20

21–100

101–367

Share of total endangered species

Endangered tree species

Other endangered vascular plant species

No data

Outside data coverage

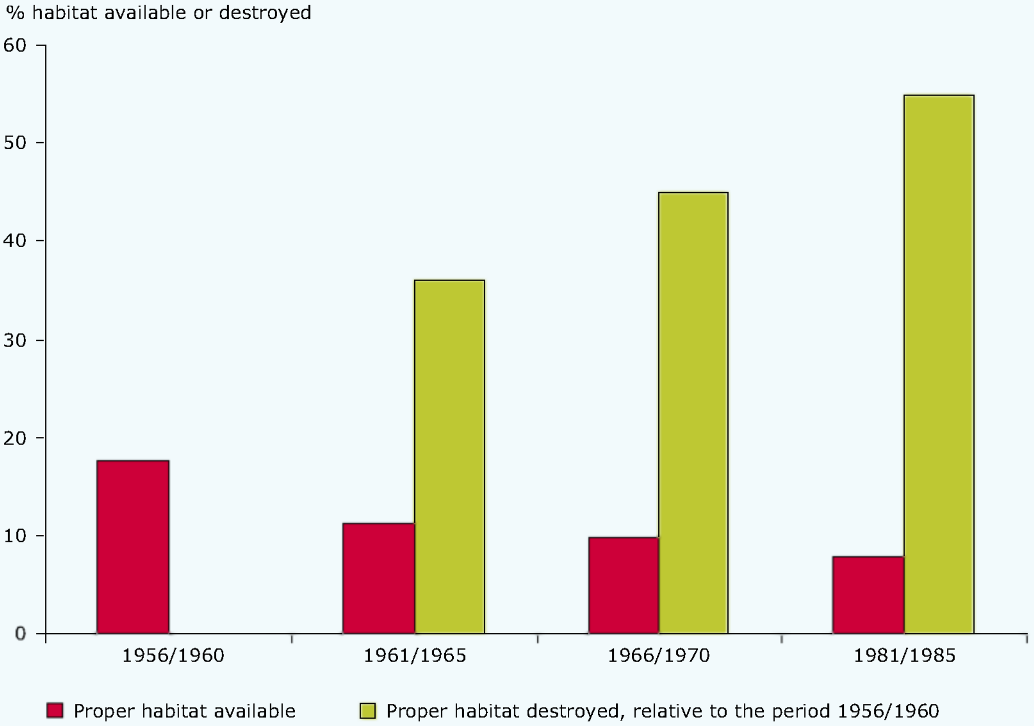
Source: UN-ECE/FAO (2000) and updates.

Box 3.2 The decline of the white-backed woodpecker

The white-backed woodpecker (*Dendrocopos leucotos*), one of the rarest European woodpeckers, is an old-growth deciduous forest specialist which has shown widespread decline over most of its distribution range in central and northern Europe (Carlson, 2000; Wesolowski, 1995). The woodpecker favours mature, deciduous forests that include many dead trees. The species disappears from regions when the amount of deciduous forest declines below a certain level. The rapid decline of this woodpecker is associated with habitat alteration and loss of old-growth deciduous forest (Figure 3.16). Deciduous forests with dead trees have been cut and replanted with conifers.

In Finland breeding population estimates show a decline from an estimated 1 000 pairs in the 1950s to a current population of 30 to 50 pairs. (Carlson, 2000; Virkkala *et al.*, 1993). Finnish sub-populations persist in a landscape below the habitat threshold; however this woodpecker may disappear as a breeding species in this country, see Figure 3.16.

Figure 3.16 Availability of suitable White-backed Woodpecker habitat in Finland for the time period when the population showed a rapid decline in numbers. Proper habitat destroyed is relative to the initial period 1956/1960



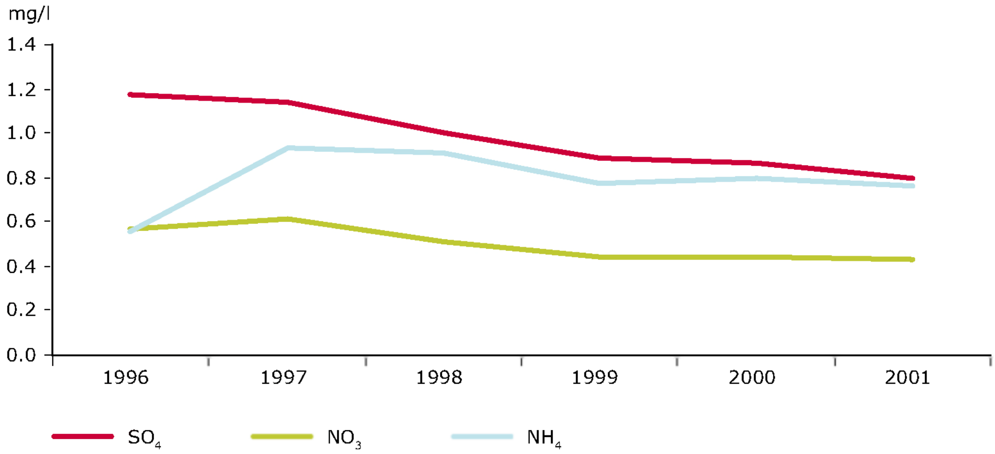
Source: Carlson, 2000.

than 700 phyto-sociological units described in the EUNIS database and classification system (http://eunis.eea.eu.int). A biodiversity-related analysis of European forest types has shown that habitat types, tree species composition and forest history are major factors for forest biodiversity in the six major European biogeographical regions (Larsson, T.-B., 2001).

Trends in species occurring in forests
Some information on common forest birds is available, but not enough to identify status or trends. The knowledge of threatened species in European forests allows a safer interpretation as 30 % of all birds with unfavourable conservation status in Europe live in forests (Figure 3.14).

Data reported by countries on forest-related vascular plants (including trees) within the UNECE/FAO assessment (2000) provide an insight of the situation of threatened species in this group of European countries, see Figure 3.15.

Figure 3.17 Development of mean plot concentration in open-field measurements of sulphate (SO_4, 285 plots), nitrate (NO_3, 294 plots), and ammonium (NH_4, 294 plots); 1996–2001



Note: Plots are located in 14 mostly central European countries and are not representative of the European scale.

Source: UNECE, 2004.

Introduced species
Several alien tree species have been introduced into Europe, a number of which originate from the western part of North America, e.g. sitka spruce (*Picea sitchensis*), lodgepole pine (*Pinus concorta*), Douglas fir (*Pseudotsuga menziezi*) and western hemlock (*Tsuga heterophylla*). Their introduction is recent, making it hard to evaluate whether they pose a risk of spreading out of control.

In addition, Europe's forests face a threat from non-native plants introduced as cover for game animals or for aesthetic or functional landscaping. These trees and shrubs are often aggressive invaders that inhibit or prevent the natural regeneration of native species e.g. *Rhododendron ponticum* (Belgium, Ireland, the United Kingdom), *Prunus serotina* (Belgium, Germany, Netherlands), *Robinia pseudoacacia* (France, Greece, Hungary), *Carpobrotus edulis* (Portugal, Spain) and *Hakea salicifolia* (Portugal).

A significant threat to European forests arises from the accidental importation of microbial pathogens and invertebrate pests on forest products. The consumption and trade of forest products has increased substantially (approximately four-fold in real terms) over the past 30 years, and is projected to increase further. There are regulations in the EU to control the trade in forest reproductive material between countries to avoid the transfer of pests and diseases and the use of seeds or planting stock of low genetic quality.

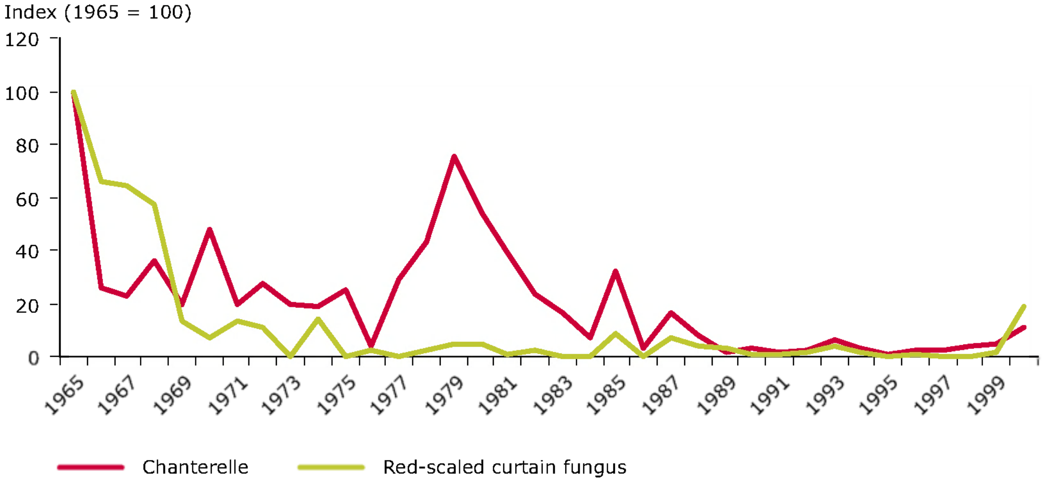
Introduced game mammals, especially herbivores, have had a major impact on the regeneration of Europe's forests. These include fallow deer (*Cervus dama*), mouflon (*Ovis ammon*), sika deer (*Cervus nippon nippon*) and rabbit (*Oryctolagus cuniculus*). The introduced grey squirrel (*Neosciurus carolinensis*) out-competes the native red squirrel (*Sciurus vulgaris*) and inflicts considerable damage, for example to beech, sycamore and oak forest. Hybridisation occurs between non-native sika deer (*Cervus nippon nippon*) and native red deer (*Cervus elaphus*). Both sika deer and the grey squirrel have as yet relatively local populations in Europe, but are spreading to wider regions

Throughout southern Europe, and up to Switzerland, the argentine ant *Linepithema humile* eliminates native ant species and interferes with natural regeneration in some ecosystems.

3.2.2 *Effects of air pollution*

Forest condition in Europe has been monitored over 20 years jointly by the European Union and the International Co-operative Programme on the Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests), established under the UNECE Convention on Long-range Transboundary Air Pollution. Forest condition is influenced by air pollution and other stress factors, including climate. European forests showed a continuous deterioration in crown condition between 1989 to 1995 and the condition then stabilised at a high defoliation level, for example with almost a quarter of the sample trees rated as damaged in 2003.

Figure 3.18 Effects of acidification and eutrophication on woodland fungi in the Netherlands



Note: The chanterelle is a fungus which lives in symbiosis with various deciduous and coniferous tree species (mainly oak and Scots pine) and the red-scaled curtain fungus is a mycorrhizal species of oak and beech; both fungi grow in forests on nutrient-poor sandy soil. Both species showed a very sharp decline since the 1960s, which is attributable to acidifying and eutrophying compounds, combined with other stress factors including climate, but the populations now seem to be making a comeback.

Source: Netherlands Environmental Assessment Agency, http://www.mnp.nl/mnc/c-en-1635q02x-01-xls.html — accessed 01/12/2005.

Atmospheric deposition of nitrogen and sulphur decreased slightly during the observation period, see Figure 3.17. However, critical loads, aimed at halting further nitrogen accumulation in the soil, were exceeded in 92 % of the investigated plots during 1995–1999. Critical loads that take effects on trees into account were exceeded in 45 % of the plots. This resulted in a situation where the plant diversity of the ground vegetation was potentially endangered in 58 % of the plots. Studies of about 200 intensively-monitored plots show a low, but statistically significant impact of nitrogen deposition on ground vegetation (UNECE and EC, 2002).

3.2.3 *Key management issues*

Biodiversity is affected by forest management, since this determines the development of the forest stands with respect to the composition of tree species and selection of provenances, the tree density and horizontal structuring, the distribution of age classes and rotation periods, regeneration measures, etc. The biodiversity values of forests are also influenced by intensification measures like drainage of peat lands and wet forest, fertilisation and forest-tree breeding, including application of biotechnology, and the suppression of disturbances like fires and pests.

The three important phases of the 'forest management cycle' for assessing management impacts on forest biodiversity are cutting, regeneration and growth.

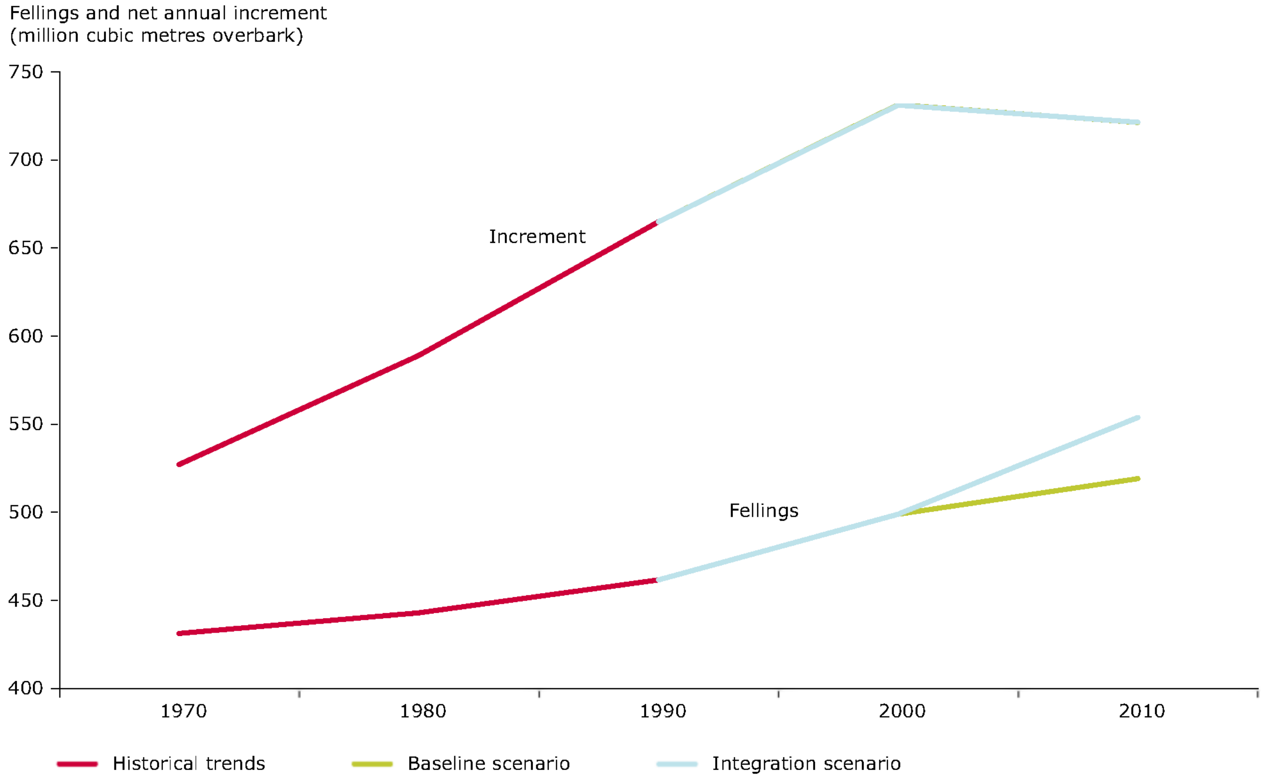
The cutting phase

The biodiversity potential of a forest stand depends on the way in which the trees are harvested, i.e. their age when harvested, the size of the clear-cut and the volume of wood extracted by felling. The wood harvested must not, in the long run, be greater than the increment in forest biomass if the forest resource is not overexploited. Felling compared with increment is thus an important indicator of forest biodiversity: for the EEA member countries as a whole, average annual felling is only 66 % of the net annual increment of the growing stock of forest available for wood supply.

Figure 3.19 shows the development of the annual increment and felling since the 1970s. Data from the UNECE/FAO European forest sector outlook studies allow adding a cautious view on the development of forest resources towards 2010 (UNECE/FAO, 2005). Changes in the definitions and methodology for forest inventories reduce the comparability of data between forest assessments. However, it may be concluded that annual felling has increased with time, under pressure from increasing market demand for wood. The increment increased steadily after the 1960s but is expected to level off during the next decade.

The area and timing of forest felling affects the habitat mosaic of the forest landscape including, for example, fragmentation of areas covered by mature forest. The effect on forest species is linked to the ecological requirements in habitat structure of the

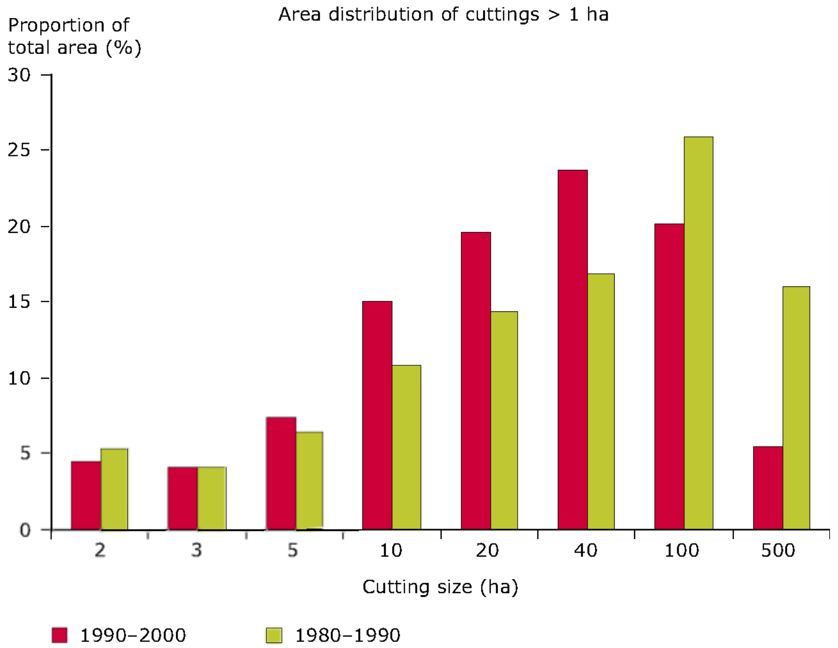
Figure 3.19 Net annual increment and annual felling, EEA countries



Note: No data were included for Malta, Cyprus, Liechtenstein and Iceland, of which the resources would add less than 0.04 % to the total.

Source: The data used for the figures are based on historic UNECE/FAO Forest Resource Assessments (UN-ECE/FAO, 2001) in combination with data from the European Forest Sector Outlook on the Development of the Forest Resources (UNECE/FAO 2005).

Figure 3.20 Decreasing the size of clear-cuts as shown in a middle boreal forest landscape in Hälsingland, Sweden



Note: Comparison of size distributions of clear cut areas made in 2 different time periods, covering a total area of about 10 000 km^2 with 77 % forested land. The rate of cutting was about 1% of the forest area each year over this period. Approximate periods for comparison are 1980–1990 and 1990–2000. The satellite data used are Landsat MSS (~ 1980) and Landsat TM (~ 1990 and ~ 2000).

Source: GMES-GSE Forest Monitoring.

Box 3.3 The effect of modern-day clear-cutting practice on the capercaillie

The capercaillie (*Tetrao urogallus*) is a sedentary bird associated with old-growth forests with a ground vegetation dominated by bilberry (*Vaccinium myrtillus*) (Rolstad and Wegge, 1989 a,b). However, it also occurs in viable populations in forests that are heavily influenced by forestry. When the dominating harvesting method is clear cutting, this leads to the fragmentation of mature stands, which in turn introduces a risk of isolation and/or of creating a landscape mosaic unfavourable for the capercaillie.

Clear-cuts influence capercaillie populations indirectly by changing the predation pressure on this species. A higher abundance of small rodents in the clear-cut areas increases the densities of generalist predators in the fragmented landscape. In most cases clear-cuts are regenerated with cultivated forest stands which as a rule show less pronounced differentiation in tree layer, a uniform age structure and less diverse tree species composition than would occur naturally. Finnish studies have shown that the proportion of capercaillie females with broods and the number of chicks in the broods decrease in forest landscapes with a low proportion of old forests (Kurki *et al.*, 1998; 2000).

Clear-cuts also influence the capercaillie directly by changing the area of suitable habitats as well as the habitat quality at different stages of the bird's lifecycle and at different times of the year. In a review of threats to grouse worldwide, Rolstad and Wegge (1987; 1989 a,b) argue that when the size of clear-cuts is sufficiently small, the capercaillie cock may perceive the forest landscape as one single forest area. Such a landscape will host larger capercaillie (cock) populations compared with a landscape with the same area of larger clear-cuts. The capercaillie females typically guide their chicks to favourable feeding grounds. Clear-cuts are normally avoided, but even here the impression is that if the clear-cuts are sufficiently small, they are accepted by the capercaillie hens with broods.

The capercaillie is a lekking bird and it has been noted that larger leks (gatherings for display and courtship) nowadays are rare. A landscape with larger clear-cuts and isolated patches of contiguous mature forest may cause an erosion of the social structure of capercaillie lekking, as only a few cocks are available at each lekking site.

species in question, and the species ability to adapt to changing environments. Studies of the capercaillie (see Box 3.3) illustrate the complex effects of the cutting regime on biodiversity.

Clear-cutting may be justifiable from a biodiversity point of view, for example in the boreal forests (since it mimics the dynamics of natural fires) but there has been a considerable debate as regards the maximum size of each clear-cut, for example about the very large cutting areas introduced during the late 1960s in response to the economic need to increase the efficiency of forestry operations. As highlighted in Figure 3.20, Swedish forestry is in the process of decreasing the size of clear-cuts.

