European Environment Agency

Europe's biodiversity

– biogeographical regions and seas

Biogeographical regions in Europe

The Atlantic region

– mild and green, fragmented and close to the rising sea

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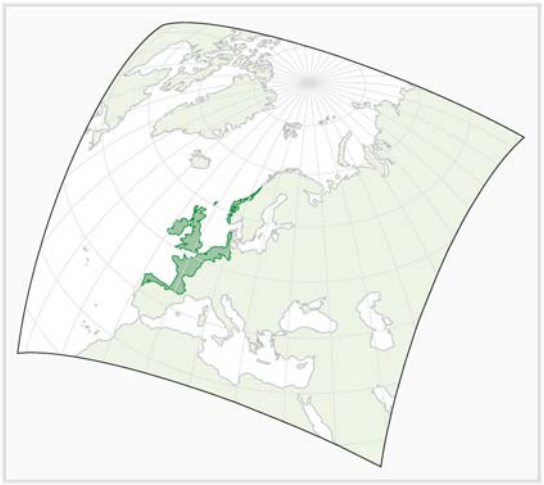


Contents

Summary

- The Atlantic biogeographical region is closely interacting with the bordering northeast Atlantic Ocean and the North Sea and has a very long coastline and islands in all sizes
- The climate is mild and humid, but the exposure to westerly wind and at the coast to tidal movements is heavy
- The low-lying coasts are connected with shallow water or lagoons. Large land reclamation areas around the North Sea are close at or under sea level and vulnerable to sea level changes
- The rocky coasts have many and varied fjords and rias, peninsulas and islands
- The major part of the landscape is fragmented and natural areas are scattered, and occur mostly in the central parts
- Some of the largest urban conglomeration areas of Europe are found in the region and a large part of the population lives along or near the coasts
- Some of the most intensively used ports of Europe are located in the north and northwest of the region
- Rivers cross the area to the sea and give entry to inner Europe's and Britain's large canal systems
- The number of indigenous species as well as of endemics is not high, compared to other regions such as the Mediterranean region
- Grasslands along rivers, in valleys and especially associated with the low coasts (fens, reedbeds, marshes) are characteristic, with decreasing coverage and deteriorating conditions
- The present forest cover is sparse but increasing mainly due to plantations. Some forests with natural species composition still exist, including forest traditionally used e.g. by coppicing
- The region is important for birdlife hosting some of the globally most important areas for nesting, migrating and wintering birds in wetlands and shallow coastal and inland waters

1. What are the main characteristics and trends of the Atlantic biogeographical region?

1.1 General characteristics

The area treated in this chapter is the Atlantic biogeographical region as defined by the European Commission and the Council of Europe for evaluation and reporting on nature conservation (Table 1, Map 1). Information on habitats and species may be found in the EUNIS web database.

Table 1. Statistics for the Atlantic biogeographical region.

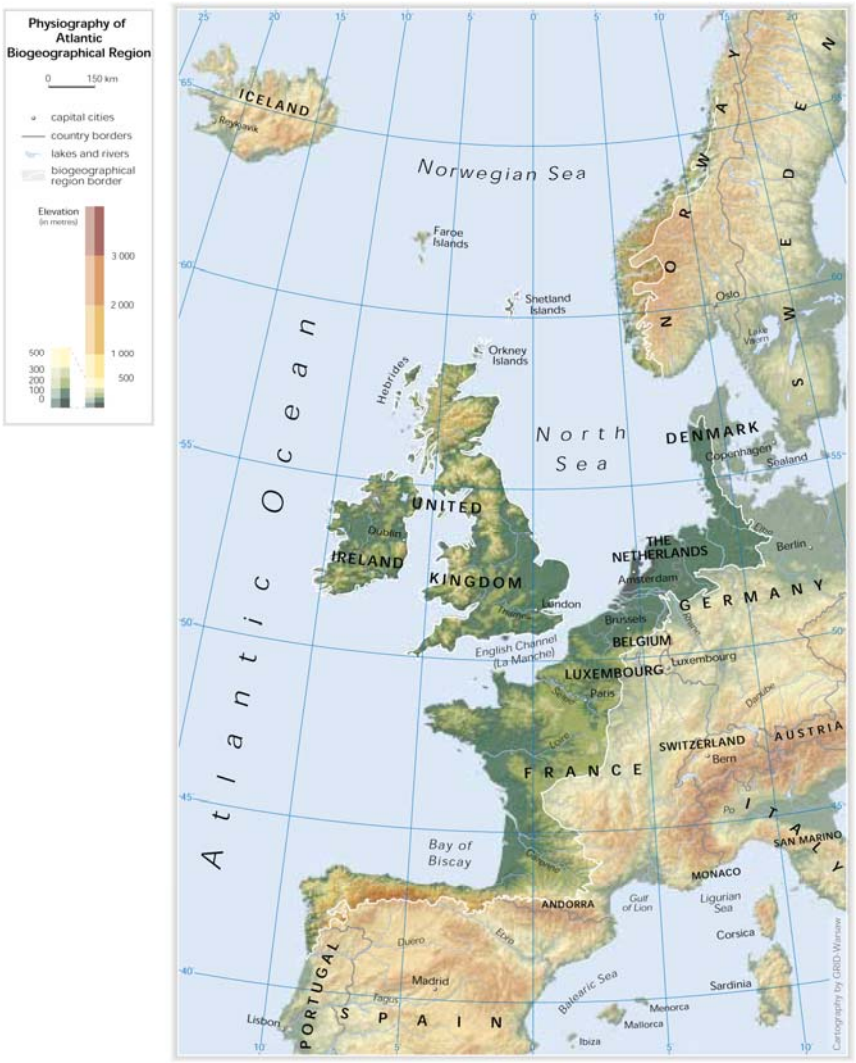
Surface area (km^2)	Number of countries in region	National composition by area	Population (inhabitants/km^2)	Main habitat types
830 000	10	France 32 % UK 30 % Ireland 8 % Germany, Spain and Norway 7 % (each) The Netherlands 6 % Belgium and Denmark 4 % (each) Portugal 1 %	Varies, on average ca 180	Agriculture/gardens 38 % Grasslands 30%

Source: compilation from various sources by EEA/ETC BD & ETC Water.

The Atlantic region roughly stretches from Porto in Portugal in the south to north of Trondheim in Norway. The region borders both the coldest and the some of the warmest parts of Europe: the Artcic and Scandinavian alpine regions in the north (Norway) and the Mediterranean region in the south (Portugal, Spain and France), but the closest contact is with the temperate western part of the Continental region. Three countries are wholly within the northern part of the region: Ireland, United Kingdom and the Netherlands. The region also covers the Hebrides, the Orkney and Shetland Islands (UK) as well as the Faroe Islands (DK).

It should be noted, that some tables and maps may lack information from Norway and the Faroe Islands (an autonomous province of Denmark), since they do not belong to the European Union.

Map 1. The Atlantic biogeographical region.



Source: EEA, UNEP/GRID Warsaw final map production.

1.1.1 Topography and geomorphology

The Atlantic region and the Atlantic Ocean are closely related: the region has an extensive and varied coastline and meets the Atlantic Sea in all countries along its coast except in northern Norway. This close link between land and sea is similar to the Mediterranean region's close link with the Mediterranean Sea. All coasts are exposed to large tidal movements. The inland landscapes consist of hilly ranges and uplands or of large and relatively flat and low-lying plains. Only few areas have high mountains: in the north in Norway, in the south in Spain and Portugal. In the British Isles some mountain ranges of medium heights are remnants of older ranges.

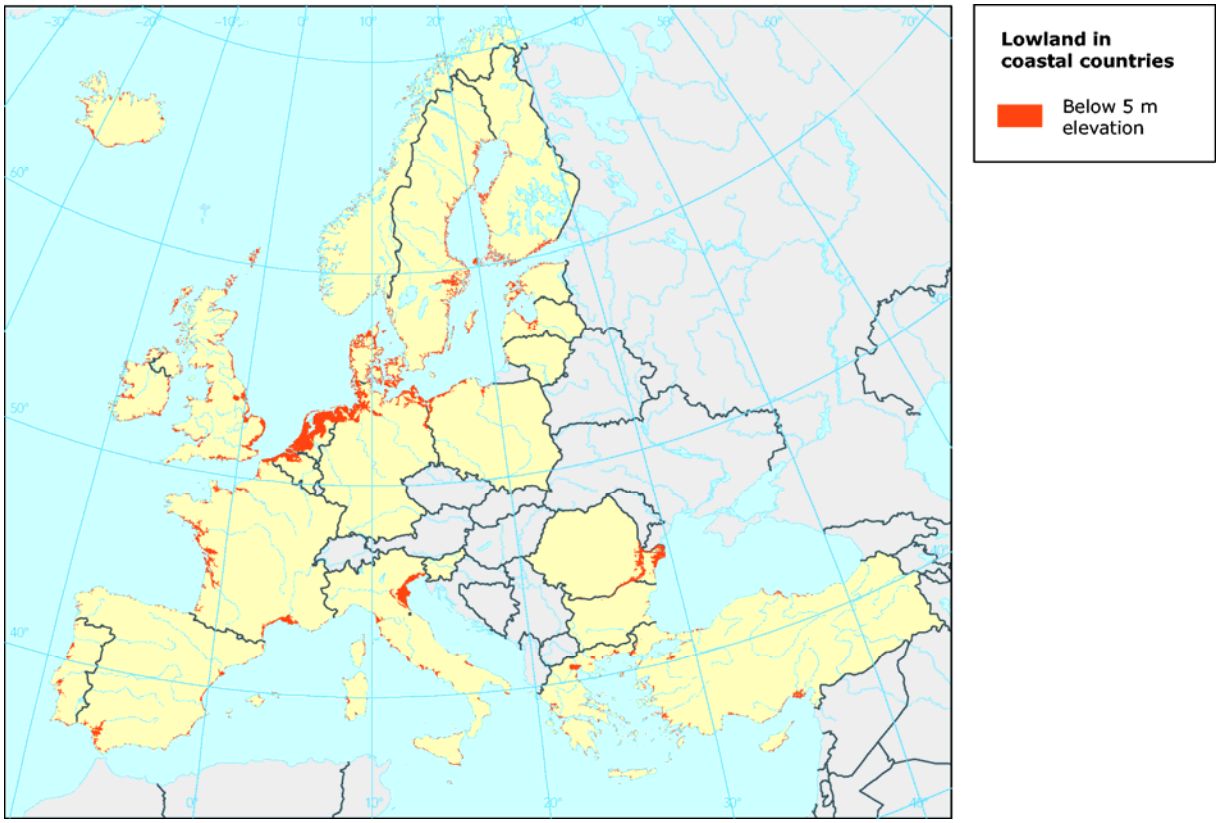
The landcape of the region has a dual history: in the south the land was not covered by ice during the last ice age and erosion and geo-morphological processes are similar to those of the western Mediterranean region. The most northern parts were covered by ice or were much influenced by glacial and postglacial processes.

The coastal landscapes both along the North Sea and the least exposed parts of the Bay of Biscay present a combination of sandy beaches with extensive dunes, marshes and fenlands. Many of these are at or below the present sea level: 60 % of the Netherlands and also areas of south western Denmark, north western Germany and eastern England.

The landscapes at the southern part of the North Sea in England, Germany, the Netherlands and Denmark are situated on glacio-fluvial plains. The sea bottom of the present North Sea is of the same origin as the present terrestrial landscape. During the Atlantic period after the ice age it was mostly above sea level (some areas more than 130 m higher than today) and interconnected the countries around it into one vast land area. For many centuries species therefore moved from the present day continental Europe to the British Isles by a land-bridge, until the North Sea gradually attained today's level at which the English Channel and the North Sea became dividers. In the sea the low terrestrial coastal zones are therefore matched with vast shallow waters, where large areas are dry during the tidal ebbs.

The region also has a history of land reclamation along the low-lying coasts for more than 1000 years. The region has also lost large tracts of land to storms and to the sea. Both processes have severly affected the morphology and ecological functions of low coastlines. The low-lying and reclaimed land as well as the shallow water areas can be foreseen to be influenced by a rise in the sea level of even 0.5 m, directly or indirectly.

Map 2. Lowland (elevation <5 m) in coastal areas in Europe.



Source: EEA/ETC BD, EUNIS.

Long stretches of rocky coasts are exposed directly to the sea in Norway, Scotland, Ireland, Wales and Cornwall, the western part of France and the Atlantic coasts of Spain and Portugal. The coasts have numerous inlets, fjords and bays, peninsulas and islands in varying sizes, in clusters around the Channel in France and England, the Irish Sea in Ireland and Britain and the outer north western islands from Scotland to the Faroe Islands and western Norway.

The central region of Britain and parts of Cornwall belong to an old mountain chain, having a mosaic inland and coastal topography. The mountains in the northern and western parts of the British Isles are also of ancient origin. They are worn down by the effects of erosion, including ice erosion, and are now quite modest in height, only few

reaching above 1 200–1 300 m. In the mountain stretches in northern Spain, however, a few mountains reach a level of 2 000 m and altitudes above 1500 m is reached in Portugal on the border to Spain. These areas are closely associated with the geologically much younger Alpine region in the Pyrenees.

1.1.2 Soils

The old northern and western mountains contain parts of volcanic origin, such as along the Irish coasts (basaltic pillar areas), while the central mountains are of crystalline rocks including granite. The substrate of the plains and low-lying hills in the rest of the region are of sedimentary origin (limestone, sandstone, chalk, etc.). On top are considerable deposits of sand, clay, gravel and pebbles, in the northern part deposited by the ice.

Generally, the high rainfall throughout the year has tended to make soils uniform, often with a well developed humus content. Brown soils (cambisols) are found overall except in the north, but acid soils, often as stratified podzols are the characteristic soil of the Atlantic region. There are still vast peat formations, especially in the most humid parts. Luvisols and fluvisols are widespread in the southern parts, while shallow ranker soils are found in the most southern areas.