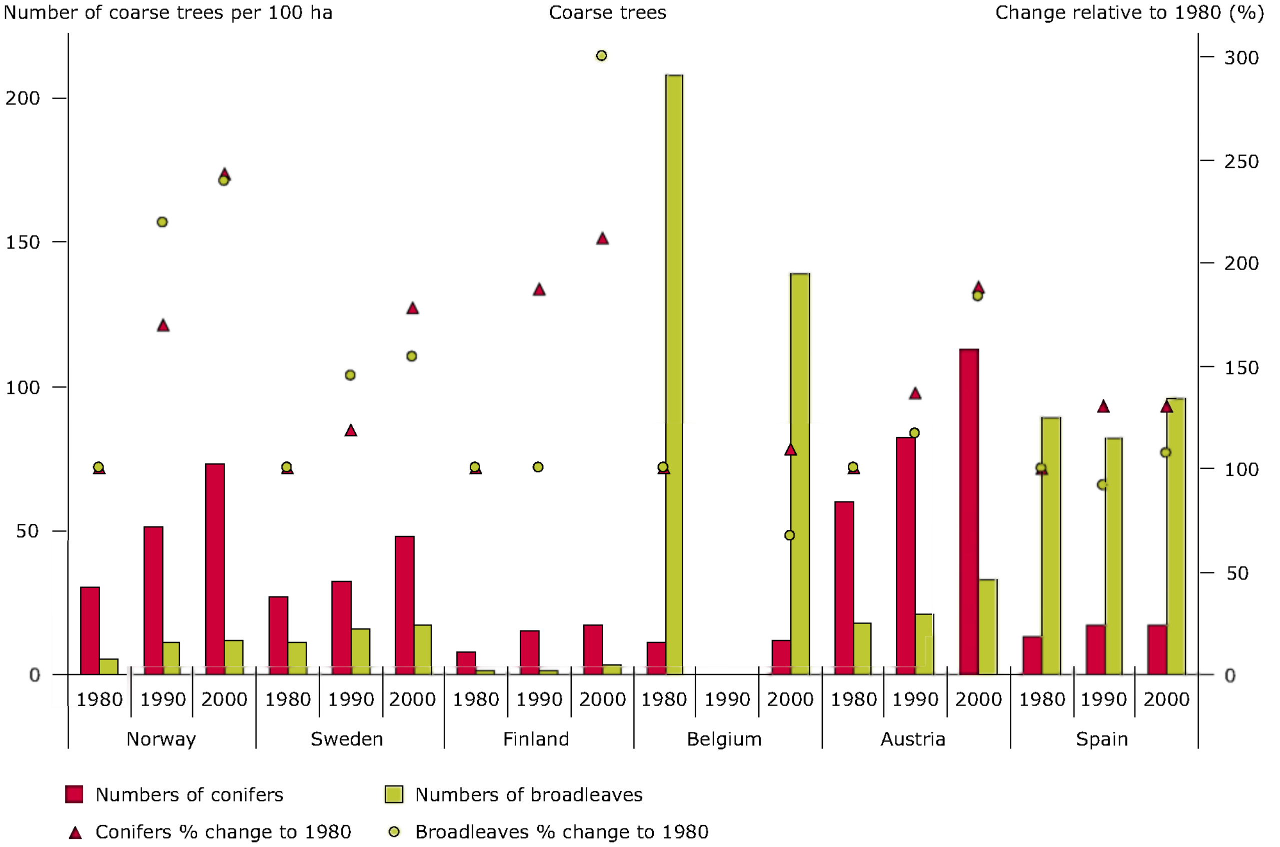
Illegal logging, if extensive, is an obvious threat to sustainability. Issues of illegal and/or unsustainable logging within Europe and in EU trading relations are targeted by the EC action plan 'Forest law enforcement, governance and trade (FLEGT)' of 2003'.

The regeneration phase
At the point of regeneration or afforestation, a choice is made whether the trees should establish naturally, by seeds from remaining or neighbouring trees, or be planted. Natural regeneration conserves the genetic diversity and maintains the natural species composition (if the stand of origin is suitable). Planting may be the only feasible method on certain sites but has been favoured because homogenous stands with little management needs are quickly created, and 'improved' genetic material can be used. The regeneration method may also affect the tree species composition of the future stand. Natural regeneration is often associated with a diverse tree species composition, while planting, if successful, typically results in mono-specific stands.

Regeneration of forest in the EEA member countries is based mostly on indigenous tree species. A number of countries have also introduced plantations of highly-productive exotic tree species during recent decades. Although this strategy seems successful so far, this may not be the case from a longer time perspective. Plantations with exotic species also need to be further evaluated from a biodiversity point of view.

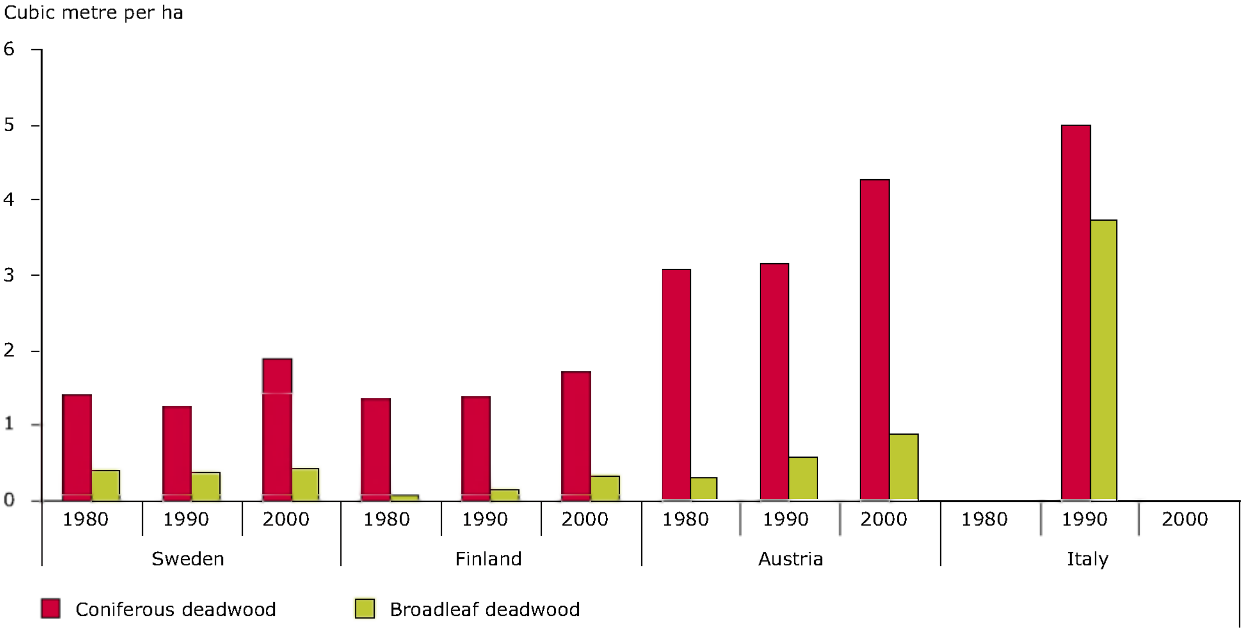
The growth phase
The standing volume of forest growing stock has continued to increase in recent decades. This can be explained by the fact that felling and natural

Figure 3.21 Number of large trees (defined as > 70 cm in southern and central Europe and > 50 cm in northern Europe) per 100 ha for countries with available time-series data



Note: Belgium: Walloon region only.
Source: ENFIN, Cost action E43.

Figure 3.22 Volume of non-decomposed dead wood (m^3 ha^{-1})



Note: The figures for Italy are for high forest only.
Note that comparability of data is limited as data were recorded using different definitions and standards.
Source: ENFIN, Cost action E43.

mortality combined have been lower than annual increment throughout Europe (Gold, 2003). This expansion of the growing stock is forecast to increase during the next few decades (UNECE/FAO, 2005).

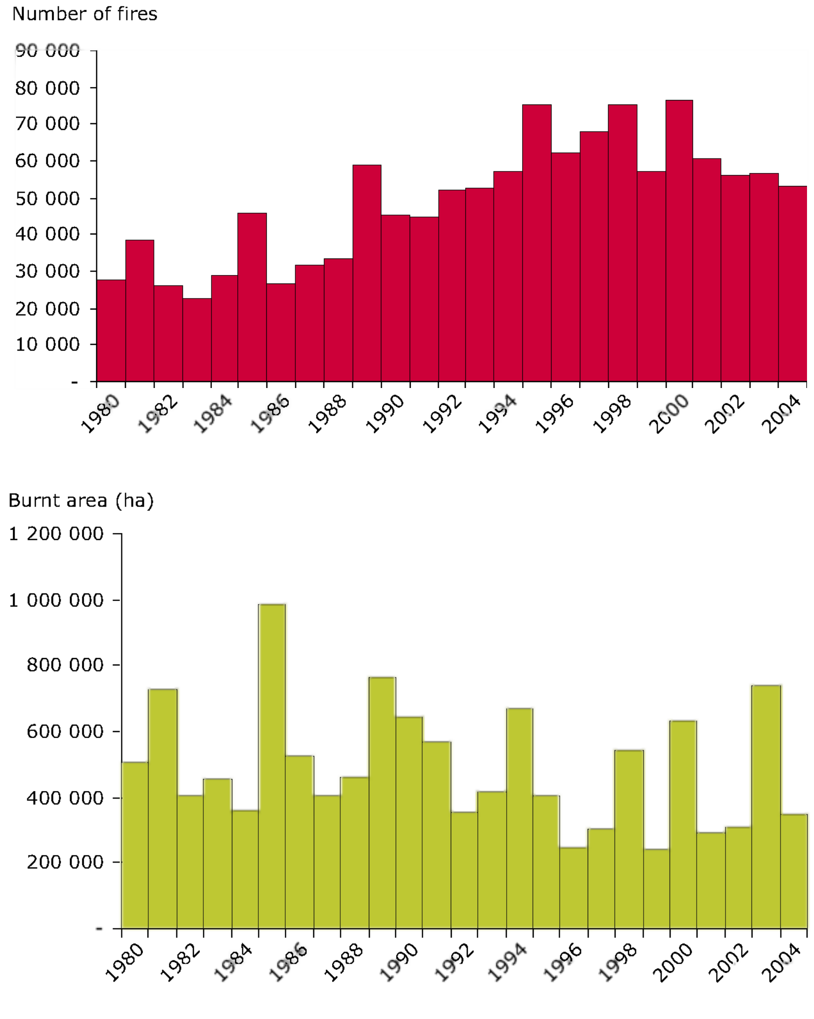
As felling takes place mainly before what would be a natural 'forest cycle' time, it is noteworthy that there is now a tendency to let the forests grow older. This may be a result of a more widespread close-to-nature management but also an indirect effect of the fact that felling is considerably less than the annual increment, see above. A distinguishing feature of older forests is relatively large trees, and there is also a positive trend as regards these, see Figure 3.21. Such trees are often valuable hosts for epiphytic flora, and may contain dead and hollow parts that are important for a number of forest species of various taxa.

Awareness of the importance of dead wood as a substrate for a large number of insects, lichens, bryophytes, and fungi has become widespread only within the past decade. Forestry practices in many European countries nowadays aim at increasing the amount of dead wood in the forests, see Figure 3.22.

Fire disturbances

Fire is a major natural disturbance factor for several types of forest in Europe. From a biodiversity perspective, effective fire suppression may threaten species that depend on habitats formed by fire, which is the case in the boreal and the Mediterranean forests. Figure 3.23 shows the trend in the number of fires and the area burnt in Europe during recent decades. A major part of the current fires in Europe are concentrated in the Mediterranean region, where the fires today are caused mainly by humans and result in economic, social, and ecological losses.

Figure 3.23 Area subject to forest fire in the EU Mediterranean region for the period 1980–2004



Source: JRC-IES — European Forest Fire Information System, Forest Fires in Europe (2004).

Box 3.4 Forest fires in Portugal in 2003

Major forest fires raged across Portugal in 2003. Nearly 300 000 ha of forest land were burnt, with cork and oak forests particularly affected. As a result, several bird species and the habitats they depend on have been threatened.

These fires also caused serious damage to protected areas such as those of the Nature 2000 network. The continued survival of certain bird species in Portugal is reportedly under threat: the Spanish Imperial Eagle, Bonelli's Eagle, Egyptian and Griffon Vultures and the Black Stork — all protected by the EU Birds Directive. Birds have been affected either directly, through being burnt or asphyxiated, or indirectly through loss of habitat and prey (BirdLife International, 2003).

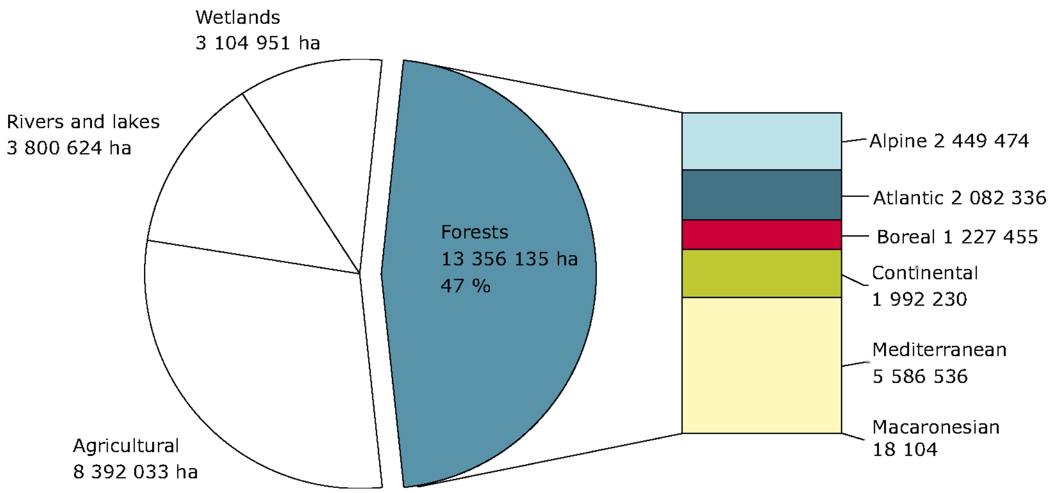
The adoption of an integrated approach to forest fire management is crucial, and starts with landscape and afforestation planning. Furthermore, the role of agro-forestry in Mediterranean Europe is vital, where the impact of growth of the forest area on biodiversity should be examined in an integrated way.

The number of fires increased in the 1990s and has reached an average of around 50 000 a year.

Protection of forests
Because of the historic use of forests and the specific small-scale ownership structure, the European concept of forest protection is complex and varied. Assessment of the area of protected forests in European countries or regions is difficult because of variations in protection categories, including the activities permitted in protected areas, but also because of differences in the naturalness of forests and the fragmentation or continuity of forest cover (Parviainen and Frank, 2003).

The Ministerial Conference on the Protection of Forests in Europe (MCPFE) requests countries to monitor, assess and report the protected forest area that is present in the country. MCPFE has established a classification of forest protection with respect to the degree of intervention allowed and the main management objectives. Protected forest areas amount to 25.5 % of the total forest area of EEA member countries ([2]) including Switzerland. These protected forest areas cover about 37.3 million ha. Of these, 23.3 % are designated to conserve forest biodiversity (MCPFE class 1), and 41.6 % to protect landscapes and specific natural elements (MCPFE

Figure 3.24 Forest area in sites proposed under the habitats directive: total area of forest by biogeographical region of the EU-15



Source: EEA-ETC-BD, Natura2000 database, 2004.

([2]) All data quoted exclude information for Estonia, Lithuania, Romania and Slovenia. Estonia and Lithuania presented data for forest and other wooded land, without the possibility of extracting further detail.

class 2). Protected forest areas under biodiversity management with no active intervention account for 5.1 % of the forest area, and forest with minimum intervention account for 6.0 %. The majority of the forests (12.2 %) are under active intervention. Protected forests designated to protect 'soil, water and ecosystem functions' or 'infrastructure and managed natural resources' cover 35.1 % of the protected area (MCPFE, 2003).

A common network of protection of habitats occurring in all ecosystems, which includes a considerable number of forest habitats is being established in the EU according to the Habitats Directive 92/43/EEC and Birds Directive 79/409/EEC (Figure 3.24).

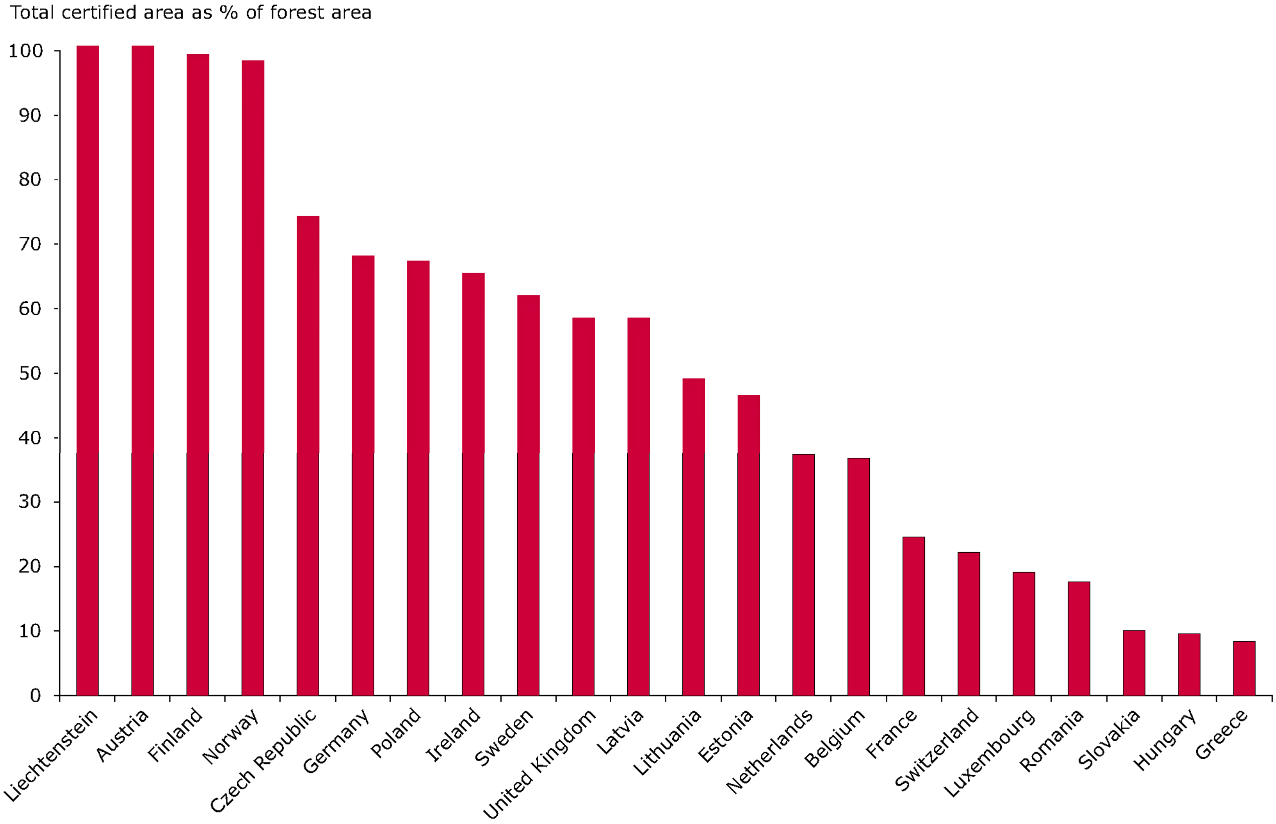
There is no single, uniform and universal model and no internationally agreed target with respect to the percentage of forests which should be protected. A current approach suggests that conservation targets can be best reached by the integration of segregated protection areas with close-to-nature forest (Bücking, 2003). Thus national networks of protected forest areas should not be seen in isolation but as a part of an overall forest management and protection strategy expressed in national forest programmes (NFPs).

Forest certification

Certification of forests is a private-sector initiative to demonstrate sustainable forest management and thus help to protect and manage biodiversity, combat illegal logging and possibly in the future also support monitoring and certify carbon sequestration. An increasing number of public and private forests have been certified over the past decade.

Producing wood products that originate from forests that are used and managed in a sustainable way is verified by an independent third party on the basis of indicators or criteria which are specific to each certification scheme. An overview of the coverage of two of the most successful certification schemes, the Forest Stewardship Council (FSC)

Figure 3.25 Forest area under certification



Note: Countries are included when the area of certified forest exceeds 10 000 ha and certified forest as proportion of total forest area exceeds 5 %.

Source: UNEP-WCMC, WWF, FSC & GTZ (2004). Information on Certified Forest Sites endorsed by Forest Stewardship Council (FSC). http://www.certified-forests.org — accessed 02/12/2005.
PEFC, 2005. PEFC Council Information Register. Statistic figures on PEFC certification. Information updated on 18/11/2005. Programme for the Endorsement of Forest Certification. http://register.pefc.cz/statistics.asp — accessed 02/05/2006.
FAO, 2005. Global Forest Resources Assessment 2005. United Nations, New York and Geneva.

and the Programme for the Endorsement of Forest Certification (PEFC) scheme is given by country in Figure 3.25.

Third-party certification of forests based on objective criteria opens the possibility of enhancing more nature-oriented forest management, resolving conflicts with indigenous people (e.g. the Sami) and strengthening rural communities. There is currently a debate about — and between — the existing certification schemes and how well they meet these objectives.

3.2.4 *Conclusions*

There are clear signs of progress in reducing threats to and enhancing the biological diversity of forests in European countries, but also several persisting issues of concern.

On the side of progress is the evidence that:

- forest area in Europe is not decreasing;
- forests are growing older and thus more valuable for biodiversity conservation;
- broadleaved tree species are now preferred to a larger extent in afforestation of agricultural land, mostly in the areas of their natural distribution;
- certification of forest products by the private sector is taking place, thus contributing to the effectiveness of sustainable management;
- forest management with a view to conserving biodiversity is gaining grounds within rural and forestry policies;
- slightly decreased effects of air pollution are observed.

Issues where urgent action is needed are:

- conservation of threatened species occurring in forests;
- control of increasing invasive alien species.

Issues where more concrete efforts are needed are:

- improvement in afforestation/reforestation with indigenous species of known provenance;
- conserving genetic resources of forest species;
- dealing with increasing rates of forest utilisation in certain parts of Europe;
- addressing the effects of changes in forest fragmentation due to changes in land use;
- more efficient control of forest fires.

3.3 Freshwater ecosystems

3.3.1 *Rivers and lakes in Europe*

Europe has approximately 1.2 million km of rivers, about half of which are relatively small rivers or streams. Larger rivers are not characteristic of Europe, as only about 70 rivers have a catchment area exceeding 10 000 km^2. There are around 600 000 unevenly distributed lakes larger than 0.01 km^2, with the highest occurrence in Finland and Sweden. As with rivers, there are far more small lakes than larger ones. Small lakes and river water bodies are important for biodiversity and often sensitive to anthropogenic pressures, such as those arising from agricultural activities.

Loss of freshwater habitats

Many of Europe's freshwater bodies have been physically modified, for example for flood protection, water storage, drainage for reclamation of land and navigation reasons. Such modifications have led to losses in or degradation of aquatic habitats and hence loss of aquatic biodiversity.