Land reclaimed from the sea is normally sandy or more fine grained silty and fertile. It is initially saline, but the high precipitation and freshwater flooding will gradually rinse the salt from the topsoils, unless the soils are inundated regularly. Former marine soils may remain salty at some depth by subterraneous connections with the seawater body. In such areas the drinking water situation may be problematic. With a predicted rise of sea level the saline influence can be foreseen to increase.

1.1.3 Atlantic temperate climate

The weather of the region is strongly influenced by what happens in the tropic part of the Atlantic Ocean and along the Gulf stream, both bringing warm and humid air and warm water masses. The Atlantic climate is therefore oceanic with moderate and mild temperatures and generally a high precipitation and high humidity. The region experiences few days without wind, as westerly winds prevail throughout most of the year. Several very severe storms have affected the region during the last decades (see information on forests below).

The Atlantic weather system is considered governed largely by the so-called NAO (North Atlantic Oscillation), with its recurring pattern of weather conditions and coupled with the Gulfstream system. It may, however, occasionally be strongly influenced for shorter periods by influx of cold weather from the north (arctic) or the east (Siberian).

The differences in temperature between summer and winter are small. The eastern limit of the region approximately follows the line where the annual temperature range is 16°C. However, the daylight length in the region varies greatly from north to south.

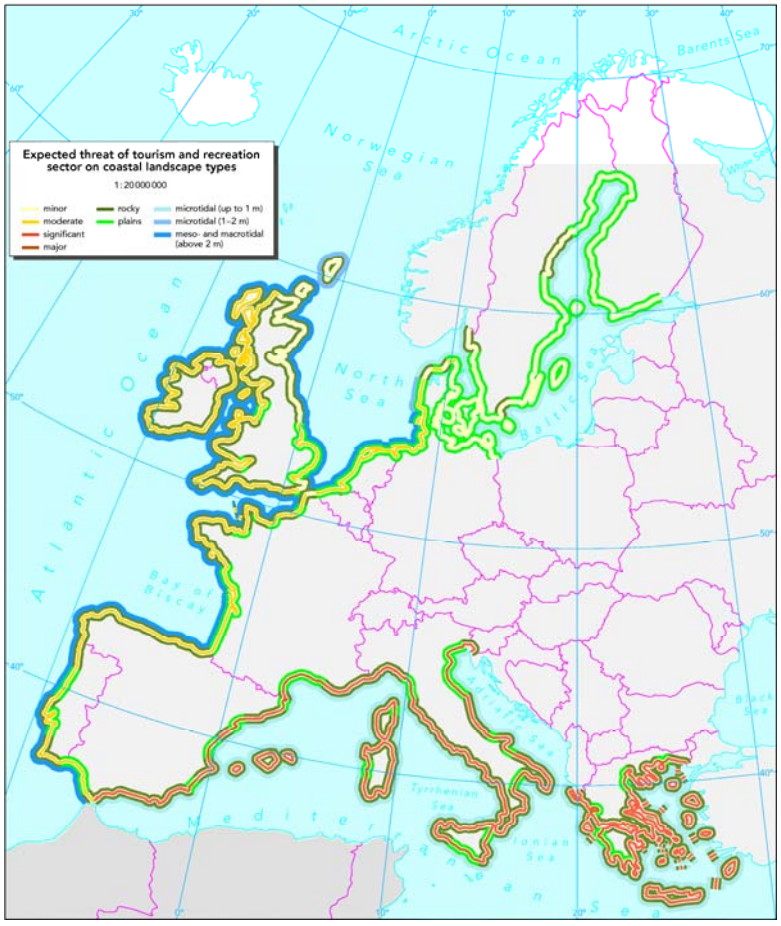
The whole region has in general a surplus of water, though there are large differences from west to east. Rainfall is very high in the western parts, reaching up to 3 000 mm per year on the mountains of Northwest Scotland, while it can be as little as 550 mm per year in lowlands in the eastern parts of the region. The climate of oceanic Spanish and Portuguese parts is called Lusitanian; it has both high temperature and high rainfall and a low annual variation. With increase in temperature this climate type may move northwards in the region, if the rainfall remains high. The high precipitation rates causes leaching of the soils and feeds the bogs and moors, among these specifically the raised bogs. Also the increased incidents of storms and heavy and prolonged rainfalls have caused huge problems of flooding.

1.1.4 Population and settlement

The Atlantic region has some of the most densely industrialised areas of the world and some of the biggest urban agglomerations. The densest population concentration of Europe is found from Paris in the south, the British Midlands and London in the west to Belgium and southern Netherlands. Since the coasts are exposed, cities and ports are mostly situated along major navigable rivers or in sheltered river deltas. Some of them are also historically dependent on mining and the first industrialisation.

Many smaller cities originated as fishing or coastal merchant towns, but long stretches of the coasts have historically not been favourable as harbours for larger vessels. Large stretches of the coasts are still thinly populated, but summerhouses and tourist facilities are increasingly being built along or close to the coasts. Also harbour facilities for pleasure craft are being built or expanded (Map 3).

Map 3. Expected threat of tourism and recreation activities on costal landscapes.



Source: EEA/ETC BD, EUNIS.

Because of the mild climate the region is densely cultivated throughout except for the highest mountain ranges and the most exposed parts. The farming pattern is very uneven over the region, with mainly pasture management in the west and mainly crop production in the east. Overall the forest cover is sparse.

The Atlantic region sees a decrease in rural population just as the other regions, but not yet the same amount of abandonment of land use as for instance in the Mediterranean region and some parts of the Continental region.

1.2 Main influences

Main influences

The main influences on biodiversity are:

- climate change (temperature, precipitation)
- urbanisation and tourism
- intensive agriculture, with decreased grazing
- land-reclamation and land restoration

Other important influences are:

- afforestation and changing tree composition
- change in and exploitation of wetlands
- contaminants
- alien invasive species

1.3 Main political instruments

Main political instruments

The main political instruments of direct importance for biodiversity in the region (some are limited to parts of the region):

- European Community regulations and directives, concerning in particular, nature conservation (Birds and Habitats Directives), the 6th Environment Action Programme, the Biodiversity Communication 2006 and the Biodiversity Action Plan, the new Financial Instrument for the Environment LIFE+, the Common Agricultural Policy and its accompanying measures, EU Forest Action Plan and other relevant areas of activity.
- Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat)
- Bonn Convention (Convention on Migratory Species) with the African-Eurasian Migratory Waterbird Agreement and the Waddensea Seals Agreement
- Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats)
- European Landscape Convention
- UN Convention on Biological Diversity (CBD)
- UN Convention on Long-range Trans-boundary Air Pollution (CLRTAP)
- Ministerial Conference on Protection of Forests in Europe (MCPFE)
- pan-European Biological and Landscape Diversity Strategy (PEBLDS)
- International Convention for the Control and Management of Ships' Ballast Water and Sediments

Special instruments:

- The trilateral cooperation on the Wadden Sea (the Netherlands, Germany and Denmark)

The marine conventions are mentioned in the chapters on the North-east Atlantic Ocean, the North Sea and the Baltic Sea.

1.4 Biodiversity status

The climate (mild, wet and windy) in combination with the impacts of the latest glaciation and the intensive use of the land for centuries combines to characterise the ecosystems and the species composition of the Atlantic region[1].

The most recent glaciation, which ended about 10 000 years ago, reduced the biodiversity of the region: the polar ice sheet and associated glaciers spread across the northern part of the region, while further south a broad belt was covered by tundra. Thermophilous species and even temperate species formerly existing in the region were driven southwards to refuge areas, which were limited by the Mediterranean Sea and the Sahara desert. The east-west alignment of the mountain chains of the Alps and Pyrenees also acted as a barrier. After retraction of the ice, re-colonisation was infuenced by the mountain chains. The flora and fauna re-distribution to the west was gradually limited as the land bridge to England was covered by water, separating the British Isles and Ireland from the European mainland, only leaving a narrow Channel river.

Despite the very favourable climate conditions, the number of species present is therefore relatively low in the region and there are very few endemic species except in the most southern parts. Some species are still considered naturally on the move from south to north, expanding their range. This may already be enhanced by the rising temperature and milder winters experienced in the region during the last decades.

1.4.1 Ecosystems and habitat types

The region is characterised by highly productive agriculture with extensive grasslands and pastures, but also by ecosystems such as bogs, mires, grasslands and heathlands dependent on humid conditions. These open and mostly tree-free grass and herb dominated ecosystems cover close to 30 % of the region. Forests cover around 13 %, scarcest in the western parts, increasing towards the east into the Continental region. New afforestation, largely by exotic conifers, is increasingly promoted on abandoned farmland and peatlands, such as in Ireland. Abandoned former sheep or cattle grazing areas as well as low-productive or remote croplands are also being turned to scrublands or being planted. Linear plantings of trees and shrubs (hedgerows) around fields and small forests are widespread in some parts (Table 2 and Table 3).

Despite the high precipitation there are not many large lakes, but several of Europe's big rivers pass the region to discharge into the north-east Atlantic Ocean. On the continental part of the region these rivers mostly flow from east to west (originating in the Continental region). Also the high precipitaion in Ireland and UK gives rise to several

[1] Several reports from the European Environment Agency deal with aspects of biodiversity in this region, among these the chapters on the North Sea and the North-east Atlantic Ocean, where some of the coastal conditions are explained, see http://reports.eea.europa.eu/report_2002_0524_154909/en

large rivers. These rivers bring great amounts of sediment, nutrients and pollution from their intensively used catchment areas, thus heavily influencing the coastal marine area. The pollution and sediments from the French rivers influence for instance the shallow water areas of the Bay of Biscay, while Belgian, Dutch and German rivers have an impact on the Wadden Sea.

All of the large and most of the smaller rivers are regulated. However, during the last decade some large de-regulation projects have been accomplished. Examples in France concern long stretches of the river Loire and in Denmark the river Skjern Å, both with EU funding.

All of the large rivers in the Atlantic biogeographic region have been regulated.
Photo: Ulla Pinborg.

Where shallow sea, tidal areas, coastal marshes and fens meet, large flocks of European water birds rest during spring and autumn migration or stay during the mild winters (Bay of Biscay, the Wadden Sea, the Zuidersee and the many estuaries and large marshlands and fens). The region also has some of the biggest land-reclamations from the sea as well as some of the biggest failures in land reclamation, some of which are now important wetlands.

Really arid lands do not exist, but especially the dunes, some easterly heathlands and on the chalk substrates conditions may periodically be so dry, that specially adapted flora and fauna are developed.

Table 2. Main habitat types of the Atlantic biogeographicalal region.

Agriculture and gardens	Grass-land	Forest and other wooded land	Heath-land and scrubs	Wetlands (bogs and mires)	Rivers and lakes	Coastal and halophytic habitats
38 %	30 %	13 %	8 %	2 %	< 1 %	< 1 %

Source: Compiled by EEA/ETC BD from Corine Land Cover (EEA) and PELCOM map (Pan-European Land Cover Monitoring, Alterra 1999, NL). June 2000.

Note: Habitat types according to EUNIS Habitat Classification

In the EU part of the region, 118 habitat types are of Community importance as set out in the EU Habitats Directive (Annex I). Of these 31 are priority habitat types (ETC/NPB and EC NATURA 2000 database, February 2003). Five types occur only in the Atlantic region (Table 3).

Table 3. Habitat types of Community importance only present in the Atlantic biogeographic region (Habitats Directive, Annex I, terrestrial part)

EU Habitats Directive code	Habitat type
21A0	Machairs (only those in Ireland included)
4040	Dry Atlantic coastal heaths with *Erica vagans*
91C0	Caledonian forest
91J0	*Taxus baccata* wood of the British Isles
91A0	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

Source: EEA/ETC BD

1.4.2 Agriculture

The Atlantic biogeographic region is an agricultural region with ca 38 % arable land. The most intensive agriculture of the region is found in France, Belgium, the Netherlands, Germany, Denmark and southern UK, where farmland also dominates as land cover. Arable areas in these countries are often drained, brooks and ditches are often covered and small habitats in field edges or e.g. ponds are removed. In Norway and some parts of Spain and Portugal agriculture is the least intensive. The total area of arable land is decreasing: every year large tracts are turned to urban use, while remote or less productive areas are being abandoned, often afforestated actively or allowed to develop naturally into scrublands. The agriculture of the Atlantic region is changing to serve the large urban populations with increasing amounts of vegetables.

38% of the Atlantic region is arable land. Photo: Linus Svensson

1.4.3 Atlantic grasslands

The Atlantic region is largely covered by permanent grassland (30 %). Ireland has more than 70 % of the agricultural land as grassland, United Kingdom and the Netherlands have more than 50 %. The region also still has a large proportion of heathlands (some 8 %), though also that area has greatly decreased. In many areas the grasslands and heathlands are mixed, or grasslands left abandoned or with low grazing intensity may turn into heathlands, while overgrazed or fertilized heathlands may develop into grasslands.

The grasslands are thus to a large degree dependent on continuous cattle and sheep grazing. The cattle landscapes are found mostly in the central lowlands, while more sheep holdings are found in hilly and upland parts (Ireland, UK and Norway) or along the coasts (France, the Netherlands, Germany and Denmark). Goats are locally important in e.g. Norway. Horses are increasingly to be found, especially close to urban areas. Some of the bird-rich grasslands are heavily grazed and naturally fertilised by geese, swans etc.

Grasing by cattle and goats is essential to maintain grasslands in the Atlantic biogeographic region. Here are goat grasing in a semi-open landscape on the Norwegian coast. Photo: Mercedes Rois Diaz.

However, it is estimated that more than 16% of the grasslands have been lost over the last 20 years across the region. Grasslands are decreasing in the lowlands and the eastern parts, where intensification of cultivation is ongoing (shift to wheat, maize). In the most humid (western) parts or in hills and mountains intensive agriculture is not economically or ecologically possible. Here most grasslands are still maintained, though they are increasingly abandoned to develop into scrubs (islands, remote coasts) or afforested (hills, mountains), concentrating the productive grasslands to more accessible areas. Existing grasslands also change because of change in management: change in number of grazing heads or intensification of the production of former semi-natural grasslands by in-seeding of new grass species or, most importantly, by fertilisation, whereby only the most robust plant species survive and only few of the many insects find host- and fodder plants.

Traditional farming mixed with grazing and forestry (agroforestry systems) is declining all over Europe because of the labour required to maintain them and the low output. The old complex farming systems on the steep fjord sides in Norwegian fjords are thus rapidly disappearing such as is the case in the Geiranger fjord, since 2005 an UNESCO World Heritage Site. Most of the grasslands that have remained in cultivation in such areas have been subject to intensifying measures and the outfields have largely been abandoned, with extensive re-colonisation by trees. The associated traditional use of woodland has almost disappeared, except in a few conservation areas, where there have been problems in re-learning the necessary skills. Similar trends can be seen in the Spanish and Portuguese parts of the Atlantic biogeographic region.

Interest has been high in protecting or enabling management and maintenance of High Nature Value Farmland (HNV areas) and to use EU funding for this as a concrete measure to serve the goals of the EU directives on protection of habitats and species. For further details, see the EEA report “High nature value farmland – Characteristics, trends and policy challenges” (http://reports.eea.europa.eu/report_2004_1/en).

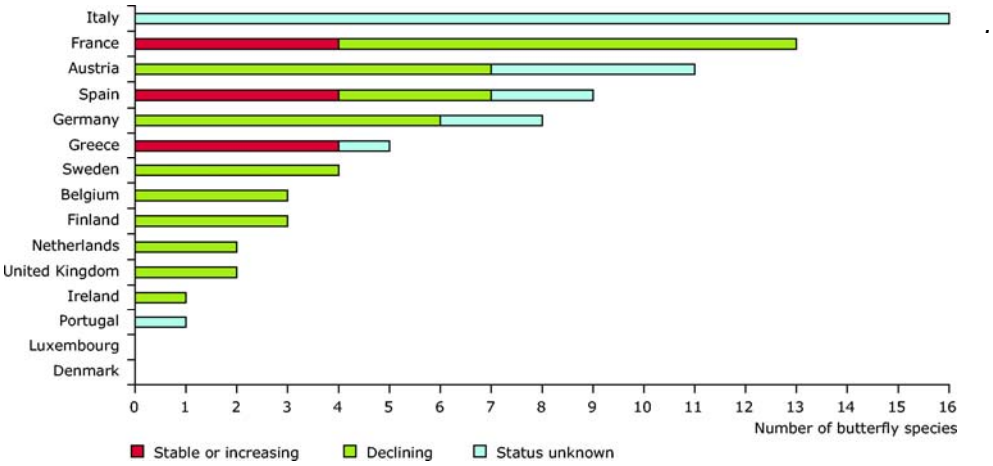
1.4.3.1 Main grassland types

The few existing natural grasslands and heatlands, together with the permanent semi-natural grasslands are crucial to biodiversity of the region. They are of very varied types:

inland grasslands, dry grasslands on sand or on chalk, grasslands in hills, uplands and mountains or along the coasts, dry or humid heathlands.

The diversity of plant species is associated with a wide variety of fauna, particularly insects, including butterflies as well as many grasshoppers, spiders, bees and flies (Figure 1). Permanent grasslands with long continuous histories also have a very richly developed soil biodiversity.

Figure 1. Population trends of agriculture-related butterfly species in prime butterfly areas



Source: EEA dataservice. Note: Denmark and Luxembourg do not retain key butterfly species that rely on agricultural habitats.

The most widespread and common is the inland grassland type (mesophile hay meadow), dominated by meadow-grass (*Poa pratensis*), cock's-foot (*Dactylis glomerata*) and meadow fescue (*Festuca pratensis*). Grazing supports other species such as rye-grass (*Lolium perenne*) or crested dogs'-tail (*Cynosurus cristatus*).

Grasslands formed under specific soil conditions, such as on flooded alluvial grasslands support plant species such as gratiole (*Gratiola officinalis*), tall violet (*Viola elatior*), and *Iris sibirica* as well as specialised bird species, such as curlew (*Numenius arquata*) and the corncrake (*Crex crex*), which is endangered worldwide.

Curlew, Numenius arcuata*, is a charateristic species of European grazed grasslands. Photo: Tom Ennis,* www.habitas.org.uk/priority

The coastal salt meadows support specific halophytic species such as sea Aster (*Aster tripolium*), mud rush (*Juncus gerardii*), sea arrow grass (*Triglochin maritima*) and glasswort (*Salicornia* spp.).

The chalk grasslands such as the Downs in southern England have a thin vegetation layer with varied subtypes with light grasses such as sheep's fescue (*Festuca ovina*), meadow fescue (*Festuca pratensis*), meadow oat-grass (*Avenula pratensis*) or upright brome (*Bromus erectus*) and favouring many light demanding and threatened specialist species: greater yellow rattle (*Rhinanthus serotinus*), salad burnet (*Sanguisorbia minor* ssp*. minor*), knapweed broomrape (*Orobanche elatior*) and fragrant orchid *Gymnadenia conopsea.* The Downs on the Isle of Wight are also fine examples, harbouring large populations of rare species such as the early gentian (*Gentianella anglica*). The warm, summer dry and light open conditions and the many plant species also favour many insect species. The Downs grasslands depend on a continuous grazing (traditionally mostly sheep), otherwise shrubs will enter. Because of decreased grazing and urban exploitation chalk grasslands are much diminished in UK.

A specific type of coastal grassland is machair which occurs in the Hebrides and along the northwest coast of Scotland and Ireland. These grasslands are low lying, undulating and windblown tracts with stable, herb-rich grassland, which have developed over long periods by the accumulation of blown sand behind coastal sand-dunes. The typically sandy soil is calcareous because of shell fragments, and machairs have a relitively low proportion of sand-binding vegetation but host several orchids, such as the Irish lady's-tresses orchid *(Spiranthes romanzoffiana)* and other plants like yellow rattle *(Rhinanthus minor)* as well as many insects. These grasslands have a long history of extensive agricultural use.

The dry acidic sandy grasslands common in the north eastern part of the region are poor in nutrients and are characterised by a combination of small grasses such as grey hair

grass (*Corynephorus canescens*) and sedges. Large areas have been developed into summerhouse and tourist facilities near the coasts or planted with conifers. Now many remaining areas are protected, but like the raised bogs the sandy grasslands are very susceptible to air borne eutrophication, which will change the plant and animal composition. Acidic grasslands form part of the dune complexes along the coasts (France, the Netherlands, Denmark), on sandy islands (France, Germany, Denmark) and on old inland dunes such as Lüneburger Heide in Germany.

Sub-alpine grasslands in the Atlantic region are found e.g. in the Cantabrian mountains (Picos de Europa National Park) of Spain, where several peaks raise above 2 400 m.

Unmanaged and abandoned grasslands gradually turn into scrubs and later to forests, though in the most sandy areas often via a heathland phase. In these intermediary phases invasive or pioneer species have a chance to dominate. Junipers (*Juniperus communis*) have always naturally been among such pioneers. In the western parts (British Isles, Ireland and the whole coast of the continent) the gorse (*Ulex europaeus*) is spontaneous, but can be very problematic where grazing is not intense. Its further distribution is naturally limited, due to its frost sensitivity. This is a species with may extend its distribution with a warmer oceanic climate. Exotic plant species such as the Japanese rose (*Rosa rugosa,* northeastern Asia), mountain pine (*Pinus mugo*, from Central Europe or the Pyrennees) and lodgepole pine (*Pinus contorta*, western North America) were frequently planted as pioneers on dry acidic sandy soils (grasslands, heathlands, grey dunes) in summerhouse areas and in pioneer coastal forest establishment. They are now spreading widely into neighbouring, often protected acidic grasslands, dunes and heathlands, where they are costly to remove such as in the grey dunes, acid grasslands and heathlands along the North Sea coast.

1.4.3.2 Grassland on dikes and seawalls

Dikes in the Atlantic region are of two types: inland dikes or embankments along canals and regulated rivers or seawalls along the coast and estuaries in tidal areas. In heavily populated or the most intensively cultivated parts of the region especially the inland dikes together with road verges may constitute the only habitats for wild species. Many of these are introduced or alien species.

The maintenance of dikes against breakthroughs caused by tidal forces or by river flooding is essential for the security of the land behind the dikes. Dikes have to be kept secure against erosion. However, regulation of the rivers and their dikes also hinder the natural flooding processes.

Formerly there was grazing and hay cutting on most dikes. Road verges and most dikes are cut mechanically, and grazing is mainly maintained on the long stretches of sea dikes together with the surrounding fens and marshes upfront and behind the seawalls (the Netherlands, UK, Germany, Denmark). Such areas in combination with tidal flats and land-reclamation are among the most important bird areas of the region (see the section on wetlands). The dikes form a refuge for sheep and birds at very high water levels.

1.4.4 Atlantic heathlands

Heathlands formerly covered wide areas of the region as in the Continental region. Present cover is less than 8 %. Atlantic heathlands are characterised by dwarf shrubs and occur normally on nutrient poor soils. They are found throughout the region, often as fragments and in mosaic with other habitat types such as grey dunes, peat bogs, oligotrophic wetlands and nutrient poor forests and shrubs. The largest remaining parts are found in the British Isles and Ireland.

The only natural heaths are those in the north, in western Norway, England and the

uplands of Scotland, where they may occur even close to the sea on coastal cliffs and islets and in some dune systems such as in northwestern Denmark. Other heathlands are secondary semi-natural heaths. They represent a development phase from bare soil, dunes, drained and excavated bogs or abandoned poor agricultural soil towards forest. They have been maintained over long time against natural forest and scrub development through a combination of extensive but constant grazing, cutting for fodder and periodic burning. This revitalised the heather and other small bushes and dwarf shrubs and has kept them in early stages in their rather short life cycle (some 30–40 years) and ensured that trees and higher shrubs do not dominate. Nowadays many heaths are protected, but no longer grazed or cut. The dwarf shrubs grow old and break up, and the areas are taken over by formerly cut and grazed or invading trees and other shrubs: broom, gorse, junipers and trees which will stay such as birch, oak, willow, spruce, pine. Japanese rose (*Rosa rugosa*) is a major invader in some heaths. The invasion process is functionally and involves species similar to that on grasslands. In such decaying heath areas machine cutting, even some burning and cleaning of invading trees and bushes are used for conservation. Grasses and sedges also take over in decaying heaths: wavy hair-grass (*Deschampsia flexuosa* possibly favoured by airborne nutrient influx) and purple moor-grass (*Molinia coerulea*).

Heaths vary from oceanic heaths in the west to sub-oceanic heaths in the east, from northern to near Mediterranean heaths in south of this region. The richest variation and the largest number of species are found in the west and south. A few genera are represented by several species with partly overlapping, but varying distributions. They also have somewhat different distribution mostly from west to east. Though low in total species number, the heaths consequently vary in composition along the north-south and west-east gradients.

The heathlands are dominated by the family Ericaceae such as heather (*Calluna vulgaris*, all Europe) and cross-leaved heather (*Erica tetralix*, a true oceanic species) with interspersed other dwarf shrubs and shrubs such as common juniper (*Juniperus communis*, subcontinental and not in the most westerly parts) and the leguminous brooms (*Cytisus scoparius,* widespread in central and western Europe), gorse (*Ulex europaeus,* oceanic) and the petty whin greenweed (*Genista anglica*). In the north and west the content of berry producing dwarfshrubs can be large: blue or bilberry (*Vaccinium myrtillus*, the whole region), crowberry (*Empetrum nigrum*, north and northwest), cranberry (*Vaccinium oxycoccus*, north and west), cowberry (*Vaccinium vitis-idaea*, circumpolar, in the region mostly in north and northwest) and bearberry (*Arctostaphylos uva-ursi*, western and northerly). On the Iberian Peninsula and in southern France the heaths are often closely linked to dry mineral rich grasslands. They are functionally related to the *Cistus* rich scrub areas of the Mediterranean region or to the heaths of the Alpine region part of the Pyrenees.

Heaths are rich in insects such as caterpillars and grasshoppers and in nectar seeking insects such as bees and wasps, moths and butterflies. The heaths are generally not very rich in birdlife, but house some very specialised birds, many of which are in decline: the red grouse (*Lagopus lagopus scoticus,* a British subspecies of the more wide-spread Willow Grouse, dependent on young green heather twigs for diet), the golden plover (*Pluvialis apricaria*) and wood sand-piper (*Tringa glareola*). Heathlands also host most of the regions few species of lizards and snakes.

Heaths as well as grey dunes may on the poorest soils house large areas dominated by a few moss or lichen species, such as cup lichen (*Cladonia* ssp.).

While heathlands still occur widespread in the British Isles and Norway, they are now mainly restricted to nature protection areas in nearly all the rest of the region. In Germany the Lüneburger Heide is an example of a vast heathland developed on former inland dunes (see these). As in other heathlands the factors decreasing grazing, airborne eutrophication, ageing of heather shrubs and disturbance of soil and vegetation by

tourism cause heathlands to change towards dry grasslands with scrubs of birch, oaks and junipers, imparing management.

1.4.5 Atlantic dunes

Atlantic dunes can be found along all coasts exposed to wind and wave action, which can bring sand to the shore and beyond. Dunes are mainly found along the Atlantic Sea, the Bay of Biscay, the English Channel and the North Sea coasts.

There are also large former inland dune tracts like in the Continental region. They were developed on glaciofluvial sand and gradually turned into heathlands, either naturally or after periods of grazing of grey dunes.

If left undisturbed the white young unvegetated dunes normally develop their vegetation cover in phases from green and then to grey vegetation as they mature and are less exposed to the sea and wind or inland only to the wind. Such dunes were and some still are grazed, many turning into and connecting with neighbouring heaths or grasslands. In many areas grey dunes formerly developed into heaths (brown dunes) or scrubs.