Small lakes and streams have disappeared from the landscape as a consequence of draining, which has been particularly intensive during the past century in order to gain agricultural land. Ponds, although very small and/or of a temporary nature,

Box 3.5 The EU water framework directive

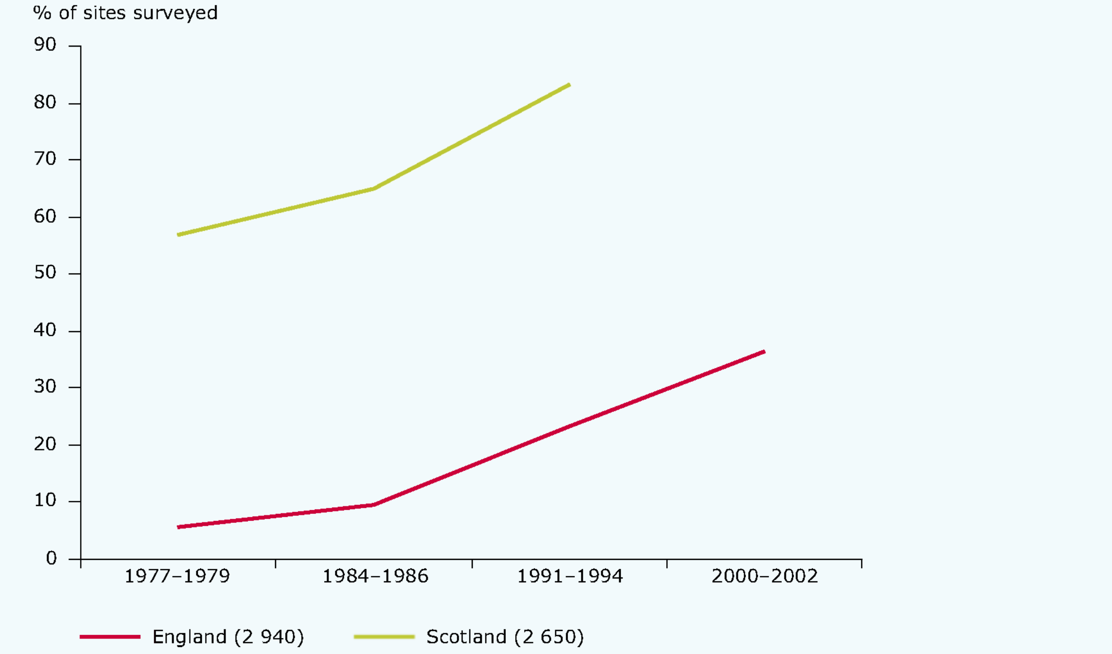
The EU water framework directive (WFD) has since 2000 been the main legislative driver of the water environment of Europe. It covers all surface water bodies out to offshore territorial marine water limits, and all groundwater bodies. One of its main objectives is to achieve good water status by 2015. Surface water status is determined by a water body's ecological and chemical status. Ecological status is assessed against a water body's reference condition which equates to a situation where there are only minimal impacts on humans. The WFD also includes measures to improve water quality in terms of potentially toxic substances and substances linked with eutrophication. EU Member States are permitted to designate water bodies as 'heavily modified' when physical modifications cannot be removed or changed to improve ecological status because of overriding socio-economic reasons. Even in such cases, measures to achieve a good ecological potential are expected to be taken as far as possible. The WFD has a direct link to the management of Natura2000 sites, to ensure the conservation of habitats and species of community importance.

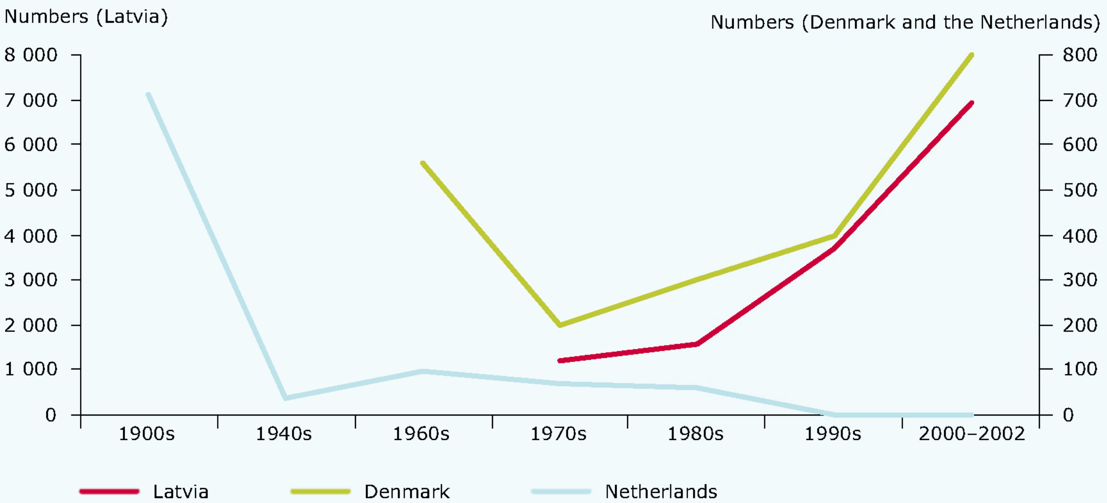
Box 3.6 The common otter population

The common otter, *Lutra lutra*, was once widespread in inland waters (rivers, lakes, marshes) and also in coastal waters. During the last century the species, in particular its inland water populations, decreased dramatically. It still thrives in Ireland, which has the densest population in western Europe (Irish EPA, 2001), but there has been a rapid decline in several other countries, see Figures 3.26A–3.26B. Destruction of habitats and pollution of watercourses, especially by organochlorine pesticides, and to some extent trapping, are the most commonly-accepted factors for this large decline.

There are now signs of recovery of the inland water populations in some countries, such as Britain, Denmark and Latvia. Otters are still absent or scarce in many other areas, for example in France, Figure 3.27.

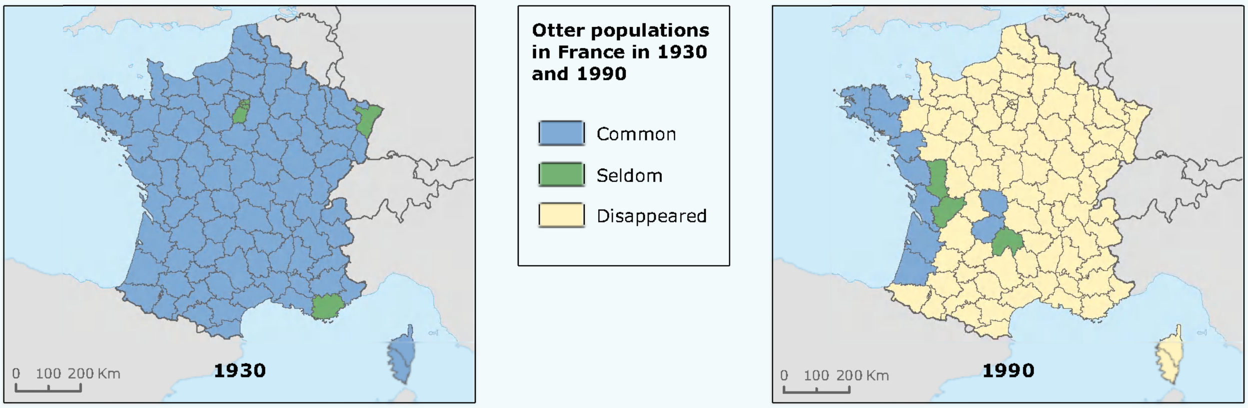
Figure 3.26A–3.26B Number of survey sites in England and Scotland with otter evidence, and numbers of otters in Denmark, Latvia and the Netherlands





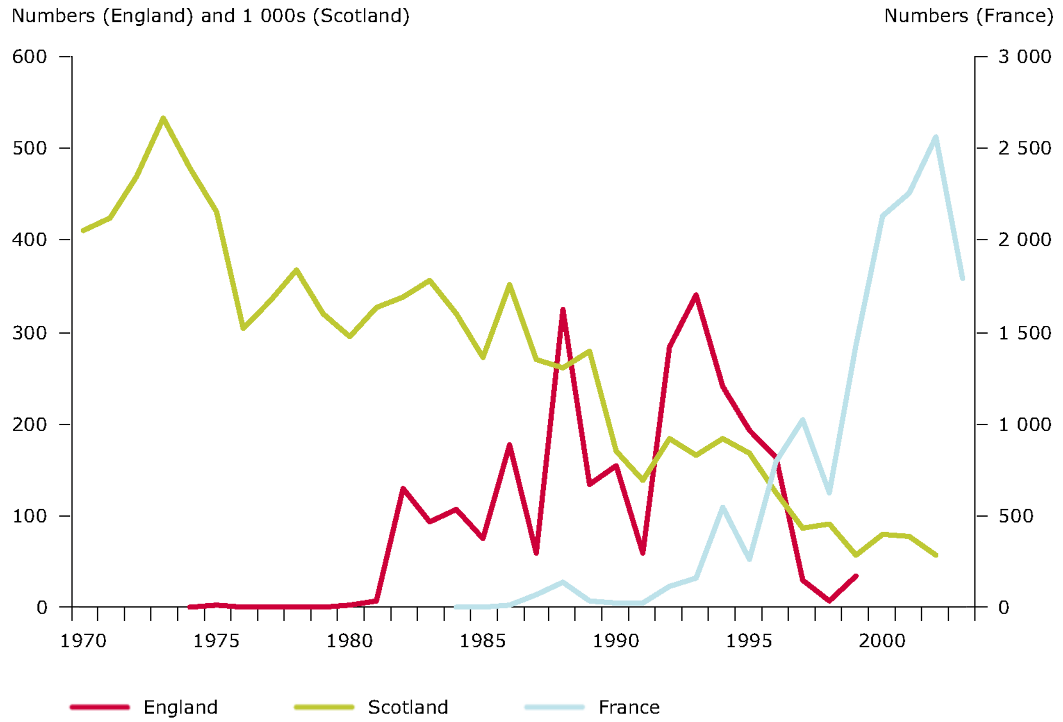
Sources: Vincent Wildlife Trust for Scottish data. England and Scotland: number of sites surveyed in brackets; http://www.environment-agency.gov.uk/yourenv/432430/432434/432458/441834/?version=1&lang=_e — accessed 02/05/2006; http://www.lva.gov.lv/; http://www.rivm.nl/; http://www.sns.dk/publikat/netpub/indikator2001eng/kap4/index.html#1.3 — accessed 02/05/2006.

Figure 3.27 Otter populations in France in 1930 and 1990



Source: http://www.cigogne-loutre.com/html/dispaloutre.html — accessed 13/10/2005.

Figure 3.28 Number of salmon returning to the rivers in England, France and Scotland since the 1970s



Notes: England: River Thames;
France: rivers Allier, Dordogne, Garonne and Rhine;
Scotland: Wild salmon caught in Scotland by fixed engine boats, net and coble and rod and line (retained).

Sources: http://www.environment-agency.gov.uk/; http://www.frs-scotland.gov.uk. CSP, V. Vauclin, 2004.

are important for biodiversity, and remain by far the most common type of standing water body in many countries. The number of ponds has been greatly reduced as part of agricultural intensification but also for other reasons including urbanisation.

Developments have been even more negative for a majority of the riparian habitats (natural wetlands, riparian forests, grazed wet meadows, etc). The main causes have been intensive agriculture and other uses of land but also interventions in rivers and lakes for water use.

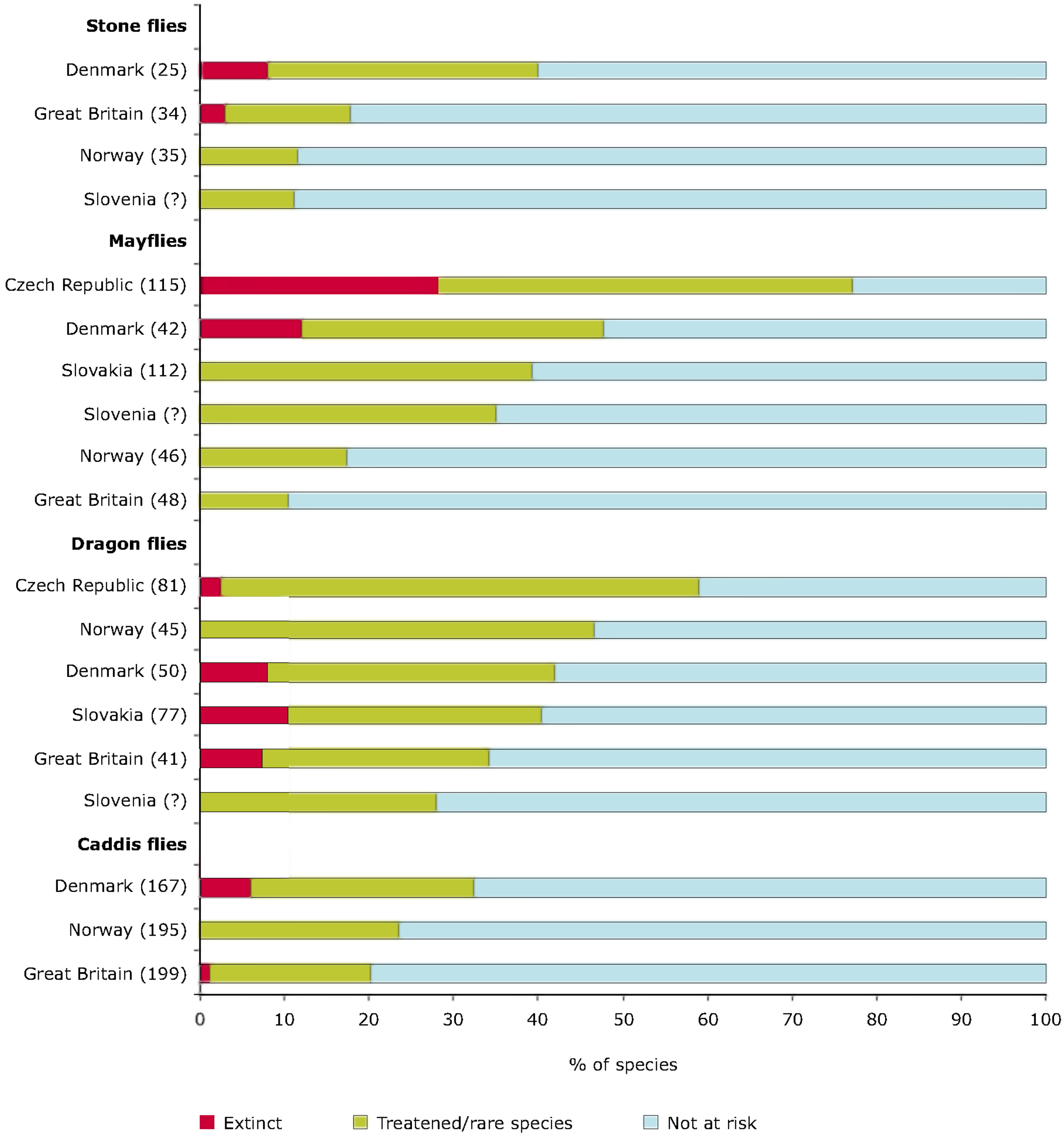
The overall effect of river dams during the last century brought about significant changes in the area of riparian habitats in Europe.

3.3.2 *Trends in species*

Poor water quality, combined with habitat loss, has affected the distribution and abundance of aquatic species and has resulted in the degradation and fragmentation of their remaining habitats.

The salmon, *Salmo salar*, is a potentially suitable indicator of river state. Once widespread in northern and middle Europe, salmon require good water quality and need a certain type of habitat to support breeding and maintain stocks. Furthermore river continuity must be maintained between seas and riverine spawning areas. The general decline of salmon in many rivers in Europe since the 1970s is ascribed to factors such as poor water quality, habitat loss and changes in climate at sea, see Figure 3.28. A recovery of salmon and sea trout

Figure 3.29 Freshwater invertebrates extinct or at risk in European countries



Notes: Number of native species (extinct and current) in brackets.

Sources: Denmark, Ministry of the Environment (2002);
Great Britain, http://www.defra.gov.uk/;
Slovakia: http://www.sazp.sk/slovak/periodika/sprava/sprava2000eng/components/flora_fauna.html — accessed 02/05/2006;
Norway: http://www.environment.no/templates/PageWithRightListing.aspx?id=2771 — accessed 02/05/2006;
Switzerland: http://www.statistik.admin.ch/;
Slovenia: www.gov.si/mop.

stocks steadily during the 1980s and 1990s was reported in some rivers, for example the Thames in the United Kingdom. This was considered to reflect improvement in water quality which allowed these fish to migrate through the previously polluted estuaries. However, over the past few years there has been a steady decline in the number of returning salmon (Figure 3.28) in the Thames, for reasons as yet unknown.

Similar declines to the salmon have been noted in other fish stocks such as eels (since the 1980s) and sturgeon (during the 1900s) in many European rivers, due to river modification by dams and weirs, and pollution. In other cases, however, improved water quality has led to increases in coarse fish stocks in rivers.

Threatened species

In many European countries, there are trends in the composition of freshwater plant and animal communities favouring fewer but more stress-tolerant species. A considerable number of the species of the original communities in many rivers, for example invertebrates like mayflies, dragon flies, stoneflies and caddis flies, are therefore now extinct or threatened, see Figure 3.29.

Non-native species

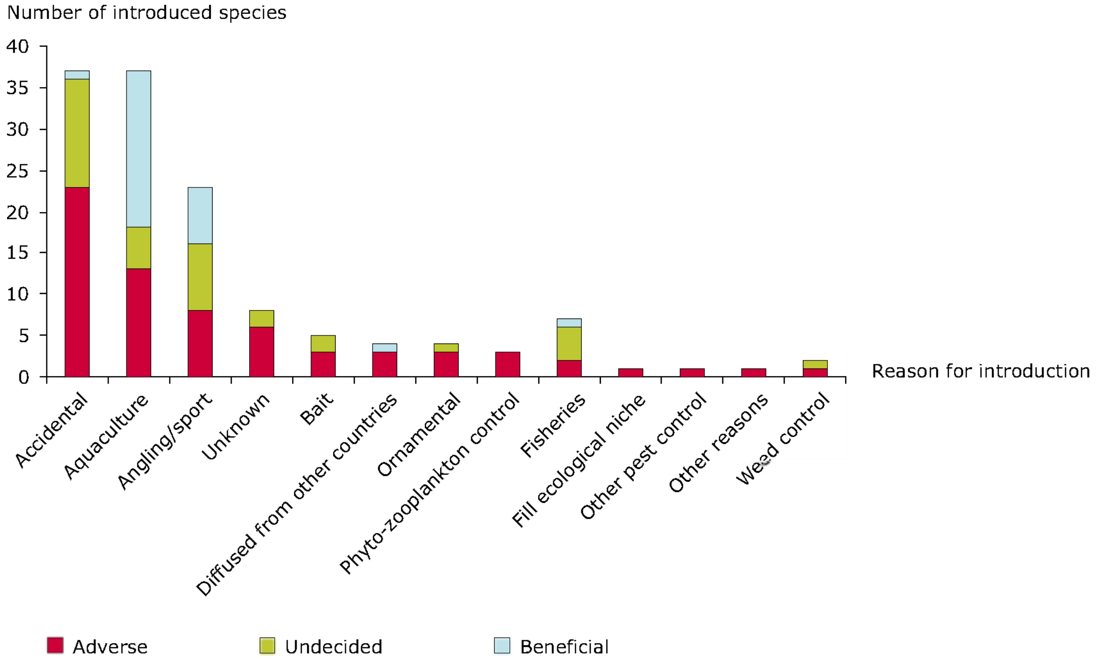
The majority of non-native species in inland waters have been introduced accidentally, either for aquaculture or for angling (Figure 3.30). For many species, the ecological effects are unknown, but the effects of those that have a known impact on ecosystems have been mainly adverse, i.e. the species are invasive.

3.3.3 Key management issues

Pollution

Increased industrial production, coupled with more of the population being connected to sewerage, has resulted in discharges of organic waste and nutrients into surface water in most European countries increasing since the 1940s. The most important sources of organic waste load are household wastewater, industries such as paper and food processing, and occasionally silage effluents and slurry from agriculture. Severe organic pollution may lead to rapid de-oxygenation of river water and high concentration of ammonia and disappearance of fish and aquatic invertebrates. Wastewater may also contain nutrients, in particular phosphorus from detergents, and other hazardous substances.

Figure 3.30 Number of introduced non-native freshwater species of various taxa which have an ecological effect



Note: Countries included: Austria, Belgium, Croatia, Czech Rep., Slovak Rep., Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, the United Kingdom.

Sources: ETC/NPB and FAO (Database on Introductions of Aquatic Species (DIAS)), http://www.fao.org/fi/statist/fisoft/dias/index.htm — accessed 02/05/2006.

Figure 3.31A Annual average concentrations of ammonium N measurements at Bimmen/ Lobith (Rhine)

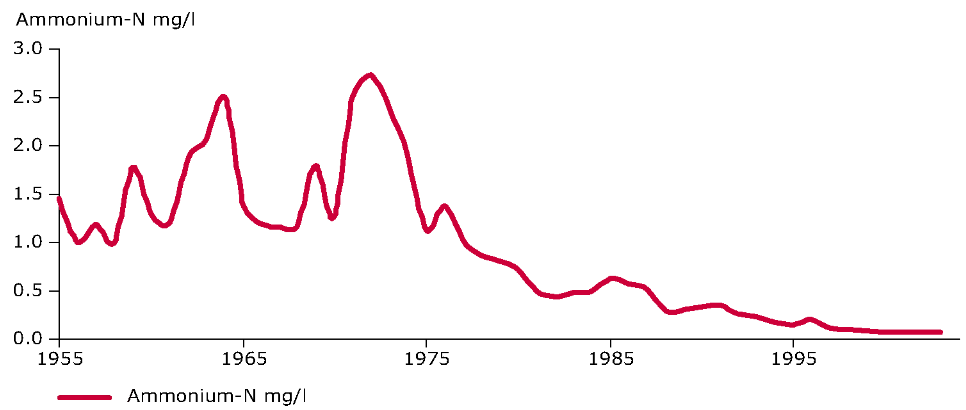
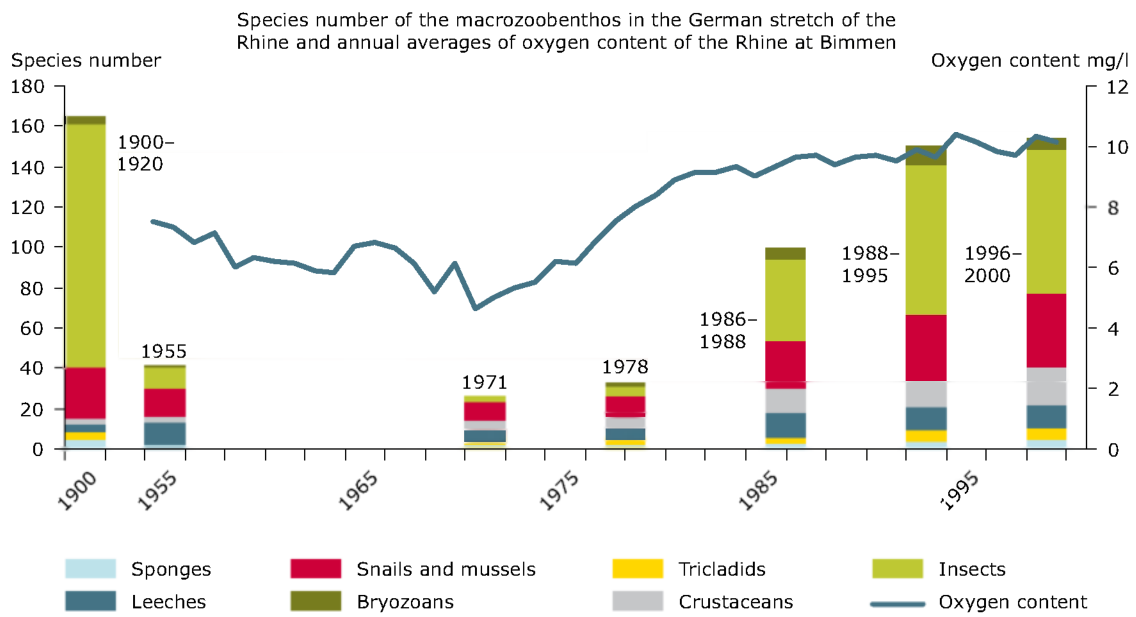


Figure 3.31B Development of aquatic community and oxygen concentration of the Rhine at Bimmen

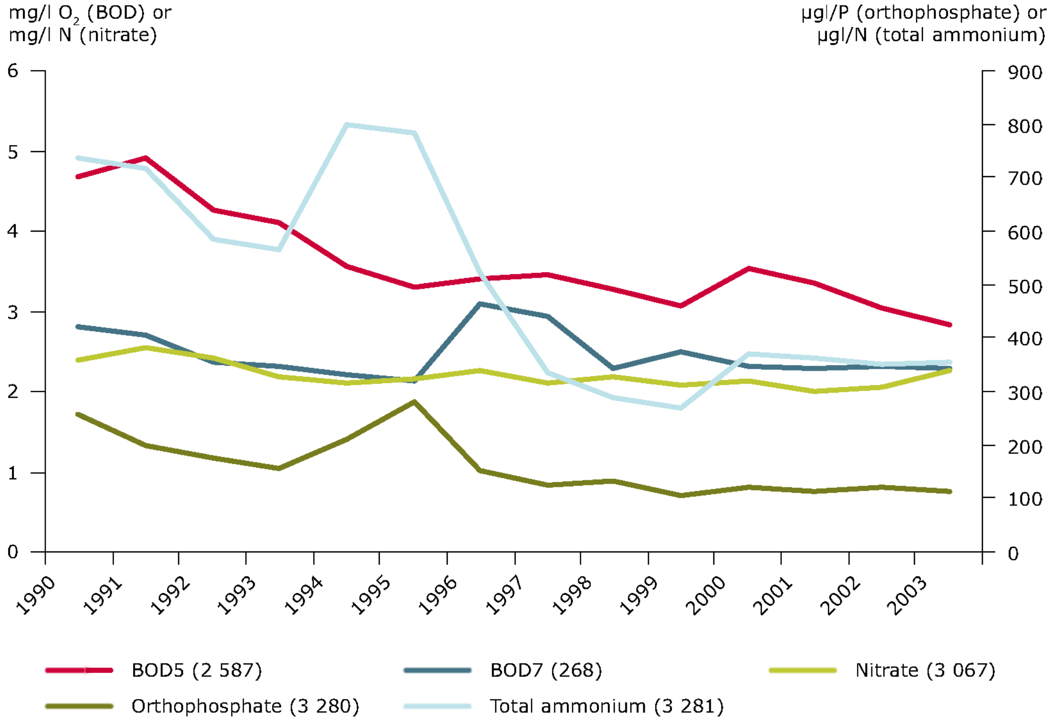


Source: Federal Environmental Agency and International Commission for the Protection of the Rhine against Pollution.