However, drifting sand and dune formation formerly caused widespread problems for farmers and landowners. Most dunes were therefore planted with sand binding grasses or afforested in large land-reclamation projects over the last 200–300 years. Also large areas were urbanised or used for summerhouses and tourism facilities. It is considered that by 1950 already some 50 % of all Atlantic dunes were distroyed or were severely altered, and almost all remaining dunes were stabilised by sand binding. Most of the inland dunes are disrupted due to urbanisation or afforestation. One of the largest afforestations of dunes and sand areas is found in southern France in Les Landes.

Atlantic dunes were estimated to cover less than 600 000 ha in the latter part of the 20th century. Urbanisation and tourism facilities continue to spread over the remaining dunes, though the trend is decreasing. However, the direct mechanical pressure from recreation and tourism increasingly disrupts both natural and planted vegetation, and air pollution fertilises the soils. Together these impacts disrupts and change the sand dune habitats. In many areas the grey dune vegetation breaks up in patches and the dunes turn white and vulnerable again.

Like in the Continental and Mediterranean regions only few fully mobile dune areas exist, mostly in remote coastal areas, and only extremely few mobile inland dune areas still exists. In the region the only mobile dune in Denmark – the large Raabjerg Mile – moves 20–50 m eastward every year into arable land. The area is protected.

Dunes on marine sands contain varying amounts of calcium-rich seashells and minerals from the sea, while inland dunes normally are very low in all nutrients. Dunes also have a high internal variation: very dry tops and south sides, humid north sides and wet bottoms. The marine dunes may have many calciphilous species such as orchids, the inland dunes hosting more oligotrophic species. In the white dunes natural establishment of vegetation is based on a small number of pioneer species. Actively binding the dune sand is also based on very few similar species. In long established grey dunes lichens formerly grew in large patches, but many of these are now being overgrown by grasses, due to nitrogen influx and in some areas to trampling. Dunes have a high proportion of endemic plant and insect species.

Grey dunes may cover large areas where the slowly establishing few moss or lichen species dominate. Lichens are very susceptible both to airborne influx of nutrients and to mechanical damage by trampling, both causing lichen covers to break. A large part of the region's total area of existing Atlantic dunes is along the Danish west coast (24 000 ha).

1.4.6 Wetlands

The term wetland has changed over time and with various political and regulatory instruments. In this report wetlands cover wet or very humid vegetated habitats with no or very little open water surface: mires and bogs, as well as habitats with open water: rivers, lakes. Wetlands can be inland, coastal or marine. The marine wetlands are dealt with by the marine chapters on the North Sea and the northeast Atlantic Ocean.

1.4.6.1 Mires and bogs

Due to the high humidity, the region is still relatively rich and has been even richer in mires and bogs. They are described with a very varying terminology both nationally and internationally. Descriptions of mire and bog types are found in the habitats part of the EUNIS database and in Devillers *et al.* 2001. These wetlands are all vegetated and may encompass in addition to mires and bogs also fens and marshes and sometimes also swamps. They do not cover open water as such, but they very often occur together with smaller or larger open bodies of water such as lakes and ponds or even rivers and humid forests. The soil varies in depth and consists of wet or very humid peat, which is partly decomposed organic matter.

As mentioned above, soils are poorer in the Atlantic region than in most other regions: many areas are sandy, and nutrients have been leached out by the humidity over hundreds of years. Where there is low or slow natural drainage this taken together with the relatively low temperatures have resulted in vast formations of deep peat soils over large areas. Here organic matter has accumulated over centuries. This is in contrast with the faster processes in for instance the Mediterranean region. However, alkaline or nutrient rich wetlands occur close to the sea or in areas with nutrient rich or calcareous substrates. Calcareous mires or bogs are poor in organic matter and are dominated by tall herbs and horsetails (e.g. *Equisetum hiemale*) and orchids.

What remains of mires, bogs and fens today is only a fragment of the enormous areas that existed 200 years ago. Ireland has had and still has the largest proportion of peatlands in Europe (more than 16 % of the territory), but only 20 % of this is left intact (220 000 ha). All natural peatlands in the Netherlands have been lost, the United Kingdom have only 10 % of its former blanket bogs and 2 % of its raised bogs (IPCC, 2000). Similar decreases have taken place in France, Germany and Denmark in this region. The reasons for the decrease are mainly: drainage and cultivation, afforestation, peat excavation, nutrient induced decomposition or combustion.

1.4.6.2 Bogs

Bogs are acidic mires with peat development. They occur in the northwestern part of the region and are dominated by bog-mosses (*Sphagnum* spp.), sedges (such as *Carex* spp. and *Eriophorum* spp.) and heathers (*Calluna vulgaris* and *Erica tetralix*). Insectivorous plants such as sundews (*Drosera* spp.) are characteristic of the nitrogen-poor conditions.

The insectivorous sundew Drosera *spp. is a characteristic species of nutrient-poor bogs. Photo: John Crellin* www.floralimages.co.uk

There are several bog types, dependent on how water and nutrients are brought to the bog. This depends on topography, substrate, humidity and air borne substances. The most widespread bogs are oligotrophic humid peatlands with a limited number of plant species. They often occur in connection with heathlands, forests or dunes.

Raised bogs constitute a special type of bog. They are ombrotrophic, being fed only by precipitation and by no or very little nutrient rich ground- or surface water. They occur mostly in the coolest parts. Their sometimes enormous domes of biomass have been formed over centuries, because bog-mosses (*Spaghnum* spp.) are able both to extract even the smallest nutrients from the precipitation and to continue to grow, generation after generation with not connection to the soil surface. Raised bogs often are the final stage of development of a lake being overgrown and turned into a bog, where the centre parts gradually lose connection for water with the surroundings. Raised bogs also occur in humid conditions in the Boreal and Continental region and in mountains of other regions (Jura, the Pyrenees, the Alps and the Carpathians), but conditions for creating this bog type are especially favourable in the Atlantic region. Raised bogs are rich in insects such as dragonflies, ants and spiders. Large areas of raised bogs have been drained and the peat has been excavated. In Ireland, where raised bogs were formerly especially abundant in the central part, now less than 8 % are left intact. This is, however, still high compared with other countries. Undisturbed raised bogs are therefore now rare and normally only relics still remain. Raised bogs with ongoing peat formation are listed as a priority habitat (‘7110 Active raised bogs’) by the EU Habitats Directive.

Raised bogs cease to grow under low humidity or precipitation regimes. They are thus susceptible to changes towards warmer and drier climates. As mentioned above, raised bogs are also very susceptible to airborne pollution, especially to nitrogen, which will start a decomposition of the peat (combustion and mineralisation). A decreased peat depth and drier conditions allow rapid colonisation of trees (birch and pines).

In abandoned or completed peat excavations a bottom layer of peat is often left, creating oligotrophic conditions, which are often humid. Such areas may naturally and rather fast develop into bogs in humid conditions (if ditches and other draining systems are allowed to stop functioning), often with some *Sphagnum*, or in dry conditions into heathlands or into a mosaic, often ending up in nutrient poor scrublands after some decades. Proper restoration of excavated peatlands can result in a valuable oligotrophic mosaic.

The extremely slow process of raised bog formation and growth can only yake place under conditions with no airborne influx of nutrients and no ground- or surface water influx. It further requires a high level of precipition. The time span needed for such natural restauration is several hundred years.

Blanket bogs are also characteristic of the region, occurring in a broad fringe along the coasts of western and northern Ireland and the British Isles, western Norway and the Faroe Islands, where they cover large tracts in the most humid parts on flat or gently sloping ground with poor or slow drainage. They are similar to raised bogs, with dominance of *Sphagnum*, but the biomass layer is thinner and they drain naturally most to the sea. The nutrient status is very low. Grasses and sedges are frequent. The yellow flowering bog asphodel (*Narthecium ossifragum*) is locally abundant. It occurs widely in the Atlantic region. In the Continental and Boreal regions it is an indicator of where continentality begins. Undisturbed blanket bogs are rare. Ireland earlier had more than 700 000 ha of blanket bogs, an area now reduced to less than 100 000 ha.

Narthecium ossifragum.
Photo: John Crellin
www.floralimages.co.uk

Both raised bogs and blanket bogs are rich in cranberries, blueberries and other berries.

Peat has been used as a basic bio-fuel for households and industry in the region in several hundred years, accounting for the largest part of the peat land destruction. It occurred where the wood supply was scarce. During the last two decades the use for energy has declined, but use of peat and peat products has increased greatly for soil improvements for plant nurseries, gardening and lately also for agricultural soil improvement. In the Atlantic region Ireland, Northern Ireland, Spain and Denmark are the main producers though with only few large suppliers. There are also large producers in the Continental and Boreal regions. Since household and garden compost based soil amelioration and the use of bark chips are now growing, this may serve to protect the remaining peat areas to some degree.

The excavation of peat is one of the major treaths to bogs in the Atlantic region.
Photo: Valtra Oy Ab.

1.4.6.3 Fens

Fens are also peatforming mires, but they are alkaline or neutral, because water and mineral supply is from the groundwater or from sideways influx of surface runoff. The peat layer is not as thick as in bogs and the total biomass production is high with richer vegetation with reeds, tall sedges or high herbs. The most calcium rich mires have little or no peat and often also low nitrogen supply. Orchids are found in most types of fens, most richly in those with a calcareous content, which may occur where the soil is rich in loam or in remnants of marine shell deposits on raised or reclaimed sea bottom in the north and western part of the region. The tall-growing horsetails (*Equisetum hiemale*) forms fen-mats often close to calcareous spring or where water seeps through calcareous soils.

Fens have been greatly reduced or altered throughout the region, beginning several hundred years ago. Fen conditions may to a certain degree be reconstituted if drainage and influx of surplus nutrients is halted. In England enormous areas of fenlands were drained in East Anglia and Norfolk and cultivated from the 1700s to the late 1900s. The peat layers shrank several meters and decomposed in the process. Today only few areas remain, mostly in nature conservation areas. The Great Fen project[2] aims at restoring more than 3 000 ha farmland to fen conditions. Among these are the Woodwalton Fen Reserve with its 47 red-listed invertebrates, large number of birds and plants, among these western outposts of the fen woodrush (*Luzula pallescens*) and fen violet (*Viola persicifolia*).

In the region fens are often closely connected to coastal salty marshes or to lagoons. Salty marshes and saline fens are mentioned below under coastal wetlands and grasslands.

1.4.6.4 Coastal low-lying wetlands and grasslands

The coastal wetlands and grasslands are among the most important areas for biodiversity in the region. They are adopted to prevailing strong westerly winds and to salt coming by water or wind. The coastal habitats are important as such, but the highest importance is found where functional interrelations exist between the sea and land.

[2] http://www.greatfen.org.uk/

The areas are normally highly productive, because nutrients are continuously brought to the habitats. The coastal zone is also the recipient of a surplus of nutrients and of pollution and huge amounts of sediments from rivers discharging into deltas by the coast. Coastal oil spills may influnce the habitats.

The tidal influence is large along the coasts in the region, though with great differences in tidal height and in influence (how far inland the tidal will reach). With a possible sea level rise and more and stronger storm incidents these parts of the region are very vulnerable. All countries have started planning for the result of a possible change in various ways and with varying commitments, England and the Netherlands having a leading role.

The impacts if tides depend on the local structure and exposure of the coasts: rocky or low-lying sandy or marshy, flat or elevated. Many rivers – small and large – cross the region from continental Europe. Thus much of the Atlantic coast consists of a chain of small or very large estuaries and bays separated by long stretches of rocky shore and sandy beaches linked to inland grasslands and wetlands with varying degrees of fresh water, brackish or saline conditions.

The low-lying parts of the region have been the target of large land-reclamation projects in the tidal zone, most often for coastal security and for agriculture or for harbours and cities. Land reclamation began in the Medieval period, but was enhanced during the 19th and 20th century and is still in progress to some limited extent, for instance in the Wadden Sea area. In the most low-lying areas where the tidal impact is largest, long stretches of security dikes or seawalls against tidal waves and high water characterize the coast. These areas are also threatened by river run-offs. Most rivers and canals therefore also have dikes. The problems are highest during periods where either the freshwater discharge from the inland catchment areas is large or when high sea level prohibits discharge to the sea.

Protection against high water levels, waves and flooding still make sea wall security and re-inforcements highly important, not the least in the light of a possible sea level and storm severity increase.

Since thousands of years the tidal system, the sea currents and the rivers still combine to form the area, with transgressions and regressions of the sea. However, local societies have for more than 700 years radically changed parts of the region's topography, geography and habitas in order to serve a combination of interests:

- reclamation of land from the sea for agricultural use, mainly for cattle and sheep grazing;
- shipping;
- coastal security systems to control the influence of tides from the sea;
- inland security systems to control river flows and flooding.

The landscapes are low-lying and occur in Germany, France, Denmark, the Netherlands and UK, with some areas below present sea level (in the Netherlands more than 24 % of the country is below sea level). On the landside they consist of a combination of permanent grassland and fens with drainage canals and regulated riverbeds. Grass covered dikes line all waterways and the seaside (on dikes see above). Land-reclamation was formerly widespread and stretched the land into the sea. This is now only in progress for security and stabilisation of the tidal zone. From the Netherlands, along Germany into southern Denmark a broken rim of grassland covered barrier islands (halligen) are the present outposts against the North Sea, remnants of a more western coastline that existed more than 1 000 years ago.

The Atlantic coast is in change. The waves and currents are constantly at work, eroding

the coast, depositing sediment, gradually filling and aligning the coastline. Some of the habitat types are thus destroyed, while other recreated. The moving sediments cause gradual closing of bays or it deflects river mouths, in many instances creating more or less enclosed lagoons or barring off coastal lakes (Box 1).

The low-lying coastal wetlands are declining both in quality and area. In the Seine estuary, industrial development and river channelling operations have reduced the surface area of tidal mudflats from 31 000 hectares to 14 000 hectares between 1980 and 1990. The same trends are evident in the Loire estuary, where 30 000 hectares of wetlands have been lost by river channelling, while over 5 000 hectares of mudflats have been lost since 1962. In addition, coastal areas have been affected by developments in the catchment basin upstream. The Thames estuary is one of the most developed estuaries in the world, but still houses large biodiversity resources, though these are much changed (Box).

The low-lying coastal wetlands comprise habitats:

- in the tidal zone (high marine influence,) with seal, birds, fish, invertebrates with many shellfish, algae, halophytic plants;
- close to the river outlets with estuaries and lagoons (varying tidal impact, varying water types, from fresh or brackish to saline) with birds, fish, reeds and plants adopted to varying nutrient and saline conditions;
- in coastal lagoons with birds, specialised invertebrates and halophytic plants.

Box 1. Interlinked tidal and fenland areas of the Atlantic region

Bay of Saint Malo with Mont Saint-Michel

Between the rocky peninsulas of Normandy and Brittany the Baie of Saint Malo lies exposed to westerly winds and strong tides. The inner most protected part is famous for the Mont Saint-Michel island with its abbey, to be reached only at low tide. The tidal differences may reach a maximum of 15 m, with around 250 km² tidal flats to be covered or exposed. The island with surrounding sea is a world heritage site. However, parts also have status as a Ramsar area, EU Birds Directive site and national reserve. The bay is an integral part of the net of sites along the western rim of the Atlantic region, used during the year by wetland- and water-birds as mentioned elsewhere.

The bay with its water exchange system, tidal flats and surroundings with saline marshes (largest in France) form an integrated system, where nutrients are interchanged between the marine and the terrestrial part, giving a high combined productivity in fish, mussels, crustaceans and birds and many other groups. Such interchanges and interdependencies between sea and land are characteristic also for the other coastal wetlands of the region, in all making integration of use and protection necessary for sustainable fisheries, tourism and nature conservation.

Birds not only use the tidal mud and sand flats of the sea and the estuaries, but also the permanent saline grasslands and fens by the bay. Many of these are part of the land-reclamation. More than 100 000 birds breed in the area, and very large numbers also use the area during spring, autumn and winter. The number of wintering birds is high, but may vary greatly among years.

Large proportion of the population of oystercatcher (*Haematopus ostralegus*), red knot (*Calidris canutus*), dunlin (*Calidris alpina*) and curlew (*Numenius arquata*) use the bay and its surroundings and mix with lapwings (*Vanellus vanellus*), golden plovers (*Pluvialis apricaria*), gulls, ducks, whooper swans (*Cygnus cygnus*), and raptors.

The lavender flowering pedunculate sea-purslane (*Halimione pedunculata*) is a characteristic species of salty marsh-rims from the Bay of Mont Saint-Michel northwards along the English Channel, around the southern North Sea and into the salty parts of the

Baltic Sea. Land reclamation was accomplished in southeastern England by planting various halophytic sediment-binding species, mainly cord-grass (*Spartina* ssp.). This species has now spread around the North Sea into the Wadden Sea and further eastwards into the saline parts of Kattegat (outer part of the Baltic), everywhere forming outer new brims and changing the rate of increment of new land. It has also been found along the French coast.

The continued importance of the large saline grasslands is dependent on permanent grazing and the value of the marine part is dependent on the quality of the water (lower by pollution from rivers) and on the amount of sand and mud sedimented. A high sedimentation will extend the marshlands, but possibly with reeds and high vegetation. It will also change the water exchange pattern and the tidal flats of the inner bay. It will also influence on the reefs formed by the polychaete tube-forming honey-comb worm (*Sabellaria alveolata*), which serve hundreds of algae and animal species. The honey-comb work reefs are also fund as far north as in English and Irish part so the region, in most cases seemingly in decrease.

The importance of coastal wetlands is evident in designations under all national and international instruments (Ramsar Convention, EU Birds and Habitats Directives, World Heritage sites), but have many other important functions as well related to the aquatic habitats in the tidal zone, estuaries, lagoons and outer river stretches:

- fishing and aquaculture (fish, shellfish)
- security and water quality (control of tides, floods and water exchange, tidal zone stabilisation, formerly land reclamation)
- hunting (seals, birds)
- reed harvesting
- recreation and tourism

or, related to the terrestrial habitats:

- agriculture, mostly grazing (sheep, cattle) or grass production
- security (dikes, drainage)
- recreation and tourism inland

The tidal zone, estuaries and coastal lowland areas and lagoons form interconnected ecosystems of very high biodiversity importance and serve large numbers of migrating and wintering birds (sea and land).

Box 2. The Wadden Sea

In the region is found very large complex wetland areas, where the sea and the land meet and interact and where regulation and land reclamation has deeply influenced this interaction. The Wadden Sea and areas such as the Wash, Morecambe Bay and the Solway Firth in Britain and the Baie de Mont Saint Michel are all of major international importance both for biodiversity as such and for production of fish and shellfish. These wetlands are patchworks of sand and mud flats, which support large populations of migratory and wintering shorebirds. Less visible, but equally important is the role they play as nurseries for plaice (*Pleuronectes platessa*), sole (*Solea solea*); herring (*Clupea harengus*) and other commercially important fish species, and the substantial harvest of mussels, cockles and other shellfish.

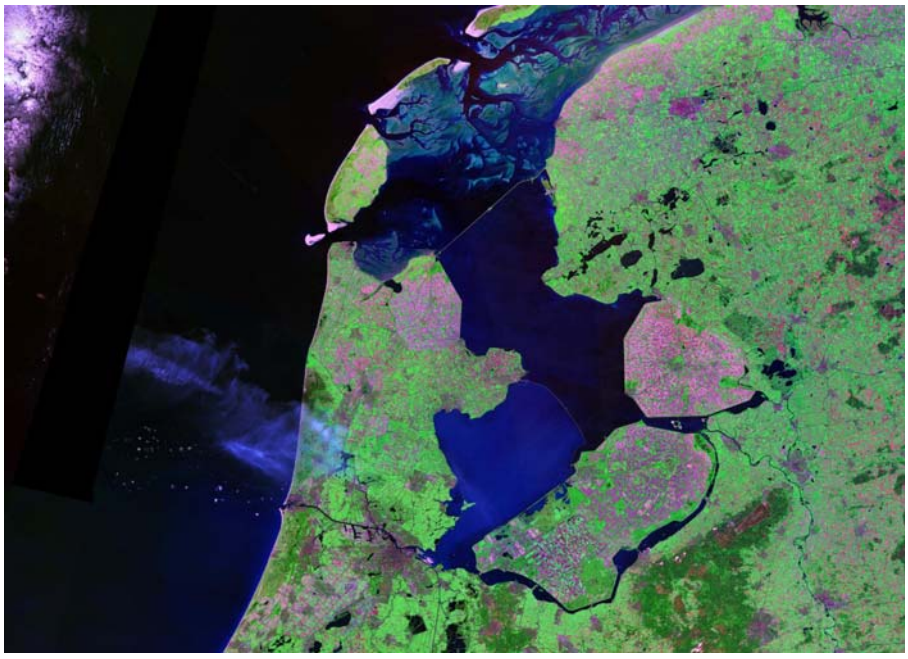
The Wadden sea is the largest of these interlocked areas in the region (13 500 km²), being shared by the Netherlands, Germany and Denmark. The Wadden Sea and its surrounding landscapes have been heavily influenced by land-reclamation for agriculture

and security during more than 700 years. The coastal region is one of the most industrialised areas of Europe, and is under considerable environment pressure. Construction of ports and embankments has resulted in damage to, and loss of, important habitats, in particular salt marshes. Neverthless the Wadden Sea is still the largest contiguous area of salt marsh in Europe.

The area has an open exchange with the North Sea, but is also fed with sediments, nutrients and contaminants from the five large rivers discharging into the Wadden Sea. The Ems, Weser, Elbe and Elder are all influenced by large scale engineering, harbour activities and dredging. Only the Varde Å in Denmark is a fully natural estuary.

The Wadden Sea is one of the key areas for migrating and wintering birds. It is estimated to be used by some 12 million individuals of more than 50 species of waterbird during the year, most of them shorebirds from northwestern Europe, Scandinavia, Siberia, Iceland, Greenland and northeastern Canada. The harbour seal (*Phoca vitulina*), the grey seal (*Halichoerus grypus*) and the bottle-nose dolphin (*Tursiops truncatus*) are all found in the Wadden Sea. The interstitial fauna (polychaet sandworms, snails) and the large blue mussel beds are essential for the migrating birds, seals and fish. The mussel beds have however in recent years been invaded and covered by the american oyster (*Crassostrea virginica*).

The Wadden Sea is considered the 10th most important waterbird area of the world and is targeted by EU Birds and Habitats Directives as well as being a Ramsar site. A specific Trilateral Cooperation on the Protection of the Wadden Sea has been established by the countries in question. It covers cooperation on fisheries, mineral excavation, hunting, tourism, land-reclamation and nature protection.



Satellite image of the Zuiderzee area. Photo: Nasa.

Box 3. Lagoons and coastal lakes – reclamation and restoration

Like in other biogeographicalal regions such as in the Mediterranean, the Black Sea and Steppic regions the many and large natural lagoons and lakes along the coast are naturally developed from bays or parts of estuaries being closed off from the sea by sedimentation. Such areas may become saline, brackish or fresh depending on the geomorphology and on the type of water brought to the lagoon from the sea or from rivers. Most of them developed naturally, some have changed form and type several times over history. Land reclamation and coast protection have influenced the development or changed many of the lagoons. In the Atlantic region these are found along the coast from southern France to Denmark and in England.

The lagoons and lakes contribute very highly to the value of the coasts, normally being rich in water birds and fish. Many of the shallow bays and lagoons are naturally eutrophic and so productive that they become overgrown with time, developing into fens or bogs and finally into grasslands and scrubs. By antropogenic nutrients from surrounding agriculture or from rivers the process of overgrowing can be very rapid.

Ijsselmeer in the Netherlands

Formerly the bay of Zuiderzee cut deeply into the northern Netherlands from the North Sea. To ensure security in the surrounding low-lying areas, better infrastructure and to allow gradual land-reclamation for agriculture a system of dikes was established around 1930 at the bay. The lake Ijsselmeer was created. Large tracts of land have since then been reclaimed from the south, but still the northern part is a lake. Since the 1980s the further land–reclamation has stopped, while the importance of the lake for freshwater consumption and for nature resources has increased.

Huge areas of reed vegetation quickly established, and a wetland and aquatic flora and fauna was soon established, followed by woodland birds. More than 320 bird species have been registered, the largest numbers being swans, geese and ducks recorded during migration. Herons, bitterns and numerous passerines are found, as are many raptors. The increase during the 1980–1990s of the former rare marsh harrier (*Circus aeruginosus*) in parts of Germany and Denmark may be associated with the beneficial conditions in areas such as Ijsselmeer. Many of the birds are fish-eating (piscivorous, gulls, terns, cormorants) and complicated interactions exist between fish and bird populations. The invasive ruddy duck (*Oxyura jamaicensis*) now occurs in the area, see below) as do a small number of other alien species such as greater and Chilean flamingoes (from captivity). Similar interactions exist in other coastal lagoons of the region.

Also elsewhere large lagoons or bays with surrounding fens and marshes were cut off from the sea or the fjords to devloped into arable or grazing land. Some failed and were abandoned after which they became valuable fresh or brackish shallow lake and mire complexes. Others were used for agriculture for several decades, but are now being abandoned and partly restored to permanently grazed grasslands and wetlands (Vejlerne, Vest Stadil Fjord and Fiil Soe in Denmark). Much of the restorations are performed under the LIFE-Nature programme. These areas are of high importance for migrating and breeding geese, swans and ducks and many threatened species of birds and amphibians.

Box 4. The Thames estuary

The Thames still has a living though regulated estuary, where the tides can be noted in London's centre every day. It encompasses a vast variation from the city and docks to the outer open parts. Since the land is still sinking and many reclaimed and drained areas are under sea level, a rise in sea level will have very serious impacts on this part of England. The huge Thames Barrier (1984) was built only to resist large waves coming up the river. Now, the Thames flood defences with all its dike kilometres are being re-planned and reconditioned. The Thames estuary outer parts house a large number of wetland species (birds, fish) and still has large areas of wetland habitats, but both species and habitats are under constant pressure from the massive urban expansion and pollution. The Tidal Thames Habitat Action Plan (TTHAP) was developed to address biodiversity issues across administrative borders for the tidal part of the Thames. Registered in the area, apart from the diverse flora, are more than 350 species of invertebrates. It is an important area for many birds, especially wintering wetland birds, among these a large part of the wintering avocets (*Avosetta recurvirostra*). The Thames tidal parts function as a base for more than 120 fish species, among these the British Dover soles (*Microstomus pacificus*). The latest new fish species found in 2004 is a blenny species (*Parablennius gattorugine*). Several other species are spreading and causing problems such as the Chinese mitten crab (*Eriocheir sinensis*), which is rapidly spreading in many parts of the world and which already burrows in a large part of the Thames dike banks.

1.4.7 The rocky coasts – the rias and fjord landscapes

The Atlantic coasts also comprise long stretches where mountains and rocky landscapes border the sea. Such landscapes are most characteristic of the Atlantic part of for instance the Iberian Peninsula and the Norwegian coasts, large stretches of Ireland and Scotland and the Faroe Islands, in France along the peninsula of Brittany. Where the sea penetrates into the land in valleys or meets the rivers in estuaries, special landscapes are formed, some with long history and still existing old habitat management. The Spanish rias and the Norwegian fjords are examples of such landscapes (Box 5).