The changes in the River Rhine between 1970 and 1996 are an illustrative example. Up to the early 1970s, oxygen depletion in the central and lower reaches of the Rhine was so serious that the river was virtually dead. The concentrations of ammonia, a consequence of increase in organic matter, had reached high levels (Figure 3.31A). The annual average oxygen concentration was around 5 mg O_2/l and the number of invertebrates in 1971 reached a very low level (Figure 3.31B). As the biological treatment of wastewater was increasingly applied during the past 30 years the biochemical oxygen demand (BOD) and ammonium concentrations have fallen, the oxygen conditions have improved and the number of invertebrate species in the river has recovered.

Large inputs of nitrogen and phosphorous to water bodies can lead to eutrophication, which causes ecological changes that result in a loss of plant and animal species (reduction in ecological status and biodiversity). The main source of nitrogen pollution in many catchments is run-off from agricultural land, but discharges from wastewater treatment works can also be significant. For phosphorous, industry and households are often the most important sources.

Figure 3.32 Concentrations of total ammonium, biochemical oxygen demand (BOD), nitrate and orthophosphate in European rivers between 1992 and 2002



Notes: Concentrations are average of the annual average concentrations per year. Total number of stations in brackets.
Source: EEA (Waterbase data collected through Eurowaternet).

The concentrations of orthophosphate, total ammonium, and organic matter in European rivers have in general been decreasing steadily over the past 10 years (Figure 3.32). In the EU-15 this is because of the measures introduced by European legislation, in particular the urban waste water treatment directive. In addition, the transition recession in the economies of the new EU Member States may have played a part in the decreasing phosphorus and nitrogen trends. The closure of potentially polluting industries and a decrease in agricultural production led to less use of nitrogen and phosphorus fertilisers.

At the European level, there are some signs of a decrease in concentrations of nitrate in rivers. The decrease has been slower than for phosphorus because measures to reduce agricultural inputs of nitrate, such as those in the nitrates directive, have not been implemented in a consistent way across EU countries and because of the probable time lags between reduction in agricultural nitrogen inputs and soil surpluses, and resultant reductions in surface and groundwater nitrate concentrations.

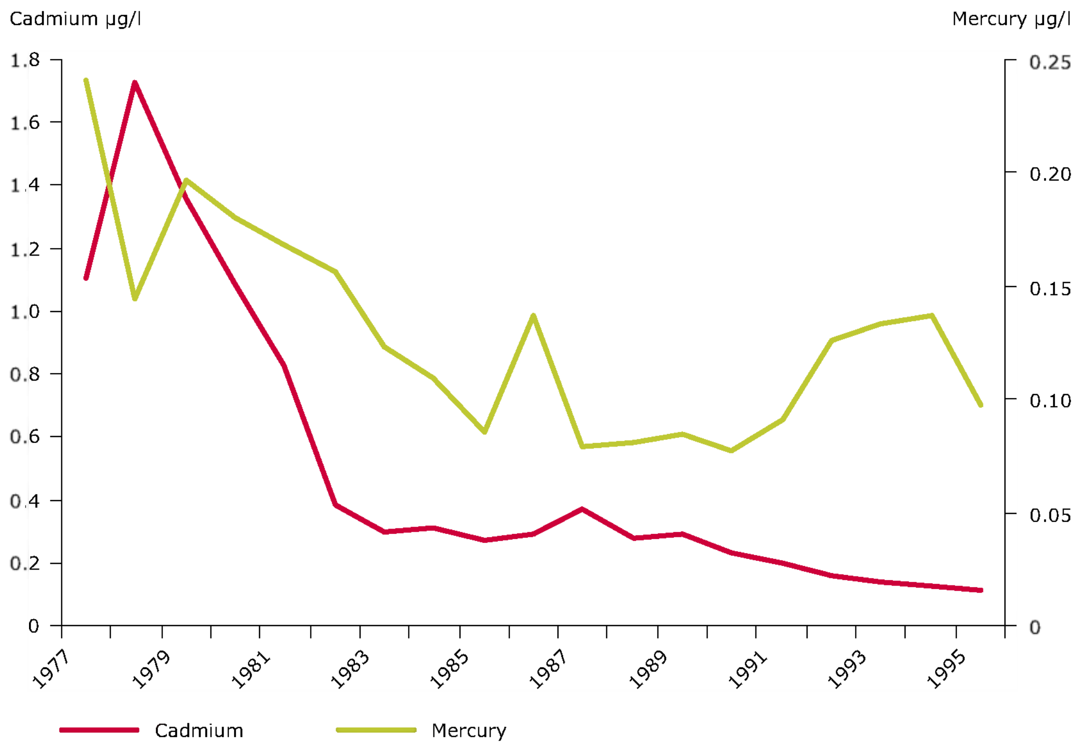
European sulphur emissions increased steadily from 1880 up to a maximum in 1980, followed by a steep decline. Surface water acidification became a public concern in the 1970s when awareness was raised by episodes of severe fish kills in rivers and lakes in the southernmost part of Norway, and along the west coast of Sweden. Measures to reduce long-range airborne sulphur pollution is one of the environmental success stories.

The ecological and physiological impacts of hazardous substances are complex and may significantly affect biodiversity. Elevated concentrations of pesticides, heavy metals, etc. have been found in many of Europe's waters. Efforts to reduce emissions of heavy metals are reflected in their occurrence in rivers, see Figure 3.33. Several classes of chemicals are known to affect sexual development and reproduction (endocrine disruption) (European Commission, 2001). A number of studies have now been carried out on freshwater and estuarine systems in Europe, and endocrine disruption has been noticed in fish exposed to effluent from sewage treatment works.

Regulation of rivers

Most big rivers in Europe have been subject to extensive damming for hydroelectric power, canalisation to facilitate transport, or drainage of

Figure 3.33 Trends in concentration of cadmium and mercury at river stations included in the EU exchange of information decision



Note: In less polluted areas, e.g. in Nordic countries, concentrations of cadmium and mercury are only 10 and 1% of these values. Average of the annual country average concentrations:
Cadmium data from Belgium, Germany, Ireland, Luxembourg, Netherlands, the United Kingdom.
Mercury data from Belgium, France, Germany, Ireland, Netherlands, the United Kingdom.

Source: EU Member State returns under the exchange of information decision.

Box 3.7 Regulation of the Danube — Europe's largest river

There have been significant structural modifications to the Danube since the 1800s, mainly to control floods and improve navigability. This involved the construction of dykes along the river, thereby reducing the inundation of the floodplains. The area of the temporarily inundated floodplains in Hungary used to be 22 000 km^2 but flood control works have reduced their area by 93 %, to only 1 800 km^2 (IUCN, 1995).

These physical modifications have had a number of indirect effects on the hydrology and channel morphology of the Danube. The reduction in river length has accelerated the passage of flood peaks, and the river regimes have become more extreme.

The straightening and dredging of the riverbed increased channel erosion, which led to a deepening of the main riverbed, as shown by the general dropping of low water levels. Riverbed degradation restricted the connectivity of backwaters to the main river channel, which led to a decreasing water supply and intensive siltation of floodplain water bodies.

The annual inundation of the floodplains is a crucial event for the reproduction and productivity of fish populations in the Middle Danube. The history of the fishery emphasises the importance of inundated floodplains. The Tisza is one of the largest tributaries of the Middle Danube, and its temporarily inundated floodplains used to cover 22 600 km^2. Comprehensive flood control dammed off 93 % of the floodplain, causing an enormous loss of spawning and production area, and a 99 % reduction in fish catches (Guti, 2001).

the riparian habitats to provide agricultural land. This activity has been intense during the past 150 years but has started to level off, because very few unregulated waters remain but also because of an increased awareness of the ecological importance of riverine habitats to buffer flooding and the conservation value of remaining little-impacted river systems.

However, there has been a number of initiatives during the past decade to restore rivers and riverine habitats such as in the river Skjern Å in Denmark, one of the largest nature restoration projects in northern Europe. Restoration work has included removal of unnecessary dikes, pumping stations, bridges and roads, and about 40 km of new watercourse have been excavated and regulated over a period of 3 ½ years. The result is more or less a return to the river bends of the Skjern Å in 1900.

Lakes in Europe have also been extensively regulated, mainly to gain agricultural land. This had also led to losses of natural water regimes and shore habitats. There are a number of spectacular projects to restore biodiversity in lakes that have been regulated, e.g. Lake Hornborgasjön in Sweden.

Finally, in traditional agricultural systems, riverine and lake-shore habitats were to a large extent grazed or mowed. The managed grasslands and meadows, which were also to a certain extent formed by periodic flooding and by movements of ice, provided particular habitats for a number of species which today appear on red lists. Recreating and restoring the management of these habitats is probably one of the greatest challenges for nature conservation.

3.3.4 Conclusions

Overall, progress towards the 2010 target to halt biodiversity loss on freshwater ecosystems in Europe is visible only with regards to water quality and the target is unlikely to be reached without restoring riverine habitats and biological communities as well as counteracting the effect of river fragmentation by dams.

On the side of progress is the evidence that:

- a marked improvement in the water quality of many rivers and lakes in recent decades has made the water suitable again for the potential return of some of the lost species;
- in many cases, improved management practices have been applied in riparian areas, for example the construction of ponds and the provision of fish ladders through dams and weirs;
- there have been a number of initiatives to restore rivers and riverine habitats.

Issues where urgent action is needed are:

- counteracting the effects of increased and almost irreversible habitat loss, fragmentation and modification due to dams and canalisation;
- reversing the trend of many freshwater species that are threatened or at risk of extinction;
- addressing the presence of chemicals that have endocrine-disrupting properties in many freshwater bodies.

Issues where more concrete efforts are needed:

- decreasing the levels of agricultural run off into fresh water systems, which now appear to have stabilised;
- minimising the increasing presence of invasive alien species;
- ensuring appropriate conservation and management of the few remaining natural freshwater systems.

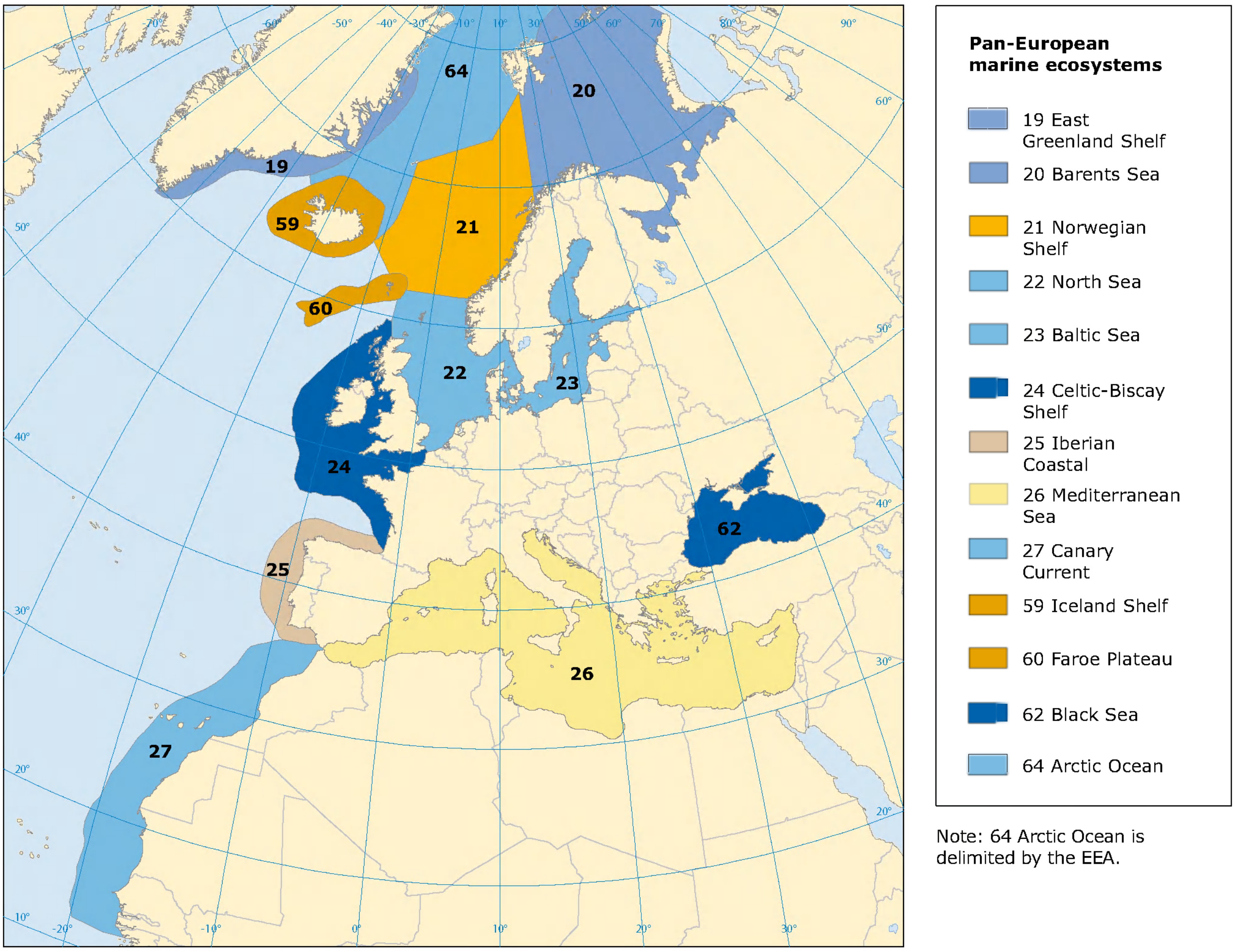
3.4 Marine and coastal ecosystems

Large marine ecosystems (LMEs) (Sherman *et al.*, 1990) are shelf-based marine systems and characteristically distinct ecological units with regard to habitats and species composition. Out of the 64 LMEs defined worldwide, 13 are pertinent to the European continent, see Figure 3.34.

The large marine ecosystems of the Baltic Sea, North Sea, Celtic Biscay shelf, Mediterranean Sea and Black Sea are linked to and influenced by the coastal zones and inland catchments of the EU area. Their coastal zones are characterised by a very long and diverse coastline, which corresponds to 11 % of the total EU area. Both the marine and the coastal environments contain diverse habitats that support a rich biodiversity. The marine environment has been exploited mainly by fisheries, the oil industry and aquaculture. Coastal areas have always been attractive for settlement, agriculture and trade and have subsequently become important for industry, transport and tourism.

The Convention on Biological Diversity (CBD) at an early stage recognised that seas and coastal areas were under threat from pollution, over-exploitation and ill-planned coastal development and adopted the 'Jakarta Mandate' in 1995. In line

Figure 3.34 Pan-European marine ecosystems



Note: 64 Arctic Ocean is delimited by the EEA.

Note: The Large Marine Ecosystem (LMEs) project was created in support of the global objectives of Chapter 17 Agenda 21, as a follow-up to the 1992 United Nations Conference on Environment and Development (UNCED).

Source: UN (see http://www.oceansatlas.org).

with this, collaboration at the global level comprises the UN Environment Programme (including the Global International Water Assessment), the UN Food and Agriculture Organization, the UNESCO Intergovernmental Oceanographic Commission, the International Maritime Organization and other relevant bodies.

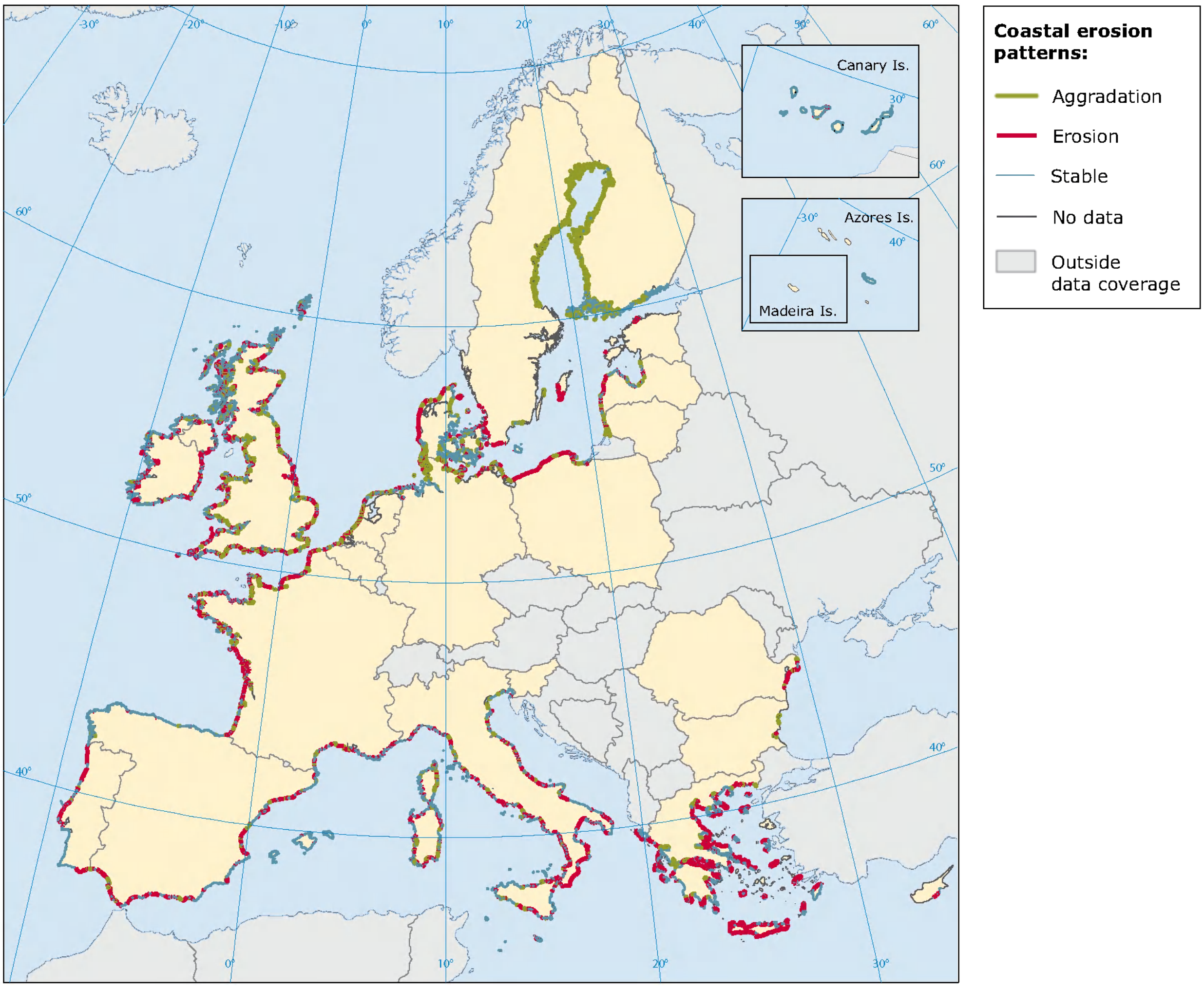
A number of activities across Europe result in pressures on marine biodiversity, the most important probably being fishing. One of the EC biodiversity action programmes focuses on fisheries (EC, 2001), while the common fisheries policy (CFP) and the marine strategy are also considering ways to minimise impacts on marine biodiversity.

3.4.1 Trends in ecosystems and habitats

In the Black Sea, an increase in phytoplankton blooms has been observed together with a sharp reduction in the biomass of small zooplankton species, such as copepods. Another clear sign of disturbance in the same area is the serious decrease in the area of the habitat of red algae (*Phyllophora spp)* due to a reduction in water transparency and a general degradation in water quality. The most extensive habitat of red algae in the world occupied 11 000 km^2 in the centre of the north-western shelf of the Black Sea. This habitat type cover has shrunk by at least 70 % since the early 1980s and by the early 1990s it had dropped to a mere 500 km^2 (Zaitsev, 1992).

In the Baltic Sea, increasing amounts of filamentous algal mats have been observed to replace the habitat of the eelgrass, *Zostera marina,* during the past ten years. In two large areas of Denmark, (Öresund and Limfjorden) the area of the eelgrass habitat in the 1990s was only 20–25 % of that in 1900 (Short and Green, 2003).

Figure 3.35 Costal erosion patterns in Europe



Source: Eurosion, 2004.

The Mediterranean coast has a more or less continuous rim of sea grass beds including the most productive beds of *Poseidonia oceanica*. Regression of sea grasses has been observed close to major urban centres, e.g. in the vicinity of Venice, Marseilles, Toulon and Alicante.