Box 5. Rias and fjords – where the sea reaches deep into the land

Rias in the Iberian peninsula

Rias are characteristic of the western and northern coast of Spain, particularly of the Cantabrian and the Galician coasts. Rias are normally long, narrow, tidal inlets from the open Atlantic Ocean, cutting through agricultural and forestlands, which are very green due to the lusitanian climate. Traditional land use and the special habitats form a distinct landscape. The interfaces between sea, rivers and lands are among the most productive in the world. Though not among the largest, the Ria de Corme y Laxe hosts the highest concentration of waders originating from North America. Increasing exploitation of resources, tourism and pollution places this type of ecosystems under serious threat.

West Norwegian fjords

The west Norwegian fjords are long and narrow inlets from the Atlantic Ocean, often with steep and high rising mountainsides. The inner fjords are protected from the ocean, but the influence of the ocean is strong at the mouth of the fjord. The fjords often have underwater thresholds, which influence the water exchange between the fjord and the open sea. On the steep or almost perpendicular sides open rocky and scree parts alternate with sparsely vegetated grassland patches. The fjord climate and the special

light condition creates different flora zones from the bottom to the top of the fjord sides. Above the fjords the mountain peaks are high, reaching into the Alpine region of Norway with a long snow cover period. Close to the waterfalls cascading over the fjord sides from the top landscape the air humidity is extremely high, producing an optimal habitat for flowering plants, mosses and invertebrates specialised to cold water and high humidity. In contrast to this the south facing sides host deciduous forest stretches favoured by warm oceanic climates. Two of the fjords with still some traditional use and the least disturbed nature are the Nærøy and Geiranger fjords. Since these fjords have high values for tourism the pressure from tourism facilities and infrastructure is strong The two fjords are World Heritage sites.

1.4.8 Rivers and lakes

1.4.8.1 Rivers

The river system in the region is complex. The commmon pattern is many small rivers originating within the region and discharging into the northeast Atlantic Ocean or the North Sea. They may form small estuaries and lagoons. There are only a few very large rivers, which fall into the Atlantic Ocean or North Sea (British Isles and Ireland): the Rhine, Elbe, Loire, Garonne and (Table 4). Their large catchments originate in the Continental or even Alpine region. Only Ebro originates in the region in Spain. Its main course is, however, eastwards through the Mediterranean region to the Mediterranean Sea (total catchment area more than 50 000 km^2).

The big rivers and most other rivers have a regulated course, along the river inland as well as in the estuaries. The big rivers have systems of dams and sluices to regulate the water flow, to avoid flooding and to enable shipping. Regulations also exist in various ways at the estuaries, to control the run-off from inland and the tidal water movement upwards from the coast. Before rivers were regulated, flooding was a huge problem in Belgium, the Netherlands, Germany and Denmark.

However, new regulation schemes are now introduced to formerly regulated rivers. Examples include:

- The large delta works in the Netherlands across the Rhine and Maas: a new sea gate regime allows some measure of salt water to enter behind the gates to maintain conditions in salt marshes behind it
- Under the plan Loire grandeur nature (supported with EU nature funds) France has been working successfully towards a large-scale restoration of the river Loire and the dynamics of parts of the river.
- The river Skjern å in Denmark: de-regulated in the early 2000s, after being completely regulated since ca 1960 (with support from EU funds).

Table 4. Rivers crossing or originating in the Atlantic biogeographicalal region, with total catchment areas larger than 50 000 km^2

River	Country (*the country is part of the catchment but the main river does not pass the country)	Total catchment (km^2)	Approx. catchment area in the Atlantic region (km^2)	Approx. % of total catchment area in the Atlantic region (km^2)
Rhine	CH, AT,DE,FR,NL,IT*, LU*BE*	185 00	30 000	16
Elbe	CZ,DE,AT*,PL*	148 000	20 000	14
Loire	FR	118 000	75 000	64
Garonne	FR	85 000	45 000	56
Ebro	ES	84 000	15 000	18
Seine	FR	79 000	45 000	55

The region's reivers plays a special role as a waterway between the sea and the Continental region for migrating fish such as sturgeon, salmon and trout. Many rivers with reasonably clean water and little or no regulation hosts salmon and trout, coming in from the sea, but salmon and trout reproduction is also taking place.

1.4.8.2 Lakes and lagoons

The region has many and very varied natural lakes, but there is no common pattern to their distribution, though most exist in the Norwegian, Irish and Scottish parts. Generally the lakes are of limited size. Only six lakes are larger than 100 km^2. They are found in the Irish island and in Norway (Table 5). Only one artificial lake is larger than 100 km^2, namely the 1 210 km^2 Dutch Ijsselmeer.

The many and large lagoons of the region are mentioned above under coastal wetlands. Lagoons occur where sedimentation along the coasts builds up reefs or barriers, gradually closing off bays or inlets, to become lagoons. Lagoons are normally very productive, often with brackish water. Some receive both fresh and salt water. They are often dynamically unstable over time or they may shift position and form. They are crucial to bird migration along the Atlantic coast and function similarly to those of the Continental Lagoons along the Baltic Sea or the Adriatic Sea as part of the system of stop-over places during migration. More and more bird species tend to stay over winter in some of the lagoons instead of migrating further south.

Table 5. Natural lakes in the Atlantic biogeographicalal region with surface areas of more than 100 km^2

Name	Country	River catchment (km^2)	Surface area (km^2)
Neagh	Ireland	390	392
Corrib	Ireland	170	200
Derg	Ireland	135	118
Snaasavattn	Norway	117	121
Ree	Ireland	103	175
Erne	Ireland	100	512

The lakes of Ireland, Scotland and Norway are often low in nutrients (oligotrophic). They may be humus rich (brown) if originating in peatlands, clear if originating from mineral conditions in mountains or on sandy soils. In oligotrophic lakes the insectivorous bladder-wort (*Utricularia* spp.) is a specialist adjusted to the low nitrogen regime. The Irish lakes are especially rich in *Utricularia.*

The otter is still threatened in the region, but the population has seen some progress in the last decades. Recently seal have been observed entering rivers from the sea. The reason is unknown, but well stocked rivers may attract young seal.

1.4.8.3 The use of rivers and lakes

The large Atlantic rivers are of importance for transport, especially those that lead far into the Continent, where they connect to other waterways and canals of the extensive European waterways. The rivers of the regions are the entry point to these inner waterways, which are now interconnected to the Black Sea via the Danube. Canals are characteristic features of the low-lying parts of Netherlands, but also in eastern England and to a much smaller degree in France canals cross the landscape.

Some rivers are used for hydroelectricity, but the present main uses of clean rivers, mostly the medium and small, and the clean lakes are for surface drinking water, fishing and angling and for recreation boating.

Clean rivers in the region are frequently visited by anglers. Photo: Gunilla Andersson.

The lakes are of very varying quality, the cleanest being in the most remote western and northwestern areas as in Scotland and Norway. Lake water has formerly been much used for drinking water. That is no longer the case. The clean lakes have since decades been used and developed for recreation, mostly for angling. They have for many years been and are now increasingly stocked with for instance trout. Angling has become a major industry in Scotland and Norway.

1.4.8.4 Stocking rivers and loss of loss of genetic diversity – the Atlantic salmon

Stocking the rivers and lakes with fish for consumption or sport has a long history in Europe, including in the Atlantic region. The stock may originate from the same fish population and thus be of local provenance, but may also originate from other populations and may therefore be genetically quite different. This may cause change or loss of genetic diversity through mixing with existing wild local species or may completely substitute of the whole genetic pool. (Box 6)

Box 6. The Atlantic salmon – loss of genetic diversity

The Convention on Biological Diversity and several international instruments stress the importance of conserving the genetic diverse resources both in domesticated and in wild species, among plants as well as among animals.

The Atlantic salmon is an anadromous species, where the adult fish spawn in rivers and the young salmon has its earliest life-stages in freshwater. As juveniles (smolts) they migrate to the sea where they grow and mature, whereupon they return to the river where they were hatched. Salmon is thus characterised by a large number of local populations with their own genetic set-up developed over time. Genetic diversity will be lost by the loss of populations or by degradation of local genetic pools.

The Atlantic salmon is not threatened as a species, but many of its distinct populations throughout the Atlantic region have become extinct or degraded. For this there is a combination of reasons:

- loss of spawning grounds
- obstacles to migration in rivers

- low water quality and pollution
- parasites
- overfishing
- stocking with non-local gene pools to intermix and suppress local gene pools

The problems of stocking and re-introduction of salmon is a highly controversial issue. Stocking with salmon for angling purposes as well as for the commercial salmon fishery will lend support to the introduction of salmon, which may be genetically different from the local wild populations. This contributes to the loss in genetic diversity and should be considered carefully. Specimen are escaping from aquacultures and invade the wild stocks of salmon. This is considered to be one of the more serious threats to, for instance, Norwegian stocks of wild salmon. In Norway securing live genes in gene banks may be a necessary precaution to preserve threatened salmon stocks.

The Rhine, one of the largest European rivers, the young salmon migrate naturally into the North Sea and return as adults to spawn. The Rhine was probably one of the most productive salmon rivers in Europe in the 19th century. More than 116 000 salmon were sold in 1895, but the population declined thereafter and was virtually extinct in the Rhine in 1957 due to heavily overexploitation and pollution of the river. In recent years the salmon has returned to the Rhine and a number of other European rivers. This has mainly been a result of the large-scale stocking of artificially reared fish, combined with improvements in water quality and re-establishment of the access to previous spawning grounds: the fish is back, though the former gene pool has changed.

On the Iberian Peninsula the Atlantic salmon inhabit about twenty rivers on the northern coast, from the river Miño to the river Bidassoa. Dispersal of salmon within some of these rivers is severely restricted by dams and other obstacles and by low water levels. The density of juvenile salmon in the rivers is rather low, less than 0.2 individuals per 100 m^2. The distribution of salmon widely overlaps with that of brown trout in the rivers of northern Spain, where they may compete for food and microhabitats. Adult brown trout can prey on juvenile Atlantic salmon, and salmon and brown trout may also hybridise, creating a genetically floating situation.

Upon returning from the Sargasso Sea for maturing in Europe, eel enters rivers and lakes largely via the rivers. Since eel cannot be hatched in captivity, stocking is fully relying on catchment of wild young eel, returning from the Sargasso Sea to grow in the parental freshwaters. Young glass eel are caught for instance in France and shipped to Danish rivers for stocking, thus disrupting completely the local population genetic pool: also the eel is back, but the gene pool has changed.

1.4.9 Atlantic forests – from deciduous to coniferous and back

1.4.9.1 Deciduous forests

The naturally predominant forests of the Atlantic biogeographical region are deciduous forests adopted to the windy and humid cool weather, while conifers mostly occur naturally on higher grounds in the mountain ranges or on nutrient poor soils.

Around a century ago the forest cover was below 10 %, but woodland and forest now represent around 13% of the region, with an increasing coverage. The forests or the cover by wooded species is even lower in the central parts, while the southern and western parts have a higher coverage. Formerly conifers were favoured for new planting, but deciduous trees gain ground. The forest distribution is very varied and uneven. Afforestation takes place near urban areas as amenity forests for recreation, on abandoned land, on remote grazing areas or low yielding arable land such as on sandy or peaty soils.

As in other regions the former natural forests management have largely disappeared. They now mainly exist along the coasts and in remote or protected areas and then mostly in small areas. Formerly coppicing of forests was widely used, but is now only done in nature reserves. Also areas with a long well-documented forest history exist, such as in the beech dominated forests Bois de Boulogne outside Paris and Forét de Soigne outside Bruxelles and the oak-rich Sherwood forest outside Nottingham.

Deciduous forests are favoured by the climate, but growth varies from south to north. Forests and scrubs do not reach full heights in the most exposed parts (coasts, highlands). Where the wind is strong, forest and the prevailing scrubs show the wind pressure in their growth form (leaning away from the wind). On the poorest soils (sand, peat, raised bogs) or in very exposed places trees and bushes also show dwarf growth. Like in the Alps or in the Mediterranean regions such forests may locally be very lush in sheltered conditions in fjords and ravines.

The characteristic naturally dominant deciduous trees are the sessile oak (*Quercus petraea*) and the pedunculate oak (*Quercus robur*) and the beech (*Fagus sylvatica*).

The sessile oak distribution is restricted to the western part of Europe, while the pedunculate oak is more continental. In the Atlantic region the two species may occur within the same region and hybridisation is common. The region has some very ancient sessile oak forests, mostly in the British Isles, where they also contain holly (*Ilex aquifolium*). To the south of the region the white oak (*Quercus pubescens*) is gaining importance. Also other tree species with Mediterranean affinities occur in the southern parts. Therefore Spain and Portugal have the highest number of tree species in the region.

Beech came to the northern areas of the region by natural immigration, assisted by introduction and use, some thousand years ago.

Beech is presently the most planted and widespread deciduous species in managed forests today. The area covered by oak is increasing as are the stands of other deciduous species. During the last 100 years, the beech provenances have mostly been imported, often from the Continental region, but lately local provenances are gaining increasing interest. Beech forests are increasingly managed by natural regeneration. This will consolidate local provenances, where they still exist.

1.4.9.2 Conifers

Over the last 50–80 years most afforestation or re-forestation projects were done in monocultural stands with conifers, so that the region is presently characterised by a variety of large and many small forests of conifers, covering around half of the managed forest area.

Compared to other regions, the Atlantic region is poor in native conifer species: in forests Scots pine (*Pinus silvestris*) and yew (*Taxus baccata*) occur, while the juniper (*Juniperus communis*) is found in open scrubs or on nutrient poor heathlands and grasslands.

Most of the planted conifers originate from other biogeographical regions of Europe, some also of American or Asian origin.

Scots pine (*Pinus silvestris*) is naturally occurring in the region but plantations differ considerably from natural stands. Norway spruce (*Picea abies*), which elsewhere is widespread in Europe occurs naturally in the Atlantic region only in Norway. However it is dominating in forest plantations in the Danish part of the region, but planting of Norway spruce is now slowly decreasing. Sitka spruce (*Picea sitchensis*) from North America is

the most widely planted tree in the north of Britain where it covers over one million hectares. It is also widespread in Denmark and Germany. Scots pine and black pine (*Pinus nigra*) from Central Europe and the Mediterranean region are widely planted in England and in northern France, the subspecies the maritime pine (*Pinus maritima*) in south western France and Monterey pine (*Pinus radiata*) from southwestern North America in the north of Spain and Portugal. The largest forest complex dominated by conifers is found at Les Landes in southwestern France.

Insect outbreaks, pollution and salt spray near the coast has severely affected conifers in the region. This has gradually led to a change in most forest policies towards using more deciduous and local species.

Box 7. Forests to bind the drifting sand

In the Atlantic region the erosion from waves and currents has through years deposited enormous amounts of sand along the coasts, forming long sandy beaches and presenting sand to drift to form dunes and to influence the landscape behind the dunes. There, meagre sheep or cattle grazing formed the main outcome, leading to overgrazing and even increasing sand drifting. In the last 150–200 years binding the sand has been a major task in such areas for instance in France, Germany and Denmark. Dune binding was done effectively with a combination of sand-binding grasses such as marram (*Ammophila arenaria*) and lyme-grass (*Leymus arenarius*) and with conifers and gradually also oak. Today the remaining unchanged coastal dunes and heathlands are highly valued and many of them under protection.

Les Landes with around 1 million ha is the largest coniferous forest complex of Europe. South of the river Garonne and facing the Bay of Biscay on 230 km, it is developed on a vast sandy plain, which close to the sea has large dune, marsh and wetland areas and more than 100 km of sandy beach. The dunes and the sandy plains were naturally covered in xerophilous grasses and sedges and in scrubs with juniper (*Juniperus communis*), oaks and local pines. Intense sheep grazing over centuries eroded the vulnerable vegetation, contributing to remobilising the floating sands. Forests (mostly of *Pinus maritima*) started to be planted around 150 years ago to bind the sand and to ameliorate the local climate. The first use of the pines was of the resin, but today the forest is a production forest complex of pine and oak plantings.

The dune plantings along the western coast of Danish Jutland followed the same lines at a stretch of more than 150 km. Today the planted forests are dominated by *Pinus mugo* var. *uncinata* closest to the coast, with *Picea sitchensis* and *Picea abies* further inland. Oaks and *Pinus sylvestris* also have an important role. These forests gradually became southern outposts for bird species adapted to northern conifer forests.

The natural field layer in the lighter deciduous forests and scrubs consists of hemi-cryptophytes and geophytes, predominantly occurring in spring, but especially the oak forests have herbaceous and bush layers throughout the year also. Dense forests such as beech forests are dark and often only have a field layer before leaves are out. *Eucalyptus* forests do not normally have any field layer.

Many of the conifer forests are dense and form close needle litter mats on the ground and do therefore not allow an extensive natural fauna and flora, resulting in a decrease of biodiversity. There is also an increased risk of fire because of the accumulated litter on the ground, and an increase in soil erosion following felling.

1.4.9.3 Special forest and scrub types

Formerly a well-developed rim of boreo-nemoral rainforests existed along the Atlantic region coasts. These forests were and are functionally similar to similar forests along the Black Sea. Now these forests are extremely reduced, though remnants still exist in Spain, Ireland, Scotland, England and western Norway. The most northwesterly areas house lichens whose closest other living areas are trans-atlantic in New Foundland or the northeastern Pacific coast.

Yew stands (*Taxus baccata*) were formerly much more widespread in the region, especially on limestone. It is now mostly found as an ancient and widely used ornamental tree, typical of many old parks or churchyards. Yew and holly (*Ilex aquifolium*) require a mild climate with high humidity and only occur in the boreo-nemoral woods in northwestern Spain, in Scotland, Ireland (Muckross, in Killarney National Park) and England (Kingley Vale near Chichester) and on the west coast of Norway as well as very scattered in forests of Denmark and Germany. It often associates with beech or oak forests. The most holly and yew rich woods link to similar types of woods in Sardinia and Corsica (Mediterranean region) and in the Rhodopian and Carpathian Alps. The western nemoral holly woods match the humid forests of northern Turkey (*Ilex aquilinum* ssp*. caspica*) in the Black Sea biogeographicalal region and the laurisilva woods with *Ilex canariensis* (Macaronesian region). Both yew and holly are common ornamentals all over the region. Fruits are spread by birds.

The Caledonian relict forests of the Scots pine indigenous variant (*Pinus sylvestris* var. *scotica*) with birch (*Betula* spp.) and juniper (*Juniperus communis*) occur in Scotland on nutrient poor and acidic podzols with dwarf shrubs and rare northern plant species and birds such as the western capercaillie (*Tetrao urogallus*) and Scottish crossbill (*Loxia scotica*).

1.4.9.4 Other trees and bushes in the Atlantic region

Several native tree species, for instance willows, poplars, alder, ash and thorns and hazel, have formerly been economically or technically important. Their main use is now for plantings, for fencing and hedgerows.

Europe has several lime species. Of these, small-leafed lime (*Tilia cordata*) occurs in France, Germany, Belgium, the Netherlands as well as in Norway. The species is lacking from northern areas on the British Isles and the northwestern Iberian peninsula. These areas host the more southerly large-leafed lime (*Tilia platyphylla*). The two limes are widely planted all over the region. The hybrid between the two, the common lime (*Tilia vulgaris*), has however become the most used lime, especially in roadside plantings and in urban areas. Limes are late flowering and serve vast numbers of insects in mid-summer. Limes regenerate vegetatively from the base and can be cut and pollarded repeatedly. Some inviduals are supposed to be of great age, descending through several centuries. Dense lime forests dominated large areas of Europe during warmer prehistoric times and were still in use for pollarding for fodder until mid-1900. In some nature reserves this treatment is still maintained. With a warmer climate limes may again naturally regenerate in northern parts of the region.

Several elms occur naturally in the region, but wych Elm (*Ulmus glabra*) and the hybrids of the Dutch Elm (*Ulmus x hollandica*) complex have been widespread in the region for more than a century. They were commonly used as large ornamentals and windbreakers in parks, in gardens and as road plantings in the countryside as well as in urban areas. The large old trees served as nesting trees for owls. They have, however, during the last quarter of 1900 died in many areas after the attacks of the Dutch elm disease, which is caused by attacks by a fungus, which is vectored by elm bark beetles. The disease originated in Asia, but spread globally during the past century. Horse chestnuts (*Aesculus*

hippocastaneum) originated in the eastern Mediterranean area, but have been widely used in the region in similar ways as the elms. The chestnut blight caused by the horse chestnut leaf-miner moth (*Cameraria ohridella*) heavily influences horse chestnuts. Lime trees have had a similar position for centuries and are now coming into wider use to fill the spaces after elm and chestnut.

Several willow species (*Salix*) occur in the region, being part of a large species-rich complex in all Europe. Only a few willow species in the region are dwarf shrubs, while the rest range from bushes to trees. They are not well recorded in the region, since they do not have much economic use. The native species naturally form natural scrubs in humid areas in bogs and mires and in forest swamps in varying combinations. A few species also fill dry abandoned areas in urban and industrial areas. The willows flower early in the spring and their ecological importance as fodder plants for early flying honey and bumble bees is only beginning to be understood.

The common alder (*Alnus glutinosus*) is spread over all Europe. It also occurs in the Atlantic region along all rivers, watercourses and in swamps. It has a binding capacity for nitrogen by the use of bacteria and can exist under low oxygen regimes. Alder was formerly widely used in households, and alder forests were kept by coppicing. These old coppiced forests are now only maintained in nature reserves. Very few new coppices are actively created. Alder coppices occur on very humid and rich soils and have over time developed a very rich flora with associated light demanding bushes such as hazel. There is an increasing interest in restoring and maintaining these forests. Some of the best-managed habitats of this type are found in England, and all are protected by the EU Habitats directive.

Ash trees occur where there is access to moving oxygen-rich water. Ash was formerly a much used household tree and also of cultural importance. It may still be seen as large ornamentals in countryside gardens and churchyards.

The common hazel (*Corylus avellana*) bush occurs naturally all over the region, in full or half-light, single or in scrubs. It has formerly been of high economic use for fuel, stakes and nuts. Hazel was kept in grazed and periodically cut thickets or coppices. The local common hazles have been very popular also in gardens and parks for several hundred years, but gradually richer bearing varieties of more southern origin are coming into use.

Hawthorns (*Crataegus*) are still characteristic of the region in the hedgerow or boccage landscapes. Their flowers are highly important for insects in the spring and their fruits for birds during autumn and winter (thrushes).

Several poplar species and their hybrids (*Populus*) have likewise formerly been in multiple use all over the region. Now they are mostly seen in characteristic plantings in the Netherlands, Belgium and France and as roadside or canal side plantings or forests, least in Norway.

Europe only has few native maple species (*Acer*). The field maple (*Acer campestre*) is the most widespread but not common. The sycamore (*Acer pseudoplatanoides*) is the most widely occurring, stretching naturally in a broad band across central Europe, though missing in the south, west and north. However, it is considered to be naturally spreading to the north and is much planted in most areas and has in many places spread as an invasive species from these areas. The use is both for silviculture, ornamentals and for roadsides. In the Atlantic region the Norway maple (*Acer platanoides*) has the most restricted distribution, occurring only naturally in the most eastern and northern parts. During the last 3–4 decades a growing number of maples have been introduced, both from North America and Asia. They are mostly used as colour full ornamentals, ranging from small to very tall trees.

The southeast Asian eucalyptus trees are gaining ground rapidly in Portugal, Spain and southern France. In the region they are expected to become even more widespread in the Iberian Peninsula and in southern France.

The Atlantic region only has a few species of evergreens such as holly (*Ilex aquifolium*), broom (*Sarothamnus scoparius*) and gorse (*Ulex europaeus*) Privet (*Ligustrum vulgare*) has during the last 4–5 decades come into wide use for high hedges in gardens and lately also for insect and game plantings (berries). Since the interest in evergreens for private gardens and parks has increased dramatically over the last 50 years, many species are imported from other parts of Europe or the world. An old example is the subtropical box (*Buxus*), which has been in use for some centuries for ornamental low hedges in gardens and churchyards, while *Rhododendron* presently is the most popularly planted ornamental in gardens and parks. *Ligustrum* and *Rhododendron* are now spreading naturally.

1.4.9.5 Forests and storms

The Atlantic region is characterised by strong wind pressure and storms, covering some of the most exposed parts of Europe to the westerly winds. By this it closely resembles the Arctic region. However, unusually intense storms still cause severe damage to society and its installations, to parks and trees, to infrastructure and water run-off as well as to the coastline. Some, but not all also cause extensive damages to forests.

Storms have the greatest impact on forest in areas with dense forest or areas with forest fragments. Thus the biggest damage to forests occurs in inland. The storms do not normally have an impact on the whole region at the same time, but has the strongest effects along either a south-central or north-central trajectory. The many serious flooding incidents seen in recent years are more a result of extreme precipitation and changed run-off situations than of the storms as such.

During the past decades the region has more than 20 heavy storm incidents, of which at least 6 left significant forest areas of the region affected:

- 1987 in England (southeast), France and further east
- 1990 in large parts of the region
- 1999 several storms hit in different or in rapid repetition from France over Germany to Denmark and further into the continent
- 2005 and 2007 several severe storm systems passed the region to cause the most damage further in the east

The damage to forests and forested areas has many aspects, among them:

- Private and public safety
- Problems for owners concerning not only economy and other resources, but also property, heritage planning
- Damage to infrastructure and installations
- Logistic and labour problems in clearing, transporting, storing, sales pricing and distribution of timber
- Insurance payments and subsequent premium conditions
- Insect and fungus diseases spoiling the timber and establishing in the forests for later attacks
- Chances to change forest composition and management

The storm damages to the forest stands and its trees vary with the wind attack type (strong pressure over time, short violent attacks), with season (trees with full crown or bare), previous precipitation regime, stand management, age and structure, with the soil, the local terrain morphology and humidity as well as with the tree species, the root system development and the health and age of the trees as well as their exposure and physical location in relation to other trees.

Information gained after the storms have confirmed that forests with a mixed composition and several age classes are the more sturdy, and that the many conifer areas with trees under stress from air pollution or diseases are the most vulnerable to storm attacks. Long-lasting precipitation will cause even deep-rooted trees to fall, especially if they are in full crown. This has in most countries served to strengthen the arguments for changes in regeneration regime to more local deciduous species and more mixed stands.

Thus the effects of the storm damages has by many stakeholders been seen as a challenge to change the forest management to use more climatically adapted species and to enhance the conditions for forest biodiversity in general.

1.4.9.6 Hedges and other linear plantings

Though the region has large agricultural areas, linear habitats (recent and new plantings, old hedgerows) of trees and shrubs are very widespread around the fields and the orchards of the region. Their functions is to act as windbreakers in exposed parts of the region, especially in the western or in coastal parts, but also to hinder desiccation and drifting of soil. Landscapes dominated by such landscape elements are often called hedgerow or bocage landscapes. In some parts of the region these have a long tradition and are very characteristic with high conservation value. This is the case in parts of France and the British Isles, to a lesser degree in Belgium and Denmark.

When fields were smaller, the hedgerow pattern was denser and the bocage landscape cells enclosed by hedges were smaller resulting in the length of the elements becoming longer.

With intensification of farming, thousands of kilometres of plantings or hedgerows have been uprooted to ease cultivation for the last 3–4 decades. However, at the same time planting of new windbreaks as well as restoration of old hedgerows are in progress in the region.

The tree and bush species of old hedgerows were and to some extent still are relicts from older forest and scrub borders, showing the local deciduous forest composition at least 100–200 years ago. Hedges established to fence off grazing animals were often planted with thorny bushes (e.g. hawthorn, *Crataegus* spp., blackthorn *Prunus spinosa*). The French and English hedges are still are mostly deciduous, and after a period of 100 years with coniferous hedges and windbreaks in Germany and Denmark, deciduous plantings are now coming back there also in these areas.