Reefs of cold-water corals occur on an otherwise flat and featureless sea floor and have a quite significant distribution, for example in the Celtic-Biscay shelf. Due to the fact that fishing practices are now able to impact the very deepest zones, surveys are already showing the signs of reef degradation.

Coastal habitats in Europe have continued to shrink, with a 10 % increase since 1990 in the area covered by concrete or asphalt. As a result, grasslands and heath near the coasts are disappearing in Greece, Portugal and Spain. The few coastal forests remaining in Europe are increasingly fragmented and under pressure from tourism and urban development. There has been a net decline of 390 km^2 in European coastal wetlands since the 1990s, which is quite alarming when taking into account that about two thirds of the coastal wetlands of Europe has already disappeared in the past two centuries.

A large part of the European coastline is to some extent affected by coastal erosion, see Figure 3.35.

3.4.2 Trends in species and communities

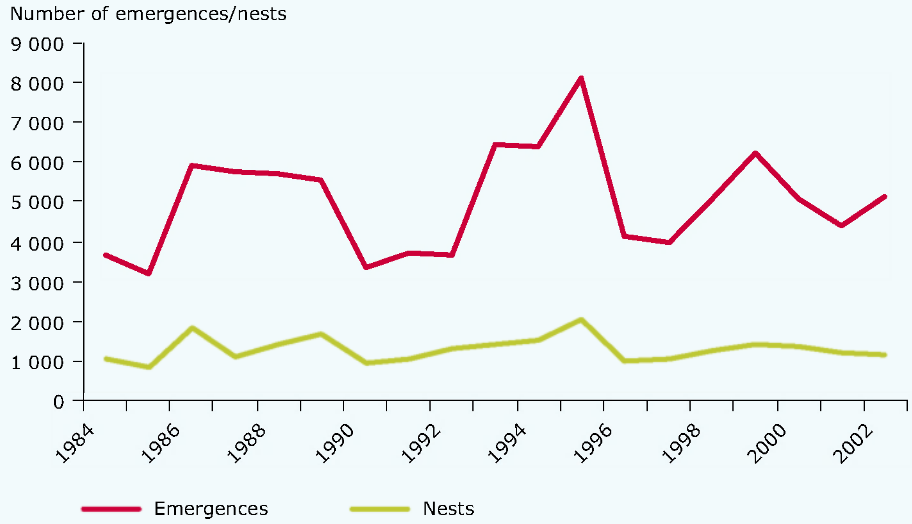
A real reduction in species richness in marine systems is relatively rare: most changes in biodiversity are concerned with relative abundance. However, the fact remains that fishing in particular can reduce numbers to 'functional extinction' of certain species, which is reflected in a simplification of food webs and linkages within the ecosystem.

Box 3.8 Trends in nesting activity of the loggerhead turtle *Caretta caretta* in Laganas Bay, Zakynthos, Greece

The loggerhead turtle is considered a threatened species by IUCN; it is listed under the new Red List categories and criteria as endangered. This sea turtle is also a species of Community importance (EC Habitats Directive) and is included as a protected species in several international conventions (Barcelona Convention, Bern Convention, CITES).

The documented loggerhead nesting effort in the Mediterranean reaches an average of 5 031 nests/season; of these, 60.6 % (3 051 nests/season) are in Greece, 27.2 % (1 366 nests/season) in Turkey, 11.4 % (572 nests/season) in Cyprus, and the remainder in Israel and Tunisia, not including nests outside the monitored areas or in countries where regular monitoring has not yet been initiated (e.g. Libya). The average annual number of nests in Laganas Bay, (1 294 during 1984-2002), represents 42.4 % of the total nesting effort in Greece and 25.7% of the total nesting effort in the Mediterranean.

Figure 3.36 Inter-annual variation of loggerhead turtle nesting activity (emergences and nests) at Laganas Bay, during the 19-year study period (1984–2002)



Source: Margaritoulis D., 2005.

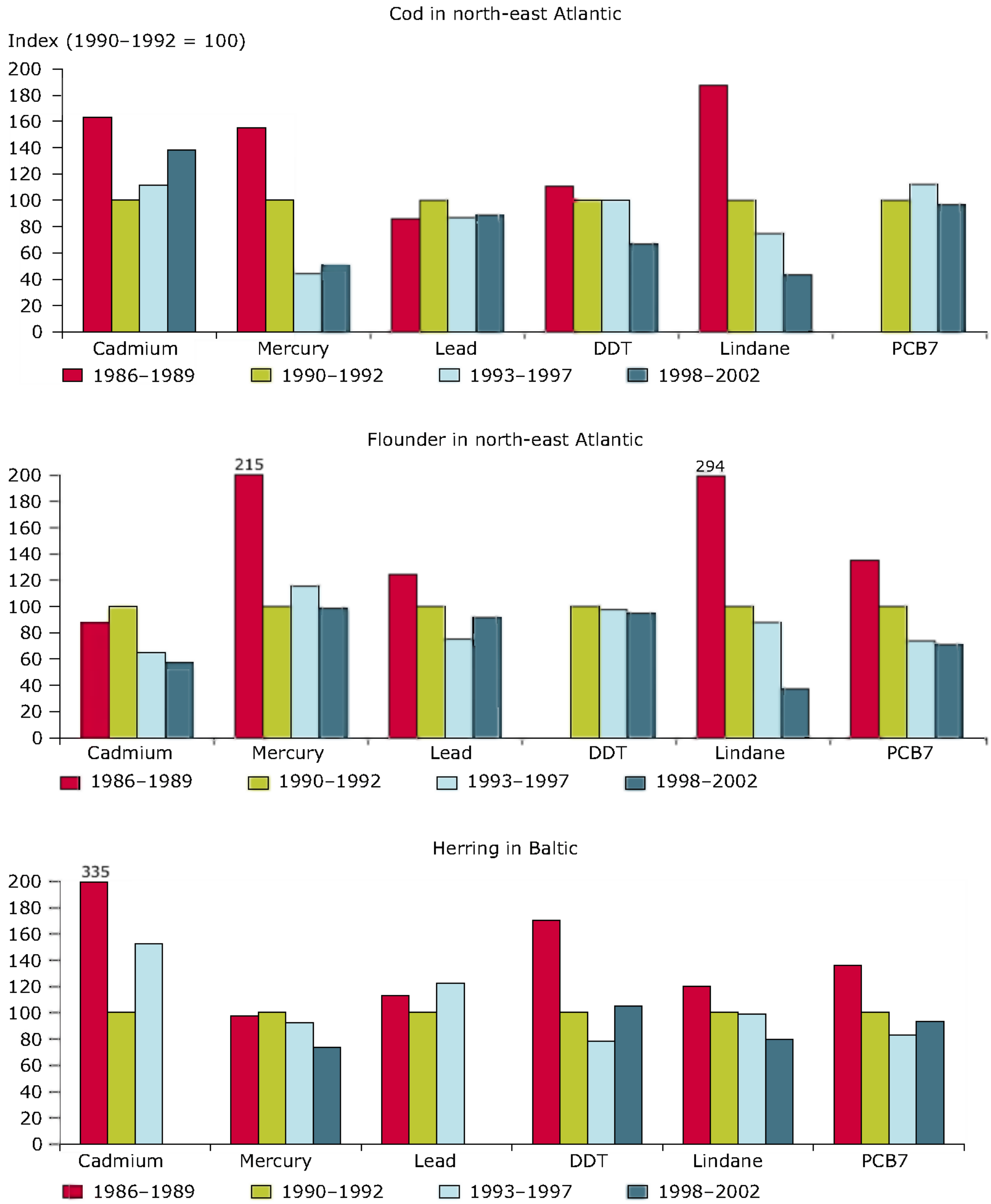
The absence of an apparent trend in the annual nesting effort, after 19 years of systematic monitoring in Laganas Bay (see Figure 3.36), should not be interpreted as indicating a 'stable nesting population' because a possible trend may be obscured by the high inter-annual fluctuations (see also Limpus, 1995). It seems that more years of monitoring the nesting activity are necessary to allow a reliable evaluation of trends in Laganas Bay.

Fish as a group interact at every trophic level and can therefore provide an integrated picture of the types of change that are occurring. In addition, because of their economic importance, there are usually time-series of data for a number of species, at least from catches.

Benthic organisms face a different situation. Living only on the bottom, they are continuously exposed to the ambient water quality and serve as indicators of the integrated changes occurring in their particular locality. Critically low oxygen levels and massive fluctuations in temperature, pH or salinity are relatively rare in marine systems compared with freshwater systems. Pollution issues are linked more with micro-pollutants than with macro-pollutants.

Jellyfish (*Scyphozoa*) may serve as an example of species that respond to multi-factorial changes. The abundance of jellyfish in many large marine ecosystems throughout the world is increasing, possibly as a result of a simplification of the marine food web, which favours species of the low trophic level. The moon jellyfish (*Aurelia aurita*), a cosmopolitan species, is no exception. The abundance of *A. aurita* is itself mediated by hydro-

Figure 3.37 Regional trends of hazardous substances in fish from north-east Atlantic and Baltic regions



Source: EEA, 2003.

climatic conditions, such as water temperature, current speed and wind strength and it has been shown to correlate with reductions in the stocks of finfish such as herring at a higher trophic level, like those associated with the North Atlantic Oscillation (NAO). The NAO also determines the distribution and abundance of several jellyfish predators, including other jellyfish and finfish.

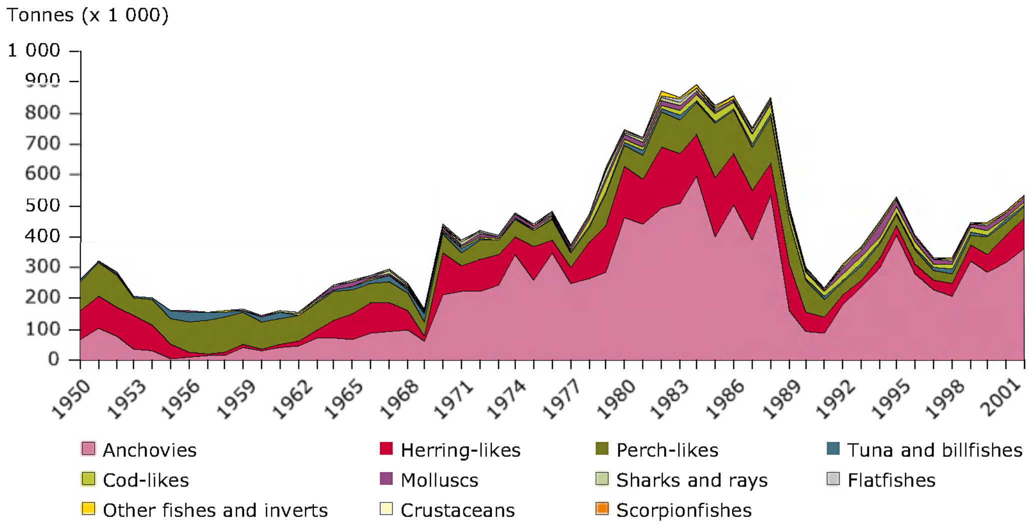
More than 300 marine species are considered globally threatened by IUCN (2002) and about 40 of these are mammals, birds and marine turtles. Several marine and coastal species and habitat types are considered of Community importance by the EC habitats and birds directives. Conservation efforts have been enhanced in recent years by the establishment of marine and coastal protected areas; however the long-term survival of several of these species remains uncertain.

3.4.3 Key management issues

Pollution

Macro-pollution sources in open marine systems include marine oil and gas platforms and the ever-increasing maritime traffic. Major oil spills in the

Figure 3.38 Landings of main commercial species in the Black Sea



Source: Large Marine Ecosystems of the World 2003.data downloaded from: www.seaaroundus.org.

open sea are relatively rare in European waters, but have big impacts, also on the coastal zone. Most of sea pollution originates from land-based sources. The role of river inflows is relatively most important for enclosed seas like the Baltic and the Black seas.

The pressure of industrial pollution can be shown by the elevated levels of heavy metals, pesticides and hydrocarbons and plastic derivatives that accumulate in living fish (Figure 3.37). The data show, in almost every case, that concentrations in fish tissues have fallen quite consistently since 1989, with the possible exception of lead. This is presumably a result of control and regulation policies on land starting to reduce effluents and emissions.

Nitrogen and phosphorus loads, originating from agriculture and households, encourage phytoplankton blooms, which result in perturbations of the pelagic system. In addition, probably as a result of decreased water transparency, bottom-dwelling macrophytes, along with their associated communities, are reduced or eliminated. For example, substantial shifts in benthic invertebrate species towards species that favour fine organic-rich sediments, typical of nutrient enrichment, have been noted in the Mediterranean (De Leiva Moreno *et al*., 2000).

A 12 % increase in fishing activity has been seen in the Mediterranean Sea over the past decade and catches have also been rising, particularly of the sardine-like and pelagic species. As the Mediterranean is poor in nutrients, this could be attributed to nutrient enrichment up through the food chain boosting fish production (Caddy, 1997). However, a positive effect on production often corresponds to a negative change in species diversity.

The impact of enrichment on the bottom communities is further exacerbated by the addition of suspended organic material to the system, either directly from run-off or from increased primary production due to enrichment. This can lead to an extension of the anoxic bottom layer, as in the Black and Baltic seas.

Fishing

Fishing has altered the relative abundance of species as it removes the larger fish of the target species, and also the large top predators. An example is the Black Sea where the number of fish species in annual catches has been reduced from 27 to 6 over the past two decades, although all the species can still be found by systematic searching.

The Black Sea was the last European system to be developed as a modern commercial fishery and the decline in large pelagic predators such as swordfish, *Xiphias gladius*, tuna, *Thunnus thunnus*, and mackerel, *Scomber scombrus* is well-documented, Figure 3.38. As the top predators declined there was a tendency for the Black Sea anchovy, *Engraulis encrasicolus pontius*, to increase, and, as shown in Figure 3.38, an even more dramatic increase in the sprat, *Sprattus sprattus*, rising to a peak in 1979. The reason for the subsequent declines in anchovy and sprat is complex but increased fishing is clearly a factor, a phenomenon known as 'fishing down the food chain'.

The reduction in numbers and size of cod, *Gadus morhua,* and other whitefish species in the Baltic and North seas is similar, as these have also been the major fish predators in their systems. The result tends also in this case to be an eruption of smaller, often prey species.

In particular, fishing for industrial purposes, other than direct consumption, may focus on smaller species. An example of the impact of such increased industrial fishing relates to sand eels, *Ammodytes tobianus.* During 1970–1990 there was a large reduction in the North Sea numbers of puffin, *Fratercula artica,* a bird that feeds mainly on sand eels (European Bird Census Council, 2004).

A further impact of fishing is by-catch. It is evident that by-catches of small whales in the Mediterranean, the Celtic-Biscay shelf, the North Sea and the Arctic are creating a significant threat. Marine turtles are commonly caught in nets in the Mediterranean, and this may be linked to their declining numbers. Physical damage, in particular by trawling, is also a threat to cold-water corals and associated communities as well as to the sea grass and *Phyllophora* beds in the Baltic, Mediterranean and Black seas.

The common fisheries policy (CFP) seeks to limit catches and fishing effort according to scientifically-determined catch limits (TACs and quotas). This has not been entirely successful, as many stocks are still in decline, in some cases to below the estimated limits for sustainable use. The CFP was recently reformulated, following a wide consultation, in order to incorporate environmental as well as industry concerns. The concept of sustainability has always been important although the precautionary principle was rather a latecomer to the tools of the CFP. There is no doubt that if fish stocks could be maintained around these sustainable limits it would both help stabilise the wider aspects of biodiversity and ultimately increase yields.

A number of stocks have been targeted for the initiation of stock recovery programmes where catches are set lower than replacement levels to facilitate recovery. The most immediate targets are the stocks of cod, *Gadus morhua,* and hake, *Merluccius merluccius,* and some cod recovery programmes are already under way. To help enforce these measures, the Commission is planning a new Community Fisheries Control Agency, to be functional by 2006. The degree of coherence between European environmental policy in this respect and the CFP, as well as its consistency with the FAO Code of Conduct for Responsible Fishing, should be further analysed.

Aquaculture

Aquaculture production world-wide is making a significant and growing contribution to fish production. Although most of this industry is in fresh water, it is having increasing impacts on marine systems through nutrient enrichment. More directly, however, aquaculture can affect the genetic diversity of wild populations. Cultured fish species tend to be spawned from a relatively small stock of females, meaning that the genetic diversity of cultured populations is much less than in the wild and the broodstock may effectively represent a somewhat 'domesticated' strain. A number of fish inevitably escape from their enclosures and may cause genetic dilution of the wild type. Since aquaculture is very intensive, there is also a risk of disease epidemics breaking out which can be spread to the local wild populations.

Major stocks liable to such effects on genetic diversity and such impacts include the salmon, *Salmo salar,* in the North and Baltic seas, the turbot, *Scopthalmus maximus,* around Spain (Celtic Biscay shelf), sea bass, *Dicentrarchus labrax*, and sea bream, *Sparus aurata* in the Mediterranean, and sturgeon in the Black Sea.

Invasive alien species

Invasive alien species are frequently introduced into marine ecosystems and may have a significant impact on biological diversity. Introduced species comprise 23 % of the total flora of Thau Lagoon, France (Verlaque, 2001), 20 % of the estuarine biota in the North Sea (Wolff, 1999) and 18 % of the total biota in the eastern Bothnian Sea (Leppakoski *et al.*, 2002).

Vessels provide suitable transportation habitats for alien species in ballast waters, sediment in ballast tanks, sediment attached to anchors, and hull fouling. Other modes of introduction include opening of canals that support natural migration (e.g. the Suez Canal). In the Mediterranean, for example, apart from introduction through the Suez Canal, which accounts for 38 % of all alien species, the major causes of translocation of species and genes are transportation via shipping (25 %) and aquaculture (20 %), including stocking.

The International Convention for the Control and Management of Ships' Ballast Water and Sediments, under the IMO, was adopted in 2004. Under this

Box 3.9 The North American jellyfish (*Mnemiopsis)* in the Black Sea

The North American jellyfish, *Mnemiopsis leidyi* was accidentally introduced into the Black Sea in the early 1980s, possibly with ballast water. The numbers of *Mnemiopsis* exploded and in doing so depleted native ichthyo- and meso-zooplankton stocks, thereby damaging the food basis for the recruitment of pelagic fish species to such an extent that it contributed to the collapse of entire Black Sea commercial fisheries in the late 1980s (FAO, 1997). Eventually, however, the *Mnemiopis* population was reduced, possibly with the help of an introduced control agent, another jellyfish, *Beroe*. For example the anchovy has managed a modest recovery in recent years, apparently without further interference from the initial newcomer.

Box 3.10 Manila clam (*Tapes philippinarum*) in the Adriatic

Among alien species in the Venice lagoon in Italy, the Manila clam, *Tapes philippinarum* is surely the most well-adapted and widespread species in the entire lagoon basin. This species, a native of the Indo-Pacific area, was introduced into the lagoon in 1983, to enhance the aquaculture activities in a depressed period for the fishery and aquaculture sector in the lagoon. The exploitation of the clam banks represents one of the main sources of environmental disturbance in the Venice lagoon. The mechanical harvesting of clam, developed since the beginning of 1990s, now consists of about 600 boats equipped with mechanical dredges, operating without any kind of management strategy, and causing heavy stress on bottom communities and the whole lagoon ecosystem (Pranovi *et al*., 2004).

At present, Italian catch of all 'mussels' is the largest in EU, estimated to be 46 000 tonnes in 2002 (Eurostat, 2004).

Convention, Parties are encouraged to take more stringent measures to mitigate the transfer of harmful aquatic organisms through ships' ballast water and sediments.

Aquaculture introductions are primarily intentional but often include associated non-target species, including parasitic organisms. Aquaculture production has been increasing steadily since the 1970s. Nevertheless, the number of introduced species has been fairly stable, with the exception of a peak in accidental introductions in the 1980s. This suggests the success of policies for regulating aquaculture in line with the Convention on Biological Diversity and the Code of Practice of the International Council of the Exploration of the Sea (ICES, 1995), through measures enforced in many European countries (licence systems, other legal measures, quarantines).

Nature conservation
Nature conservation is an important and growing element in the coastal and marine environment. Significant areas of important coastal and marine habitat types and habitats of endangered marine species such as the Mediterranean monk seal *Monachus monachus*, the sea turtle *Caretta caretta* and others have been proposed for inclusion in the Natura2000 Network, see Figure 3.39.

3.4.4 Conclusions

Seen in an ecosystem context, the loss of biodiversity in all European seas and coasts is considerable and shows little sign of being reduced. The only area of progress, although not spectacular, is the improvement in the abiotic conditions of the Black Sea, which was badly damaged in the past; conditions in the Mediterranean Sea remain critical.

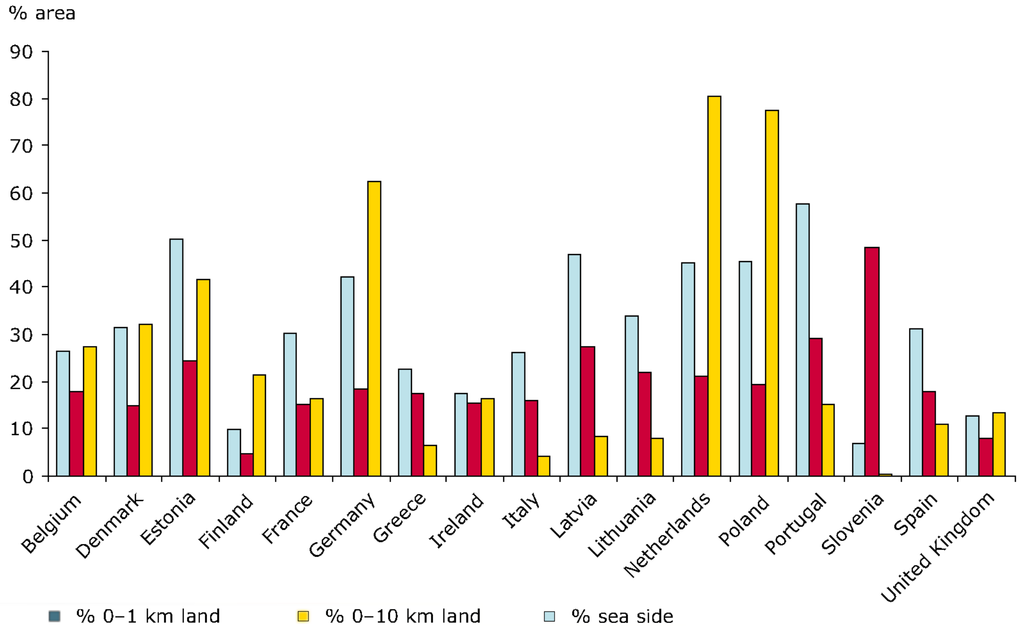
Issues where urgent action is needed are:

- counteracting the continuous loss and fragmentation of natural habitat areas on the coastline as well as soil erosion, caused by urbanisation, tourism and infrastructure development.

Issues where more concrete efforts are needed are:

- restoration of fish stocks;
- reducing pollution from land based sources;
- reducing the risks of oil spills;
- conserving threatened and endangered marine species;
- effective management of aquaculture in order to decrease the risks of pollution and genetic erosion;

Figure 3.39 Percentage of coastal surface covered by Natura2000 designated areas



Note: Refers to 10 km zone for terrestrial and for marine side, respectively.
Source: EEA, 2005.

- controlling and reducing the increased numbers of invasive alien species in the marine environment.

3.5 Wetlands

All EEA member countries, which include the EU Member States, are Contracting Parties to the Ramsar Convention on Wetlands (1971) and therefore use the convention as a common policy framework regarding wetlands. The convention defines wetlands as 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres'.

A main activity within the Ramsar Convention is 'to develop and maintain an international network of wetlands which are important for the conservation of global biodiversity and for sustaining human life through the ecological and hydrological functions they perform'.

The 32 EEA members countries including Switzerland have designated 673 Ramsar sites (excluding territories overseas), covering 8 180 418 ha (September 2004) see Figure 3.40. This area represents about 19 % of the total wetland area of these countries (Nivet and Frazier, 2002; 2004).

A high percentage of designated Ramsar wetland sites are also designated as special protection areas (SPAs) under the EU birds directive. With the introduction of the EU habitats directive in 1992, further emphasis was placed on the designation of priority wetland types as special areas of conservation (SACs), resulting in combined SPA/SAC wetland sites.

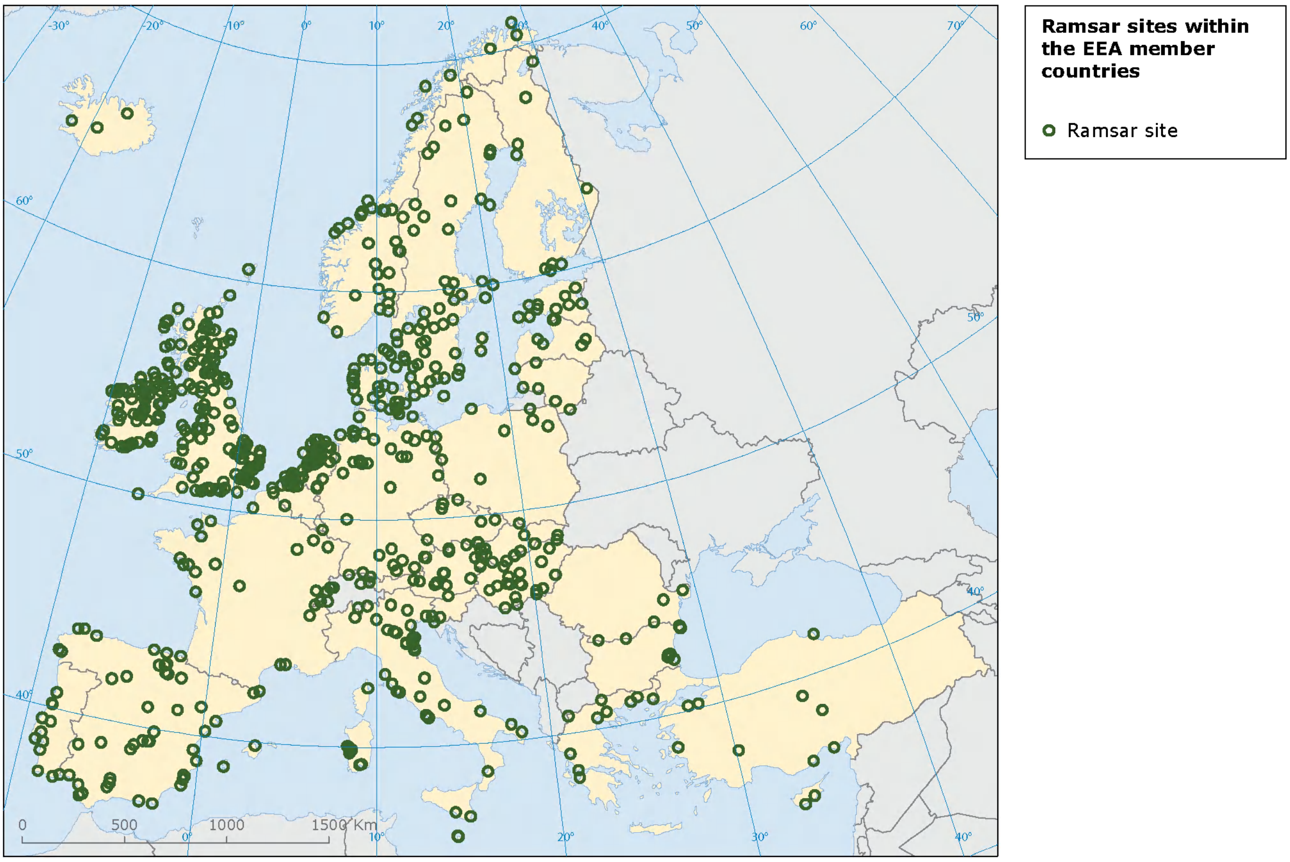
Concern about the extent of drainage and damage to traditional agricultural landscapes, including wetlands, as a result of subsidised intensification of agriculture under the common agriculture policy, led to Article 19 (National Aid in Environmentally Sensitive Areas) of a Council Regulation on Improving the Efficiency of Agricultural Structures (789/85).

Currently, the common implementation strategy for the EU water framework directive includes horizontal guidance on wetlands.

3.5.1 Trends in habitats and species

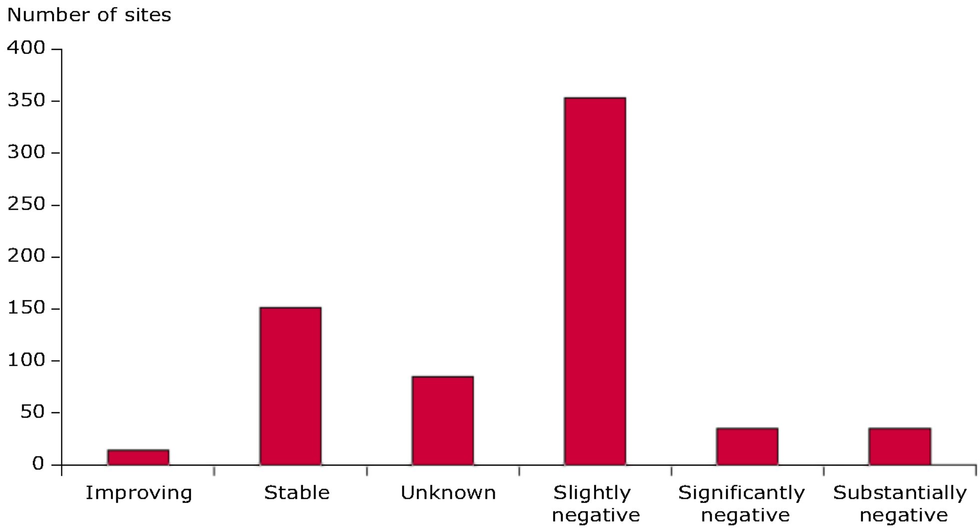
The contracting parties to the Ramsar Convention report on the designated site status at the time of designation and ideally at six-year intervals thereafter. Figure 3.41 presents an analysis of these reports, showing the majority of Ramsar sites as having mainly slightly negative development in ecological state.

Figure 3.40 Map of distribution of Ramsar sites within the EEA member countries (open circles), indicating sites designated to protect threatened species (green)



Note: The locations of designated Ramsar sites are shown on this map as circles which are not related to the scale of the designated wetlands.
Source: Ramsar sites database, September 2004.

Figure 3.41 Change in the ecological status of Ramsar sites within the EEA member countries according to national reports to the Ramsar Convention



Note: There is no objective measure in place for countries to report changes in wetland area or ecological status. The data behind the figure are uncertain, for example Nivet and Frazier (2002, 2004) concluded that only 16 countries have adequate national wetland inventory information available.
Source: Ramsar sites database, September 2004.

Figure 3.42 Relative population size of water bird species for 1989–2002 within Ramsar sites

Note: Relative population size is based on the mean of combined population levels. 'Ramsar' include all IWC stations within an 8 km radius of a Ramsar site.

Source: IWC and Ramsar sites database, October 2004.

The national reports have been criticised for presenting outdated information and lacking in consistency. To achieve better information about the ecological conditions and biodiversity status of wetlands designated as Ramsar sites, Wetlands International conducted a questionnaire-based survey in 2004.

Table 3.1 summarises the feedback obtained from the EEA countries with respect to 21 key factors. The survey appears to indicate that since at least 1993, there has been a slight overall improvement in the ecological and biodiversity status of wetlands and therefore the analysis shown in Figure 3.41 may be too pessimistic. Conservation management measures and the involvement of local communities were rated as very positive. Ramsar site designation was almost always cited as leading to better maintenance of ecological character, but SPA designation was thought to be a stronger mechanism in some EU country reports.

The biodiversity status of wetlands was mostly reported to be the same as the ecological status, although, according to case studies cited by the country authorities in their responses, there are specific concerns about many IUCN red-listed species and birds directive Annex 1 species, resulting from continuing development pressures.

Trends for selected waterbird species

Wetlands International's Waterbird Census (IWC) has delivered data for 12 waterbird species that depend on various wetland habitats, Figure 3.42. The overall relative population size trend was stable or slightly positive for 1989–2002.

3.5.2 Pressures on Ramsar sites

Threats to Ramsar sites are reported by contracting parties to the Convention. Within sites, the most significant impacts recorded are due to physical loss or modification of habitats, agriculture, and various forms of pollution, the last being the main threat within the surrounding catchments. Figure 3.43 lists the threats to Ramsar sites according to national reports.

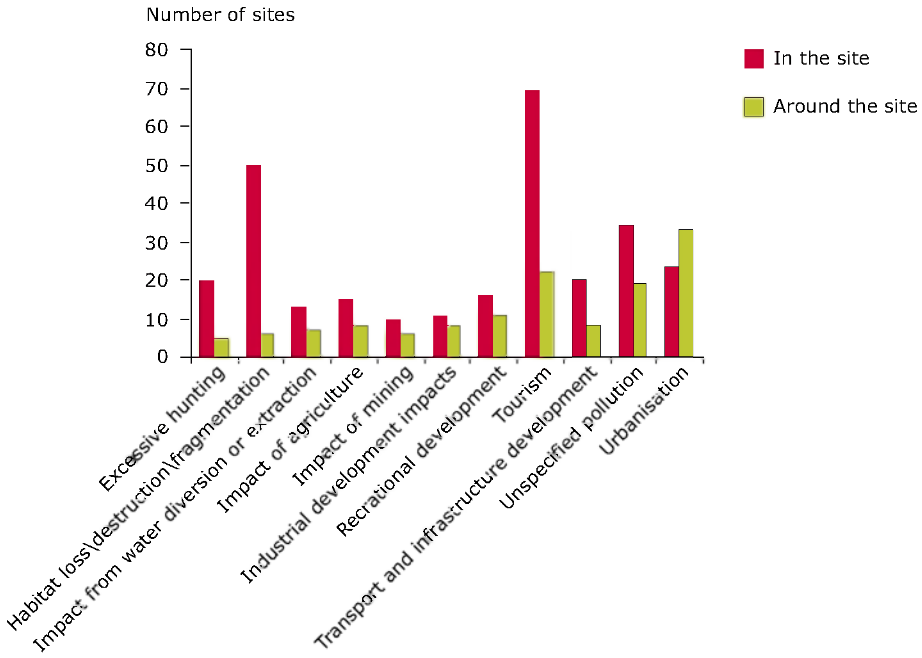
Among the key factors reported in the 2004 survey (Table 3.1), consistent strongly negative drivers

Table 3.1 Change in ecological and biodiversity status of wetlands since 1993 (or 1991), and their causes

Country and site if sub-national Respondents included national Ramsar administrative authorities, international organisations and NGOs	**Ecol. status**	**Net change since 1993 or * = 1991**	**Cons. management**	**Local comm. awareness**	**Cultural values**	**Industrial dev./infrastructure**	**Urban development**	**Tourism**	**Afforestation/deforestation**	**Agricultural intensity**	**Agricultural runoff**	**Urban/industrial pollution**	**Water abstraction**	**Drainage**	**Damming**	**Changing salinity**	**Erosion/siltation**	**Natural resources extraction**	**Drought/desertification**	**Aquaculture**	**Fishing**	**Hunting**	**Invasive alien species**	**Effect of Ramsar designation**	**Biodiversity status**
Bulgaria — inland	☹ –	*☹ –					☹		☹		☹		☹		☹						☹	☹		☹	N/A
Bulgaria — coastal	☹ –	*☹	☹			☹	☹	☹			☹		☹			😐					☹	☹		☹	N/A
Cyprus — coastal Larnaca Saltlake	☺ –	*☹	😐				☹	☹		☹	☹	☹										☹			☹
Estonia — inland	☺	😐	☺	☺						☺				☹										☺	☺
Estonia — coastal	☺	😐	☺	☺						☺							☹				☹			☺	☺
France — inland Languedoc Roussillon	☺ –	*☹	☺	☺	☺		😐		☹	☺	☹			☹	😐			☺	☹				☹	☺	N/A
France — coastal Languedoc Roussillon	☹ +	*☺	☺	☺	☺		☹	☺		☺	☹	☹							😐	😐	☺	☹	☹	☺	N/A
Greece — inland	☺ +	*☺	☺	☺							😐	☺	☹											😐	N/A
Greece — coastal	☺	*😐	☺	☺				☹			😐													😐	N/A
Hungary — inland Kiskunsag	☺	😐	☺								☹											☹	☹		☺
Iceland — inland	☺ +	☺ +	☺	☺	☺										☹									☺	☺ +
Iceland — coastal	☺ +	☺ +	☺	☺	☺																			☺	☺ +
Italy — inland Tuscany	☹ +	*😐	☺	☺	☺			☺		😐	😐	😐	😐											☺	N/A
Italy — coastal Tuscany	☺ +	*☺ +	☺	☺	☺			☺		😐	😐	☺					☹							☺	N/A
Luxembourg	☺	☺	☺	☺																				☺	☺
Netherlands — inland	☺	☺								☹	☺		😐												☺
Netherlands — coastal	☹ +	☺	😐														😐				😐				☹ +
Portugal — inland	☺ –	*☹					😐	☹		☺				😐	☹			☹			☺	☺	☹	😐	N/A
Portugal — coastal	☹	*😐				☹	☹	☹		☺				😐				😐			☺	☺	😐	😐	N/A
Romania — coastal Danube Delta	☺ +	☺ +	☺	☺		☺				☺			☺	☺	☺		☺	☺			😐	😐		☺	☺ +
Slovak Republic	☺	😐	☺				☹		☹		😐			😐	☹								☹	☺	☺
Slovenia — inland	☺	*☺	☺	☺	😐		☹	☺				☺						😐			😐	😐	😐	☺	N/A
Slovenia — coastal	☹ +	*☺	☺	☺	😐	☹	☹	☹			😐	😐	☹							☹				☺	N/A
Spain — inland Mediterranean region	☹ +	*☺	☺	☺				☺		☺	☹		☹				☹						☹	☺	N/A
Spain — coastal Mediterranean region	☹ +	*☺	☺	☺	☺		☹	☺				☹	☹			☹							☹	☺	N/A
Sweden — inland	☺ –	😐	😐	☺				😐		☺	😐			😐										☺	☺ –
Sweden — coastal	☺ –	😐	😐	😐							😐													☺	☺ –
Sweden — inland Lake Hornborga	☺	☺ +	☺					☺						😐	☹						☹	☹		😐	☺
Switzerland Neuchâtel Lake	☺	😐	😐	😐			☹	☹									😐								☺
Turkey — inland	☹ +	☹		☺									😐			☹			☹					☺	☹ +
Turkey — coastal	☺	😐		☺				😐																☺	☺

Key: Smileys indicate current status ☹ = poor; 😐 = no change; ☺ = good. '+' or '–' sign = direction of change.
Note: Of the 31 EEA member countries, 18 responded at the national or at least the sub-national level. The 13 non-responding countries represent 40 % by area of the total Ramsar sites within the EEA countries.
Source: Wetlands International/Ramsar survey, September 2004.

Figure 3.43 Site-related threats as reported to the Ramsar Convention



Source: Ramsar sites database, January 2006.

were urban development, agricultural runoff, water abstraction, drainage, damming and alien invasive species. Excessive fishing and hunting were also reported. Interestingly, tourism was considered to be either a strongly positive or a strongly negative driver, and is therefore worth further consideration.

Intensification of agriculture, often supported through the EU CAP, has in the past been considered to be one of the most important drivers of change regarding wetlands and biodiversity (see Figure 3.43). In the 2004 survey, however, further changes due to agricultural intensity were mostly reported as declining.

Introduced plant and animal species are widespread in European wetlands and some of them may be considered as invasive alien species, posing a threat to biodiversity. The contracting parties reported the presence of invasive alien species in a limited number of Ramsar sites (48 out of 673) and the issue of invasive alien species was highlighted as a cause of change of ecological status by a few respondents to the 2004 survey (see Table 3.1).

3.5.3 Key policy developments

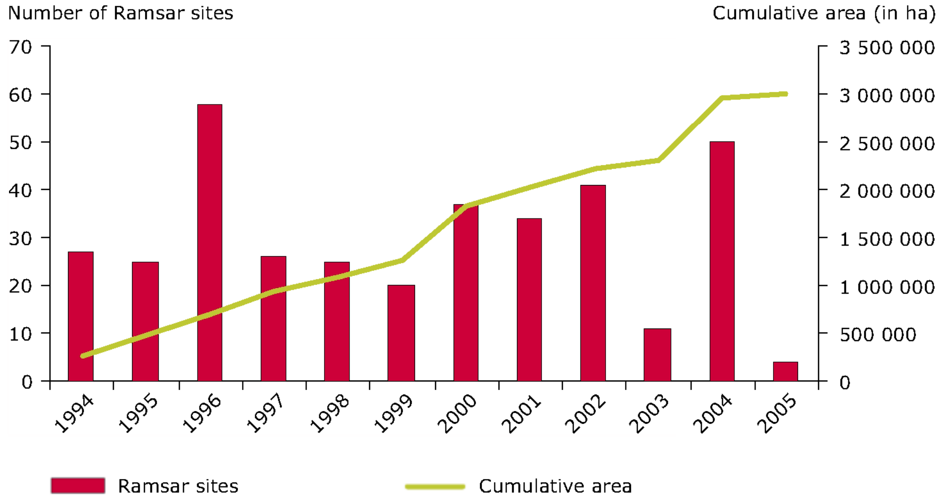
The Ramsar Convention's 8th conference of the parties in 2002 marked a milestone in progress towards completing the Convention's overall policy framework to respond to the pressures noted in previous reports on wetlands in Europe (see EEA, 2000). Resolution VIII.34 on 'Agriculture, wetlands and water resource management´ was adopted as a response to the recognition that agriculture was a major threat. The resolution encouraged contracting parties to adopt, by 2005, specific management planning which, among other targets, aim to 'minimise the adverse impacts of agricultural practices on wetland conservation'.

Contracting parties in Europe have continued to designate wetlands under the Convention, although the rate is now declining (see Figure 3.44). The Convention is therefore regarded as a relatively mature instrument, with a large proportion of priority wetlands in Europe already designated.

In an independent report by the World Bank with WWF (Castro *et al.*, 2002), Ramsar site designation was considered to be a significant factor in increasing conservation success.

Reporting to the Ramsar Convention Bureau on restoration of Ramsar sites in the period 1998–2002 was undertaken by countries, among which Denmark, Germany, the Netherlands, Romania, Slovenia and Sweden showed many activities in wetland restoration. Conservation management and restoration of wetlands features as a target in about 80 % of projects financed by Life-Nature funds in the EU-15 (EC, 2003). Currently the LIFE project

Figure 3.44 Number of Ramsar sites and cumulative area designated since 1994 within EEA member countries



Source: Ramsar sites database, January 2006.

database contains 90 projects related to raised bogs, mires or fens and 112 projects dealing with freshwater habitats.

3.5.4 Conclusions

The overall outlook for the wetlands of international importance appears to be slightly positive, at least in the medium term, thus contributing to reaching the 2010 target of halting the loss of biodiversity in Europe. The sites are still facing important threats, which might have a different weight than in the rest of the wetlands in Europe, due to the outstanding biodiversity importance of the Ramsar sites. In the majority of sites, there have been negative changes in ecological state, which, when further analysed according to key factors, allowed a slightly optimistic evaluation of progress.

On the side of progress is the evidence that:

- areas designated as Ramsar wetlands in Europe have increased steadily in the past decade;
- water bird census shows stable populations;
- restoration projects have been implemented in many countries;
- local community awareness has increased in many countries.

Issues where urgent action is needed are:

- reversing the trend of the continuing wetland habitat loss in Europe;
- removing pressure from water abstraction, drainage or damming;
- removing underlying causes for conversion of wetlands to afforested land.

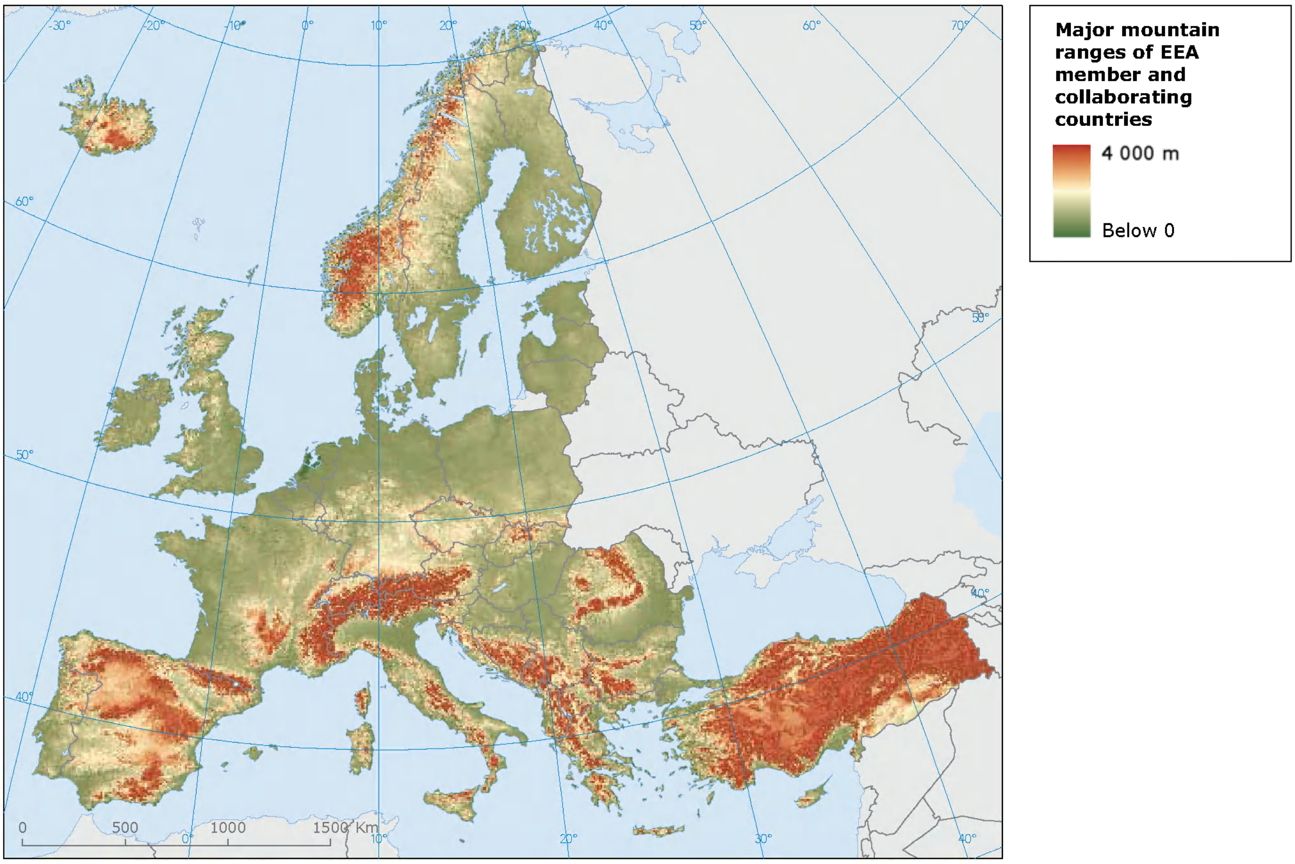
Issues where more concrete efforts are needed are:

- minimising agricultural run-off of fertilisers where this still occurs;
- excessive hunting and fishing still reported;
- unspecified pollution sources pose significant threats;
- urbanisation and transport development has been contributing to significant habitat fragmentation;
- tourism and recreation are considered an important driver of change.

3.6 Mountain ecosystems

Mountain environments in Europe host significant biodiversity, but the ecosystems they contain are vulnerable, particularly when subjected to rapid changes, because of the low productivity and slow response rates of organisms. More than 2 500 out of about 11 500 vascular plant species registered for the European continent are found mainly above the tree line (Väre *et al.*, 2003). European mountains also host many endemic species due to their isolation and special climate conditions combined with their biogeographic history, see Chapter 4.

Figure 3.45 Major mountain ranges of Europe



Source: EEA based on GTOPO30 (data available from U. S. Geological Survey, EROS Data Center, Sioux Falls, South Dakota, USA).

Recent changes in traditional uses of land, such as abandonment of farming and livestock grazing, are also influencing mountain vegetation as well as species diversity. These changes are accompanied by large-scale industrial projects, like damming for hydroelectric power, mining, and transport infrastructure, often with quite drastic consequences for nature and biodiversity. A large part of European mountain areas are also important tourist sites and recreational landscapes, with increased pressures, for example from the development of ski resorts. From a longer time perspective, climate change is predicted to have substantial impacts on mountain ecosystems.

The special need to consider mountain areas has been recognised politically in the past few decades. The Convention on Biological Diversity has established a special 'Mountain Biodiversity Programme of Work' and recently asked the parties to report on measures taken regarding mountain biodiversity.

The sustainable development and protection of European mountain areas and their ecosystems is supported by many policies including the common agricultural policy, particularly through the implementation of agri-environmental measures, the habitats and birds directives, the water framework directive and the EU Soil Protection Strategy.

Regional initiatives include:

- The Convention on the Protection of the Alps (1995, involving eight countries and the EU), which aims to preserve and protect the Alps, and the many collaborative networks established for the region (e.g. the International Commission for the Protection of the Alps, the Alliance in the Alps, the Network of Alpine Protected Areas).
- The Charter for the Protection of the Pyrenees, which aims to protect the fauna and flora along with the development of sustainable tourism, transportation and agriculture.
- A long-term cooperation in the Scandes, and adjacent high boreal and Arctic areas (e.g. via the Nordic Council of Ministers) related to the Sami people and reindeer management, tourism and biodiversity.

- A number of initiatives for the six countries connected to the Carpathians, for example the Framework Convention on the Protection and Sustainable Development of the Carpathians (2003), the Carpathian Ecoregion Initiative (a network of NGOs and research institutes) and the Association of Carpathian National Parks and Protected Areas.

Several of these initiatives have paid considerable attention to the management and restoration of the populations of the large predators and the conflicts related to this.

3.6.1 *Trends in mountain biodiversity*

The mountain regions of Europe have a high proportion of natural or semi-natural area, of which forests as well as pastoral landscapes are significant. Montane grasslands, above the tree line, are formed mainly under influence of extensive transhumance (the seasonal long-distance movements of herds). In line with the general development of High Nature Value farmland systems discussed in Section 3.1, traditional farming in the mountains has decreased considerably during recent decades, resulting in a change in habitats and biodiversity. In some mountain areas, forest plantations have replaced traditional land use, see also Section 3.2.

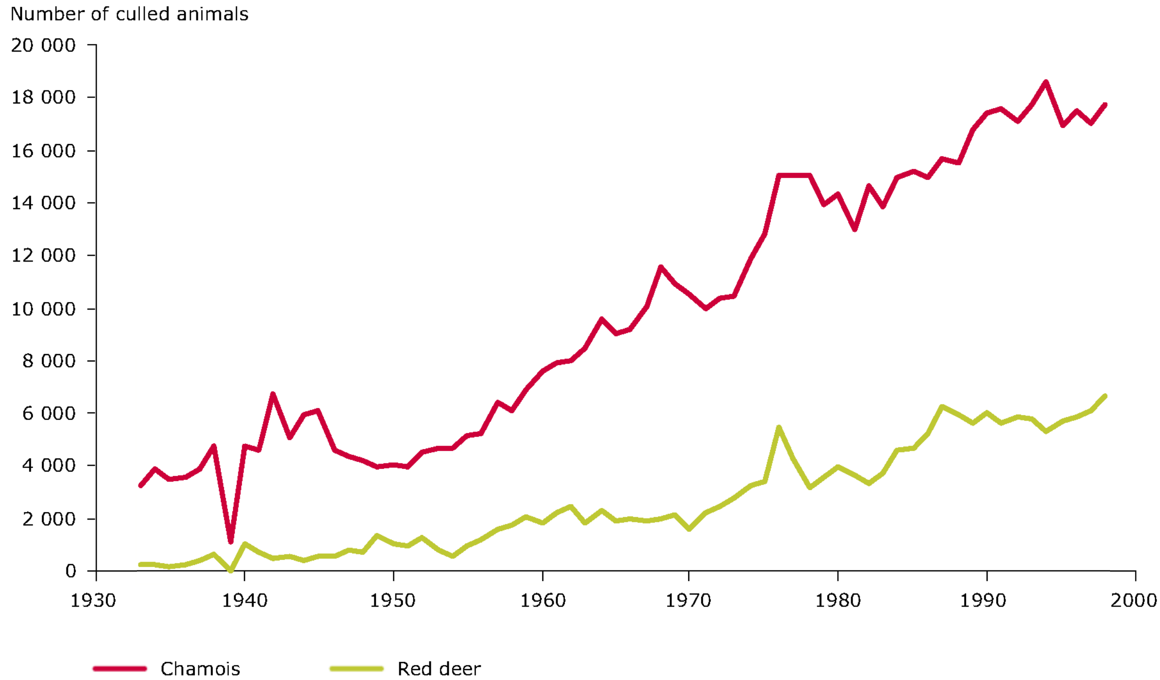
Trends in selected species groups

The populations of several large herbivores in the Alps have increased, partly as a result of direct human actions such as reintroductions, see Figure 3.46. However, the long-term development is hard to predict since there is increasing human pressure and changes in land use.

The Southern chamois, *Rupicapra pyrenaica,* nearly became extinct because of intensive hunting and poaching. Regulation of hunting over 40 years has led to an increase in the population in the Pyrenees, the Cantabrian Mountains and the Apennines from a few thousand to 50 000.

But there are also negative examples. The Pyrenean ibex, *Capra pyrenaica pyrenaica*, for example, has been in decline for centuries because of hunting. The small residual population in Spain has recently also faced other threats such as a lack of habitats, competition with other ungulates, human disturbance, poaching, and insufficient genetic diversity. These led to a serious decline in the population and eventually extinction (of the last individual by a falling tree) in 2000.

Figure 3.46 Number of culled chamois (*Rupicapra rupicapra)* and red deer (*Cervus elaphus)* in the Swiss Alps and Jura mountains



Note: There are also some negative trends for chamois, for example the species has decreased dramatically in recent years in the western Carpathians.

Source: Loison *et al.*, 2003.

Figure 3.47 Summary of the causes of change of 49 selected butterfly species in the Alpine biogeographic region in their selected habitats

Region	Habitat	Habitat loss	Land use change	Climate change	Fragmentation	Eutrofication	Acidification	Toxification	Lowering groundwater	Invasive species	Disturbance	Exploitation	Lack of or wrong nature management	Natural succession	Factors abroad	No cause/not relevant	Unknown
Alpine		**7**	**5**	**2**	**4**			**1**	**1**					**1**		**11**	**17**
	Grassland	2	2		1											3	7
	Tillage															7	1
	Unvegetated	2	1	1	1			1									5
	Woodland	3	2	1	2				1					1		1	4

Note: The number of species for each combination is given.
Source: Van Swaay, 2003.

European mountain ranges are centres of richness for butterfly species. Butterflies are under pressure from habitat loss, land abandonment, and fragmentation of habitat (Figure 3.47).

As already mentioned, European mountains host a large number of vascular plants (but also, for example, bryophytes). Little information exists to reflect the population development of common plant species in mountains but, for example, species dependent on traditional land use, such as high-altitude mountain flora, can be expected to be decreasing. Particular attention should be paid to a number of species that are endemic to mountains. This is supported by the fact that about one third of the approximately 5 500 vascular plant species in the Alps are considered extinct, endangered, vulnerable or rare.

Species and regions in need of special attention
Several threatened mountain species are high in the public awareness (flagships for conservation) as well as being associated with conflicts and costly to manage and conserve. This is typically the case for a number of big predatory species.

The wolverine, *Gulo gulo*, is the only large mammalian predator in Europe naturally confined to mountains. The main diet of wolverines is semi-domesticated reindeer. Long-term hunting and persecution has led to a reduction in population size and distribution. Wolverines are now protected, but the total population in northern Europe is less than 1 000.

The brown bear, *Ursus arctos*, originally widespread in Europe, is today largely confined to mountains (and the boreal forest) and is at least regionally one of the rarest large mammals in Europe. In western Europe, the species has long been in decline because of expanding human populations and conflicts with husbandry, deforestation, and hunting. In some boreal areas, in particular in Sweden and Finland, the approximately 2 000 bears occur at low densities, but, because of protection, the population is expanding slightly. A substantial number of bears can also be found in the Carpathians (Romania, Slovakia) and the Balkan mountains (Bulgaria, Greece). The western European populations (in the Pyrenees, Cantabrian Mountains, Trentino Alps, Apennines) are very small and fragmented. In Austria, bears are being reintroduced (the population is now 15–20 individuals).

The brown bear is highly rated by people in favour of conservation but less appreciated by local people, because of damage to husbandry but also general fear. Negative campaigns and/or hunting (both when regulated and by poaching) have given bear issues a certain political standing.

Bearded vultures, *Gypaetus barbatus* occur in mountain regions of Europe. Hunting, poisoning and abandonment of traditional herding (less food for vultures) during the last century resulted in a serious decline in abundance to some one hundred pairs in the Pyrenees, Alps, Corsica and Crete (WWF, 2002; CEC, 2000). A number of projects, several supported by EU Life funds, have been carried out to promote the species, by reintroduction, promoting traditional land use, etc. For example, since 1986, 2–3 captive-bred individuals have been released on the French side of the Alps each year.

Table 3.2 Numbers of species in each category of threat in the Carpathians

Systematic group	Critically endangered	Endangered	Vulnerable	Extinct	Extinct in the wild	Data deficient
Vascular plants	39	135	155	13	1	1
Mammals	2	12	44	2	-	-
Birds	7	11	11	-	-	-
Reptiles and amphibians	1	6	7	-	-	3
Fishes and lampreys	3	14	11	2	-	-
Invertebrates	74	125	141	-	-	-
Total	126	303	369	17	1	4

Source: WWF, 2002.

The richness of species in mountain regions, and the high degree of endemism, is reflected in the overall threat status, for example as shown by an assessment for the Carpathian mountains (Table 3.2).

Traditional breeds of domestic animals in the Carpathians, such as the Carpathian red and greyish brown cattle, are also critically endangered as a result of declining traditional farming practices. This problem is not specific to the Carpathians as 91 % of mountain breeds of sheep in western Europe are threatened. The reasons for the decline are a combination of crossbreeding to improve meat and/or milk production and abandonment of traditional husbandry systems (Brook and Ryder, 1979).

3.6.2 *Key management issues*

Population, development and changes in land use

Socio-economic development is a major driver of changes in biodiversity in mountain areas. Many such areas show an increased utilisation, especially through increase in tourism and the development of transport infrastructure. On the other hand human populations in mountain areas are generally declining and ageing. However, different mountain regions may show different patterns (Figure 3.48). The Alps is the major exception to the general decline, the population having increased in the French Alps and in several parts of the Swiss and Austrian Alps. This trend is very much influenced by amenity urbanisation within easy reach of large cities.

There has been a general decrease in traditional farming practices in mountain areas. The decrease has till now been stronger in the western than in the eastern parts of Europe. Abandonment usually reduces the earlier great richness of habitat types on a landscape scale, and negatively affects the biological diversity associated with the habitats formed by traditional farming (Norderhaug *et al*., 2000). Some species, however, are benefiting from the increased amount of shrub and woodlands.

Traditional pastoral activity, including the seasonal long-distance movements of herds (transhumance) in several mountain areas, like the Pyrenees, has diminished considerably. In the past, shepherding brought animals to appropriate pastures at the right time, including those above the tree line, and also burned scrublands to improve the grazing. Generally sheep are now left to wander at random

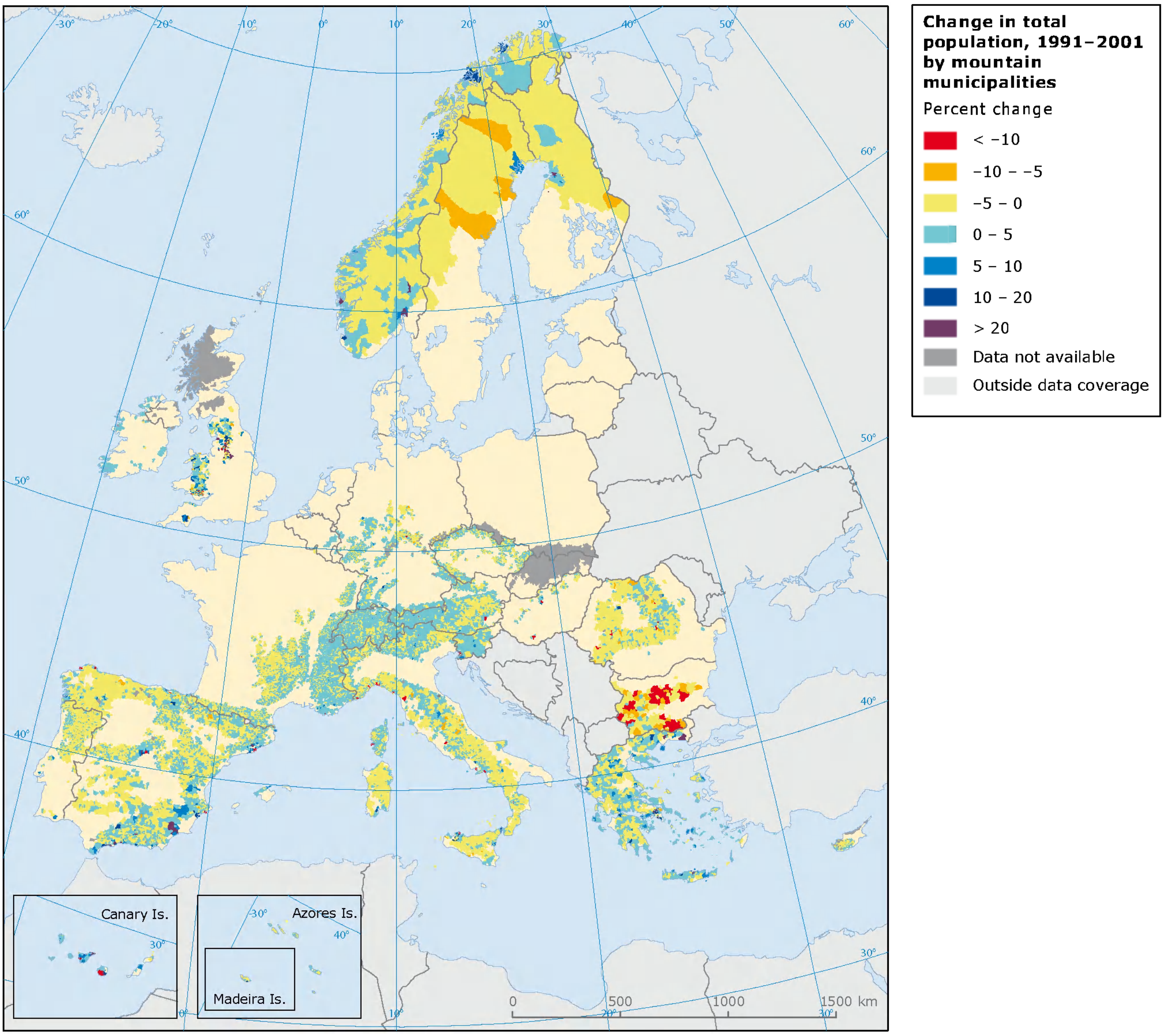
Box 3.11 Reindeer husbandry in the Scandes

Reindeer husbandry is a traditional practice of the Sami people, which persists in a modern form. Particularly in Sweden and Norway, the husbandry is migrational, with reindeer feeding in the mountains for part of the year. In Finland, there has been a general increase in the number of reindeer since the 1950s, while the number of animals in Sweden and Norway increased strongly during the 1980s (due to extensive supplemental feeding during winter) which resulted in heavy grazing effects on dry vegetation habitats. The number of reindeer has decreased during the past decade, perhaps as a result of low winter food abundance.

High numbers of reindeer in dry, lichen-dominated areas in northern Norway, Finland and some part of Sweden have resulted in serious overgrazing of the vegetation.

Decrease in the cover of lichens on Finnmarksvidda, Norway as a result of reindeer grazing and trampling (Johansen and Karlsen, 1998).

Figure 3.48 Change in population between 1991 and 2001 in mountain ranges in Europe



Source: Nordregio, 2004, DG REGIO 2005 update.

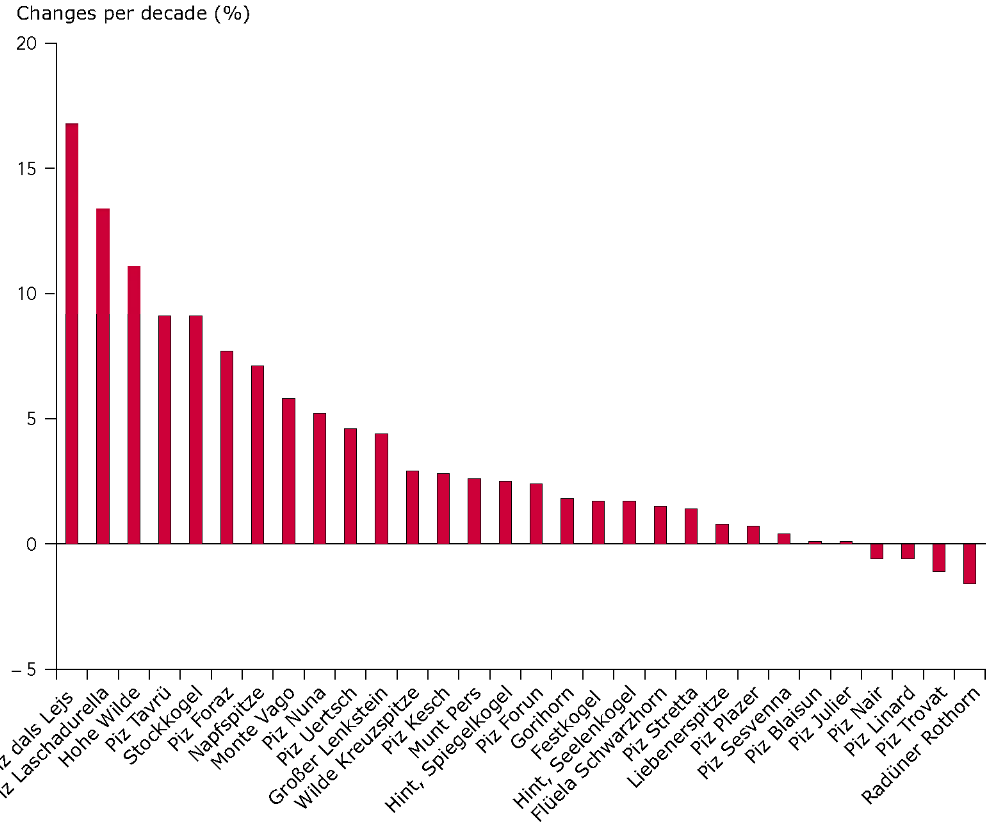
over wide areas, which results in over-grazing in some patches and the invasion of scrubland in others. Forest re-growth and coniferous plantings are an increasing element, replacing old grazing in several areas.

The tourism sector is increasing its relative importance in most mountain areas; for example the Alps now receive some 100 million tourists each year. There is thus an increasing pressure to develop mountain areas for tourism. Tourists visit mountains for a wide range of activities. A particular case is winter activities and ski resorts, where the preparation of ski pistes often has substantial impacts on the natural vegetation cover, resulting in erosion.

The increased pressure from human land-use in the mountains will inevitably lead to the development of infrastructure such as roads. Mountains may also be intensive passages for more long-distance transport. For example nearly 150 million people a year cross the Alps, and heavy freight transport is also intense. Increased pressure from rail and road traffic can be also be seen between France and Spain, where traffic goes mainly by the coastal routes at either end of the Pyrenees. This increased traffic, and improved roads and railways, including new tunnels, fragment untouched areas and pollute and deteriorate the quality of recreation areas.

Mountains are subject to long-range air pollution. Damage from air pollutants has stabilised in

Figure 3.49 Change in species richness on 30 high summits of the eastern Alps during the twentieth century



Note: Species summits are listed on the x-axis.
Source: Grabherr *et al.*, 2002 in EEA (2004).

recent years, but should be further brought down. A number of heavy industries, often connected with mining, e.g. smelting plants, are located in mountains. There are examples, including from the Scandes, of heavy metal pollution which has been shown to impact biodiversity at quite some distance. Although there were significant reductions in industrial output in the Carpathians during the first few years of the economic transition process, air, water and soil pollution caused by industry are still major threats to the region's biodiversity.

Climate change

Mountain areas can be considered as 'early warning systems' for climate change because they have different climatic belts at different altitudes, which contain biological communities for which climatic condition is a limiting factor. Even small climate changes, in particular at higher altitudes, can thus be expected to be reflected in the responses of biological diversity. For example in the Alps, Grabherr *et al.*, 2002 have demonstrated an upward migration during the twentieth century which has led to an increase in the richness of plant species on mountain summits (see Figure 3.49).

Species composition in mountain areas is predicted to change during the coming decades. A 3 °C increase in temperature, well within the predicted range for 2100, corresponds to a shift in species distribution of 300–400 km to the north in temperate zones, or 500 m in elevation (Hughes, 2000). Many species will have difficulties in responding to such rapid change by migration or adaptation and are likely to become more restricted in distribution or extinct (Root *et al.*, 2003). Experiments with temperature enhancements have shown disintegration of existing plant communities as species respond individually rather than as an assemblage to the changes.

A simulation of possible tree-line changes in the Swedish mountains, based on the predictions of regional climate models, shows that the alpine tree-less heaths may (if climate change overrides other factors) be reduced by 75–85 % by 2100 as a result

Table 3.3 Sites of Community importance (habitat directive) in the Alpine biogeographic region (EU-15)

Member State	MS area	Alpine region	Sites of Community importance	
	(km²)	Area (km²)	Number	Total area (km²)
Austria	83 858	47 040	103	6 250
Finland	337 300	16 390	19	17 901
France	547 030	30 700	129	9 346
Germany	357 021	4 160	43	1 413
Italy	301 230	50 081	452	12 435
Spain	497 335	9 500	63	4 664
Sweden	414 864	100 600	146	44 668
Total	2 584 650	258 471	959	96 460

Source: ETC/NPB, 2003.

of upward migration of the tree line (Moen *et al.*, 2004).

Policy responses

Within the framework of the Natura2000 process, the Commission has adopted a list of 959 sites of Community importance for the Alpine biogeographic region, covering seven Member States, Table 3.3. The enlargement of the EU with 10 new Member States in 2004 means that additional sites must be added, particularly in the Carpathian mountains.

A number of other EU programmes and directives recognise mountain areas in need of special attention, including the common agricultural policy (agri-environmental measures), the European Regional Development Fund (efforts to promote sustainable development, e.g. in the Alps), the EU Directive on Less Favoured Areas CEE 75/268 (mountain forests) and the EU water framework directive (mountain areas with important water catchments). There are no easily available sources of precise information on the extent to which these policies cover mountain regions.

3.6.3 Conclusions

There is not much evidence of progress in reducing threats to and enhancing the biological diversity of mountains in European countries, which are subject to rapid changes. The 2010 target may be partly met in areas where traditional uses and activities continue to shape the ecosystem structures.

On the side of progress is the evidence that:

- populations of some endangered large carnivores and herbivores are increasing due to successful management;
- long-range pollution has stabilised while the threat of pollution from industry is relatively local.

Issues where urgent action is needed are:

- minimising the high risk of local extinctions of several species;
- counteracting the already visible effects of habitat fragmentation and/or change due to changes in land use.

Issues where more concrete efforts are needed are:

- minimising the effects of development of tourism infrastructure and long-range transport;
- reversing the strong trend of abandonment of traditional uses (farming, grazing).

4 The EU and global environmental issues

4.1 Local pollution and long-range transport of pollutants

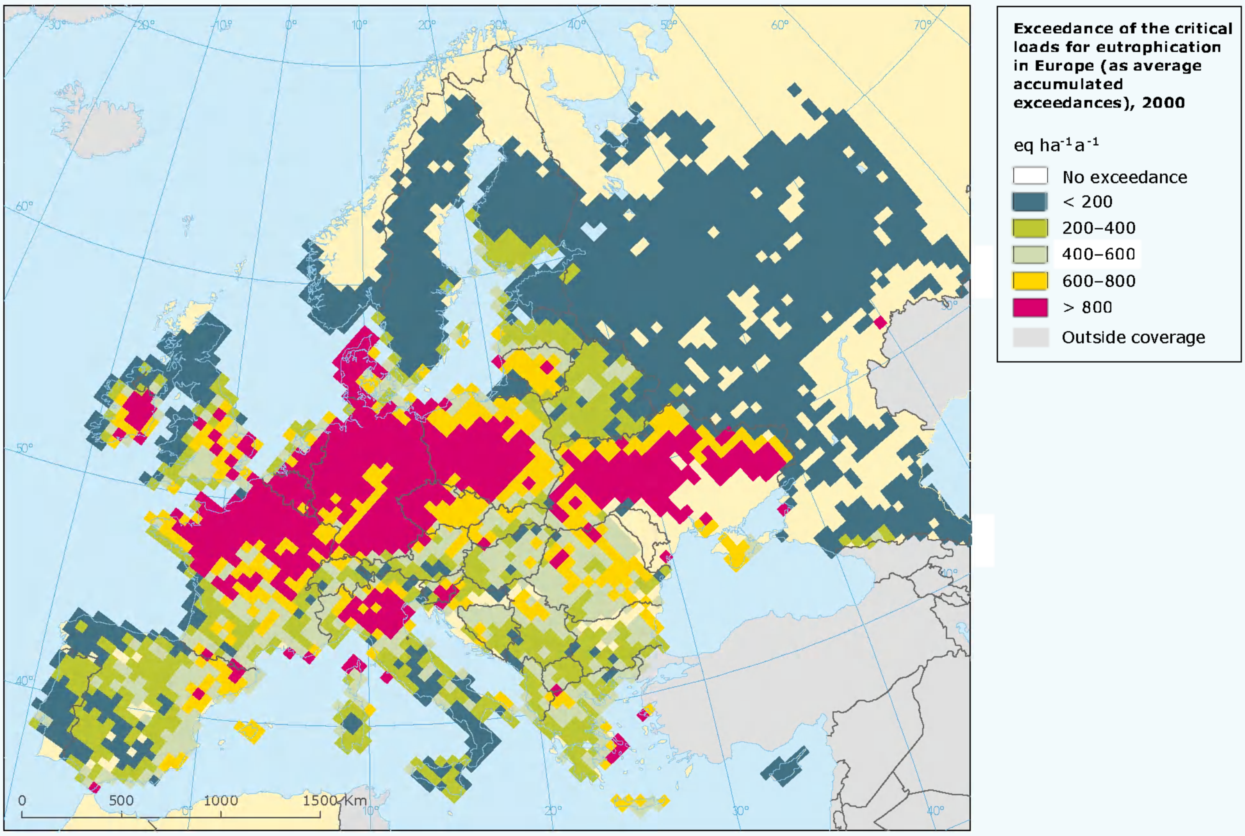
Pollution by oxygen-consuming substances and phosphorus has been reduced markedly in recent years as a result of lower discharges from wastewater treatment plants and industry. Pollution by heavy metals and some other heavily-regulated chemicals is also decreasing. This resulted in an average improvement in water quality in European rivers and lakes during the 1990s (EEA, 2004b).

On the other hand releases and deposition of nitrogen compounds have not reduced noticeably. Nitrogen is released into the atmosphere from fossil-fuel combustion and the application of fertilisers and spreading of manure in agriculture. It returns to land as dry and wet deposition, as oxidised

Box 4.1 Exposure of ecosystems to acidification, eutrophication and ozone (CSI 05) — May 2005 assessment

- **Eutrophication** has fallen slightly since 1980. However, only limited further improvement is expected by 2010 with current plans.
- There have been clear reductions in **acidification** of Europe's environment since 1980, but with some tailing off in that improvement after 2000.
- Most agricultural crops are exposed to **ozone** levels exceeding the EU long-term objective and a significant fraction are exposed to levels above the target value.

Figure 4.1 Exceedance of the critical loads for eutrophication in Europe (as average accumulated exceedances), 2000 (Version 1.00)



Source: UNECE, 2005.

or reduced nitrogen. Nitrogen is also transferred directly to water bodies — rivers, lakes and groundwater — from manure and the application of fertilisers in agriculture.

Excess nitrogen in the environment causes acidification and eutrophication (over-fertilisation) and subsequent pressures and impacts on sensitive ecosystems and species (Box 4.1, Figure 4.1).

Tropospheric ozone is potentially one of the most phytotoxic of the major air pollutants. Typical symptoms of the effects of increased ozone concentrations on plants are visible leaf injuries, growth and yield reductions and altered sensitivity to biotic and abiotic stresses (Box 4.1).

The effects of eutrophication and acidification often occur far from the sources of pollution, as a result of transfers through the atmosphere and water bodies. Marine and coastal and other aquatic ecosystems, grasslands and forests, are all sensitive to eutrophication (Box 4.2, Figure 4.2), which has become a widespread problem — both globally and within Europe.

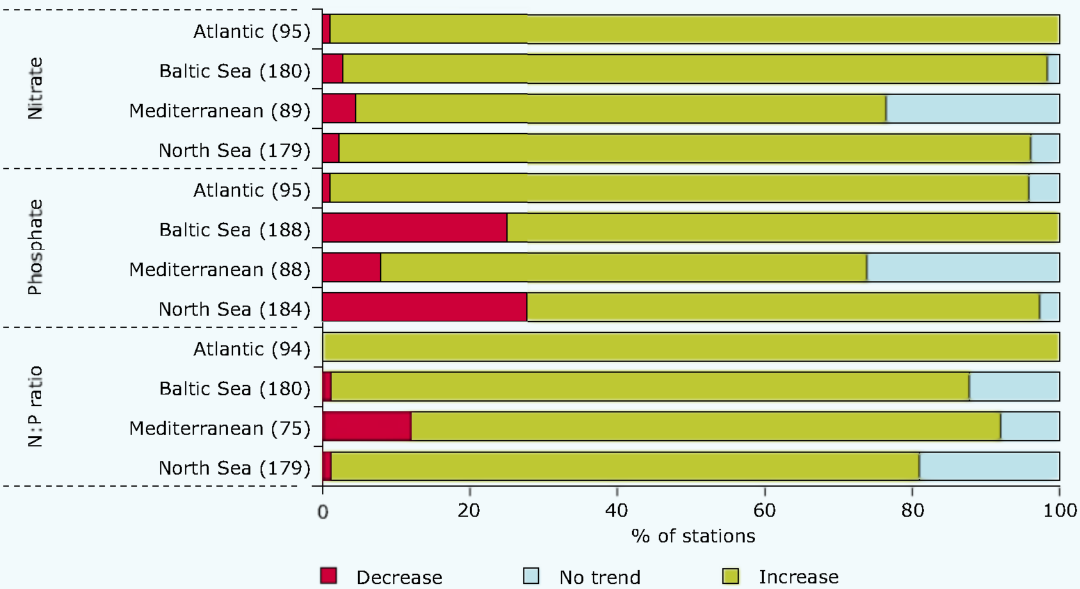
4.2 Climate change

The interlinkages between biodiversity and climate change have been recognised on a global level through cooperation between the three 'Rio Conventions': the UN Convention on Climate Change, the UN Convention to Combat Desertification and the UN Convention on Biological Diversity. At the EU level, the 6th environmental action programme identifies 'tackling climate change' as a major area and, although biodiversity is not addressed explicitly, the targets and actions will be of relevance for Europe's biodiversity (Table 4.1).

Box 4.2 Nutrients in transitional, coastal and marine waters CSI-21 (EEA)

Phosphate concentrations in some coastal sea areas of the Baltic and North seas have decreased over recent years, but they have remained stable in the Celtic sea and increased in some Italian coastal areas. Nitrate concentrations have generally remained stable over recent years in the Baltic, North and Celtic Seas but have increased in some Italian coastal areas.

Figure 4.2 Summary of tends in winter nitrate and phosphate concentration, and N/P ratio in the coastal waters of the North Atlantic (mostly Celtic seas), the Baltic Sea, the Mediterranean Sea and the North Sea, 1985–2003 (Version 1.00)



Source: Waterbase, 2005.

Table 4.1 Summary of relations between biodiversity and climate change

Phenology
Changes in plant phenology (timing of flowering, fruit ripening, leaf unfolding, leaf colouring, length of growing season)
Changes in animal phenology (changing migration departure and arrival times and breeding times)
Disturbances in plant-animal synchrony
Changes in species behavioural pattern
Impacts on plant physiology, including responses to drought/ floods
Changes in migration routes (birds, butterflies, fish)
Changes in extent/population of wintering, breeding and migration areas (birds)
Changes in altitude migration (butterflies)
Changes in ecosystems
Depletion of species which cannot move
Changes in biomass productivity
Changes in species composition, including spreading of pests
Changes in permafrost distribution and rate
CO_2-related
Contribution of ecosystems to CO_2 sequestration
Conversion from high nature value ecosystem to areas for carbon sink purposes

Large uncertainties remain about the capacity of ecosystems to resist, accommodate and even sometimes benefit from climate change. Climate change may become the dominant force in changes to the continent's biodiversity, on top of habitat destruction, pollution and over-harvesting.

The one certainty is that a changing climate will put pressure on many species and ecosystems. It is thus of paramount importance to protect as much as possible of the natural landscape to improve the chances of a smooth transition to new climatic conditions. As climate zones shift, species will need to move. For some, this may be easy enough; for others it could be very hard. Species need ecosystems within which to live, and if the ecosystem as a whole cannot move, then the migrant may become homeless.

Ecosystems are shaped less by average conditions and more by large natural disturbances such as fires, floods, high winds and droughts. Climatologists suggest that the frequency and intensity of such extreme events may change even more than average conditions.

Climate change will impact biodiversity and ecosystems differently across Europe (Box 4.3). In the Arctic, higher temperatures have already brought a greater variety of plants to Arctic lakes, and new niches may open up as permafrost thaws, glaciers retreat and temperatures rise. But there will probably also be a loss of some endemic plants. Moreover, as sea-ice conditions change, there will be threats to marine mammals. In particular, polar bears need sea ice from which to hunt in the cold Arctic waters. With no sea ice, they will be stranded. Mountain regions are also likely to be strongly affected.

Marine ecosystems will suffer complex changes associated with changes in temperature, as will coastal zones as rising sea waters invade freshwater ecosystems, storms become more intense, water quality changes in the warmer temperatures, and

Box 4.3 Projected impacts of climate change on European flora

Following previous surveys within the Euromove model, a survey by Thuiller *et al.*, 2005, within the European project 'Advanced terrestrial ecosystem analysis and modelling (ATEAM-website http://www.pik-potsdam.de/ateam/) on projected changes in the late 21st century distribution of 1 350 European plants species under seven climate change scenarios concludes:

- even under the least-severe scenario considered (mean European temperature increase of 2.7 °C), the risks to biodiversity appear to be considerable;
- more than half of the species studied could be vulnerable or threatened by 2080;
- different regions are expected to respond differently to climate change, with the greatest vulnerability in mountain regions (about 60 % species loss, including many endemic species) and the least in the southern Mediterranean and Pannonian regions;
- the boreal region is projected to lose few species, although gaining many others from immigration;
- the greatest changes, with both loss of species and large turnover of species, are expected in the transition between the Mediterranean and Euro-Siberian regions.

On the other hand, the impacts of land-use change, which were not taken into consideration in the survey, could increase the vulnerability of these refuges to fire or other disturbances, which in combination with climate change could compromise the survival of remnant populations.

flows of sediments and fresh water down rivers change. Wetlands, already under grave threat from development, will suffer further damage from climate change.

Some Atlantic coastal wetlands may cope well with sea inundations because they are adapted to a wide tidal range. They have evolved protective features like sand spits. But both the Mediterranean and the Baltic seas are virtually tideless and have no coping strategies. Several predictions put the likely loss of coastal wetland habitat in these two seas under 2–3 degree warming at more than 50 %. In the Mediterranean, the deltas of the Ebro, the Nile and Po rivers, and the lagoons within them, are thought to be particularly at risk.

The Mediterranean region as a whole, while prone to coastal changes, will probably also face more droughts and fires, land degradation due to desertification and spreading salinity in newly irrigated areas, and loss of wetlands. Several studies have concluded that this is probably the part of Europe most vulnerable to climate change. Much of the region's biodiversity is already close to its climatic limit, and is particularly vulnerable to the droughts that climate models suggest will become ever more frequent. Even small changes in temperature and rainfall could have severe consequences for some tree species most typical of the Mediterranean landscape. In practice, increased fire risk may become the most serious threat. Fire is already the crucial survival determinant for a number of tree and shrub species in the region.

4.3 Biotechnology and biosafety

Developments in technology pose opportunities as well as challenges for biodiversity policy and the chances of achieving the 2010 target. New biotechnology techniques have the potential to deliver improved food quality and environmental benefits through agronomically-enhanced crops, leading to more sustainable agricultural practices in both the developed and the developing world.

However, the subject of biotechnology, and GMOs in particular, has also raised concerns about possible impacts on human health and the environment, including biodiversity. The European Community is a signatory party to the Cartagena Protocol on Biosafety, which seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology.

Furthermore, the EU has been legislating on GMOs since the 1990s, focussing inter alia on regulating the deliberate and accidental release of GMOs to the environment. Directive 2001/18/EC on the deliberate release of GMOs into the environment applies to experimental releases, such as field tests, and the placing on the market of GMOs, for example their cultivation or import or transformation into industrial products.

Intentional and unintentional movements of GMOs between EU Member States and third countries are regulated by Regulation (EC) No 1946/2003 on transboundary movements of genetically modified organisms.

4.4 Europe's impact across the globe

As shown by the 'ecological footprint' (see Section 1.1.4), carbon dioxide emissions from burning fossil fuels are alone responsible for the half of humanity's footprint. However, the remaining part of Europe's impact on the natural and biological resources of other countries is created by its imports of a range of crops such as coffee, tea, bananas and other fruit, soy and palm oil, wood and fish.

Europe's demand for fish is a potent case. Fish is the last wild source of animal protein available to Europe in and around its territory. Demand is increasing, while most of the fisheries of Europe are seriously overexploited. Despite growing production of fish from aquaculture, Europe has increasingly turned to foreign waters to maintain supplies. In 1990, the EU-15 imported some 6.8 million tonnes of fish products; by 2003, that had increased almost 40 % to 9.4 million tonnes.

EU fleets work in the territorial waters of 26 foreign countries where the EU has negotiated access. Half of these are in Africa. While the deals are open and legal and contain clauses on sustainable harvesting, there are criticisms that, particularly in Africa, some EU fleets are depleting fish stocks and depriving local artisan fishers of their traditional catches.

Europe also imports large quantities of shrimps. Most shrimps in international trade are the products of aquaculture, so there is little direct loss to wild shrimp populations. However, particularly in Asia, shrimp farmers create their ponds by clearing coastal mangrove forests. The increase in shrimp farming over the past two decades has been a major cause of the destruction of around a quarter of the worlds surviving mangroves.

Timber is another critical natural resource widely exported to Europe, often from poor developing countries where the sustainability of the trade has been widely questioned. The volume of timber imported by the EU is less than that by some countries. Europe is responsible for about 4 % of world trade in timber, but the trade is concentrated in some areas. European companies dominate the trade in timber from the countries of Central Africa, for instance, taking 64 % of timber exports from the region. Timber makes up a fifth of the EU's total trade with Central Africa. Within the EU, France is the largest importer, followed by Spain, Italy and Portugal.

Europe is also a major importer of vegetable oil products, especially soybean oil (and meal) and palm oil which are produced in the tropics on forest land cleared for this purpose. Soybean products come primarily from South America, and palm oil from South-East Asia. Globally, the EU is the second biggest importer of soy products and, after efforts were stepped up to eliminate animal protein in animal feed, it has become the world's largest importer of soybean meal.

While Europe does not directly import water, it does import large volumes of crops that have been grown using scarce irrigation water in other lands. Economists have characterised this as 'virtual water'. Three commodities — wheat, rice and soybean products — make up almost two-thirds of the world trade in virtual water.

The EU imports 92 % of all internationally traded wild birds, the leading importers being Italy, the Netherlands and Spain. Many of the birds are listed as endangered by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). A study by non-governmental organisations found that over the past four years the EU imported three million birds listed under CITES.

5 The way ahead

The review of the implementation of the EC Biodiversity Strategy in 2004 found that while there have been some successes in implementation, there have also been shortfalls. Two main areas for improvement have been identified.	• **The need to address next steps with respect to most actions laid down in the biodiversity action plans.** • **The need for a clear sense of priority which has broad-based agreement among key stakeholders.**
Following on the assessment of the ECBS and the Message from Malahide, the Commission is preparing a Communication on biodiversity which will refocus Community biodiversity policy on essential steps to be taken to meet the 2010 objectives.	• **A number of key issues related to biodiversity conservation that are not fully addressed by the present EU policy framework, should receive more attention.**
These include assessing the dependence of human health on responsible biodiversity management, spatial planning, the internalisation of external costs to biodiversity and the distribution or sharing-out of competence between different levels of governance.	• **An important issue is the need to develop integrated data sets throughout the continent.**
This will allow accurate determination of changes at the regional and global level, as well as a conceptual framework for their interpretation, and will provide more specific policy guidance for halting the loss of biodiversity.	• **The gap between the broad objectives established at the EU level and the necessary local actions needs to be bridged.**
There is now an opportunity from the global level downwards to move from the high-level and stakeholder commitments and strategies to action on the ground. Actions will differ depending on geographical scale, so targeting and appropriateness to the local, regional, national and global levels will be key considerations when framing possible courses of action.	• **Every individual has the power to influence political decisions and initiate new ways of consuming.**
For most European citizens, food is no longer only a matter of survival. With a large variety of choice for various products in our markets and supermarkets, it is rather a matter of comfort and convenience, and sometimes even of luxury. Our consumer behaviour should take into account the real social and environmental costs involved in making these products available to us. Encouraging signs are visible with the increase in production and demand for organic products and the demand for farmers markets and fair-trade products (Worldwatch, 2004). Local, European and global-level alliances such as the Seafood Choices Alliance, the International Social and Environmental Accreditation and Labelling (ISEAL) Alliance, Forest Stewardship Council and Marine Stewardship Council are encouraging consumers to make choices that are right both for them and for the environment.	• **Stronger and wider partnerships are needed to ensure local implementation of the wide range of instruments available at the EU level.**

These partnerships should be enabled to support integration of biodiversity in all fields of activity and bring about the required changes in individual behaviour. They should raise awareness of the consequences of our living style, the effectiveness of our policies and the different scenarios for the future of Europe and the planet itself. They should bring about the necessary technological improvements in order to keep open as many options for our future nature and biological resources as possible and shape the future of our cultures — our very special European diversity.	• **Biodiversity conservation is not just about preserving special habitats and threatened species in Europe and elsewhere. It is about preserving the basic life-support systems on which life on Earth depends.**
Whether market instruments can be used to protect biodiversity and the ecosystem services in Europe and at the global level or whether legal instruments will continue to be the main framework of action is an open question. What is clear is that much more effort is needed to implement to the best effect the policy instruments already available for the benefit of biodiversity.	• **New instruments of various kinds are likely to be needed if the huge task of maintaining our ecosystems and biodiversity, on which our standards of living depend, is to be achieved.**

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