Such new or plantings have for some decades contained significant proportions of exotic species, but the trend is now towards an increase in use of local deciduous species. They are also now being broadened to 3–5-rows of trees or bushes. Various national or association based subsidy schemes exist to support maintenance or new establishment of these habitats.

1.4.9.7 Plantings for game

With the increased interest in hunting and game management during the last decades game plantings have become much more frequent in the landscape. In many areas these are no longer isolated habitats in arable land around existing ponds or marl pits, but are now part of game management plans. Game plantings have gained in average acreage and degree of permanent management, and they are normally accompanied by a mixture of game fodder-plants, several of which are crops, some are exotics and others may be cultivated from wild species. Despite their mixture of local and exotic tree and bush species, fodder and wild plants, game plantings may together with linear plantings and

road verges be the only semi-natural habitats in intensively cultivated areas, and also be the only habitats with trees and bushes that attain a significant height. The plantings do attract and serve both wild-living and released game as well as other wildlife, but they also add invasive species to the countryside. In many areas beekeepers locate their hives in the relatively sheltered game plantings. Various national or association based subsidy schemes exist to support maintenance or new establishment of these habitats.

1.5 Species

The Atlantic region is not rich in endemics and the overall number of species is relatively limited. The region is of significant importance for wetland species and epecially so for by providing stopover places for migrating birds. As generally is the case in Europe the numbers of plants and animal species generally decrease from the south to the north. This means that some species only occur in some parts of the region, and that other species fill a similar ecological function in other parts. However, ecological conditions vary within rather limited ranges in the region, allowing some species to exist all over the area.

Characteristic for the Atlantic region is a large and growing number of invasive alien species, reflecting e.g. the fact that trade and transport connections to other parts of the world have been intense for a long time.

There is a certain degree of movement and dispersal of species within the region, epecially so a general shift of species from the south to the north. This is a process that can be expected to increase with a predicted change in global tempertaures. A similar pattern is also seen in the Boreal region and along the northern parts of the Continental region. Species moving may represent all kinds of ecological types, and include a small number of species, which for long been have moving northwards after the glaciation.

Table 6. Species of European importance in EU Member States in the Atlantic biogeographical region. Birds Directive, Annex I and Habitats Directive, Annex II.

Number of all birds directive annex I species and sub-species in the EU-15 Member States in the Atlantic biogeographical region (March 2000), limited to breeding bird species	94
Number of all habitats directive (FFH) annex II species and sub-species present in the EU-27 Member States in the Atlantic biogeographicalal region	134
Number of all habitats directive annex II species and sub-species in EU-27 Member States in the Atlantic biogeographicalal region, by group:	
Mammals	22
Reptiles	4
Amphibians	5

Fishes	20
Invertebrates	32
Vascular plants	42
Mosses/liverworts	9

Source: Reference list of habitat types and species present in the Atlantic biogeographical region (EC, 2008).

This chapter does not deal with marine species along the coasts, except where it is relevant to mention them in connection with sites of interest.

1.5.1 Flora

There are no precise figures concerning the flora in the Atlantic region. Vascular plants can be estimated to include more than 2000 species. 51 plant species have been listed in the Annex II of the Habitats Directive and of these, 14 are endemic to the region. This is the smallest number among the biogeographical regions, illustrating a much lower endemism here compared with for instance in the Mediterranean and Macaronesian regions. The north of the region was completely glaciated and has the lowets number of of plants species, with few endemics, while the highest numbers occur in the Iberian Peninsula. In the EU part of the region 19 species of flora are priority species according to the Habitats Directive.

Two groups of taxa are particularly characteristic of the region: the heathers (Fam. *Ericaceae*) and many leguminous plants. Their distribution patterns and ecology are illustrative of the biogeographical affinities and status of the region. The Ericaceae or heath family consists of dwarf shrubs. The family includes species such as the widespread heather (*Calluna vulgaris*), cross-leaved heather (*Erica tetralix*), bill- or blueberry (*Vaccinum myrtillis*) and cowberry (*Vaccinium vitis-idea*). The leguminous shrubs are brooms (*Cytisus*), gorse (*Ulex*) and greenweeds (*Genista*). These species or species of similar types occur over all Europe, with varying and overlapping distributions. Where they occur in heathland and moors, both in lowlands and highlands, they contribute with berries and wintergreen shots to the survival of wintering birds.

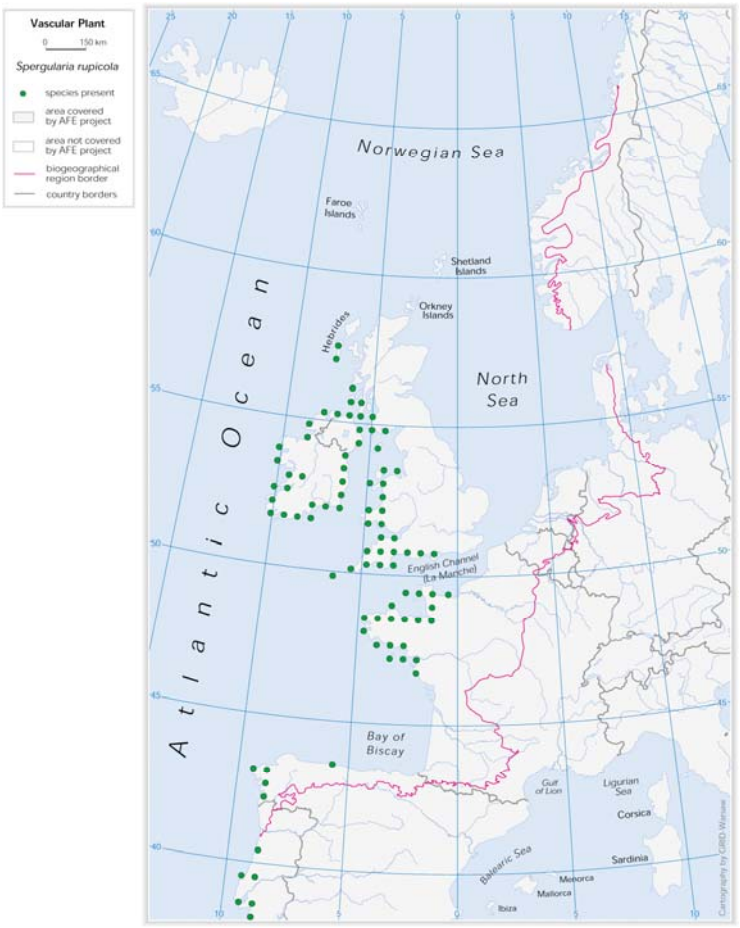
Agrostemma githago*, a species that occurred in agriculture areas. Do to changes in agriculture practise and the use of herbicides, the species has declined.*
Photo: John Crellin www.floralimages.co.uk

The northwestern part of the region is particularly rich in mosses and liverworts, because of its mild and wet climate and relatively unpolluted atmosphere. The bryophyte flora of Ireland and Britain, some 1000 species, together account for over 60% of the total European bryophyte flora. Only 9 species have so far had to be listed under the EU Habitats directive.

Wild species such as corn cockle (*Agrostemma githago*), cornflower (*Centaurea cyanus*), red hemp-nettle (*Galeopsis angustifolia*), corn buttercup (*Ranunculus arvensis*) and small-flowered catchfly (*Silene gallica*) were once widespread and considered weeds in agriculture. Due to changes in agriculture practices and the use of pesticides these species are today threathened.

New species are also introduced to the area and other species have had an increasing distribution area.

Map 3. Cliff spurrey on rocks



Source: EEA/EUNIS.

1.5.2 Fauna

According to the European atlases, the Atlantic region host 320 bird species, 111 mammals, 32 reptiles and 29 amphibians. Comparable data are not available for fish or invertebrates. These numbers are expected to grow only slightly as species naturally occurring in other regions may increase their distributions, mostly because of climate

change. Of these nearly 500 species, some 20 %, are threatened at an European level, mostly birds.

For the EU part of the region 81 animal species are listed in Annex II of the Habitats Directive: 21 mammals, 19 fishes, 5 amphibians, 4 reptiles and 32 invertebrates (Table 6). Only 3 of these may be considered endemic to the region: the fish houting (*Coregonus oxyrinchus*) – today to be found only in Denmark being extinct from range outside the region, the freshwater pearl mussel form (*Margaritifera margaratifera durrovensis*) and the root vole (*Microtus oeconomus arenicola*), the latter two in populations classified as subspecies. There are 94 bird species listed on Annex I of the Birds Directive. The region hosts the largest colonies of seabirds in Europe.

Table 7. Number and threat status for vertebrate species in the Atlantic region

	Total	Amphibians	Reptiles	Mammals (3)	Breeding Birds
Number of species (1)	492	29	32	111	320
Number of threatened species at European level (2)	102	1	0	20	81

Source*: EUNIS from the major European species Atlases. Compiled by EEA/ETC BD.*

Note: 1) extinct or introduced species are excluded. 2) Only present species taken into account. 3) excluding cetaceans.

1.5.2.1 Mammals

More than 110 mammal species occur in the Atlantic region has, most of them small rodents. Wolf (*Canis lupus*) and brown bear (*Ursus arctos*) exist in very small numbers in the Iberian part while accidential specimens of brown bear enter Norway (from stable populations in Sweden, Boreal biogeographic region). Just as for birds, some 20 % of the mammals are threatened at European level.

The situation of threathened species varies. As an example actions for the otter (*Lutra lutra*) are widely recognised (Box 8) while the state of the water vole (*Arvicola terrestris*), another aquatic species, is more complex.

In the Atlantic region the water vole is found in Denmark, the Netherlands, Belgium, Germany and UK mostly along rivers and in wet meadows in, but is absent from Ireland and western France. Views of this species fall widely apart: in UK it is appreciated as a friendly character of children's books, while it is seen as a pest for instance in Denmark. The different views depend on the status of the species: in UK it does not occur in great numbers, while the higher population elsewhere is highly troublesome in gardens, lawns, parks, along rivers etc. The species is not listed in any international conservation legislation. While management plans exist in UK to protect the water vole, it can be legally eradicated in Denmark.

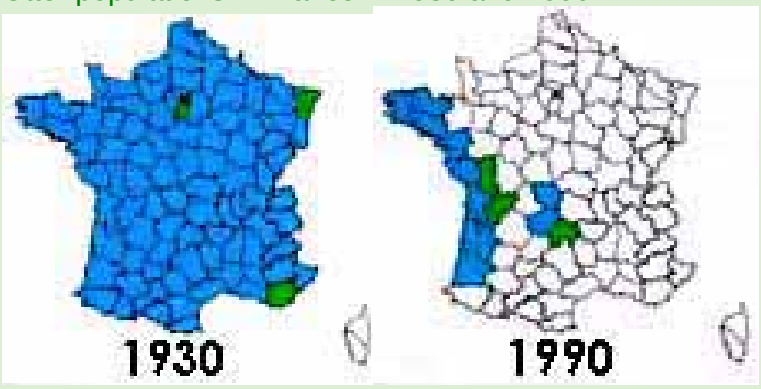
Box 8. The otter returns in some areas

The otter (*Lutra lutra*) was formerly distributed all over Europe and still occurs in the western and eastern parts of Europe, but has disappeared drastically and has today only scattered occurrences in a wide central belt through all of Europe from north to south. In the Atlantic region it was naturally missing only from the Faroe Islands. Seemingly stable populations exist in Spain, south western France, Ireland, Cornwall, Wales, Scotland, Norway and in Denmark. Otters are believed to be absent from France, Belgium, the Netherlands and Germany. Research has shown that the Spanish and Danish populations are distinct and unique, while the rest of the European otters are closer related to each other.

The otter needs clean water, peace and open rivers or lakes with adequate size and morphology, which allows the otters to find nesting cavities plus access to food. It therefore gets into conflicts with fishery and angling. It wanders up and down rivers and lakes, often crosses roads, where under-passing of bridges are unfavourable, and animals crossing bridges via the road on top, are killed by traffic. It is thus a species, which is bound to come into conflict with many aspects of modern society, not only in urban areas, but also predominantly in the intensively cultivated, regulated and trafficked countryside as well as in rivers and lakes. It was for many years subject to hunting and trapping.

Because of the decline, the otter became subject to a wide interest, first under the Bern Convention. From 1991 it has also been listed under the EU Habitats directive, Annex II. The otter became a flagship species and efforts to protect and secure it has embodied the multiple efforts by authorities to solve conflict between the species and human life: coverage of small waterways, water pollution, river and lake bank management, recreation disturbance, fishing with nets, unfavourable under-passages under roads.

Otter populations in France in 1930 and 1990



Notes: blue: common, green: rare, white: disappeared
Source: http://www.cigogne-loutre.com/html/dispaloutre.html

Efforts have been taken to turn the decrease since the 1970s. Numbers have begun to recover, and the species has returned to areas in England from which it had been lost and is now found throughout the region except for the most intensively farmed lowlands (eastern England, northern France, Belgium and the Netherlands). Actions include: general waste water treatment, less nutrient rich drain water from agriculture, re-opening of waterways, creation of suitable under-passages under bridges and road embankments as part of all road projects, different river and lake side management, fishing nets stopping otters from entry, and naturally nature reserves with disturbance-free parts.

1.5.2.2 Birds

The Atlantic region is important for birds. More than 320 bird species breed in the region, but several additional birds migrate through the region or use it as wintering grounds. The region is thus the central part of the East Atlantic Flyway – a concept identified in relevant international agreements - between arctic and temperate breeding grounds and temperate and tropical wintering areas.

An interest in protecting the birds and the areas of importance during various seasons was initiated with appointing sites under the global Ramsar convention (see below). Subsequently the resident species were included for protection in the Bern Convention under Council of Europe and the EU Birds Directive. Despite the high degree of urbanisation but due to its valuable coast and wetland, the region has an extended system of bird protection sites along the breeding grounds and flyways.

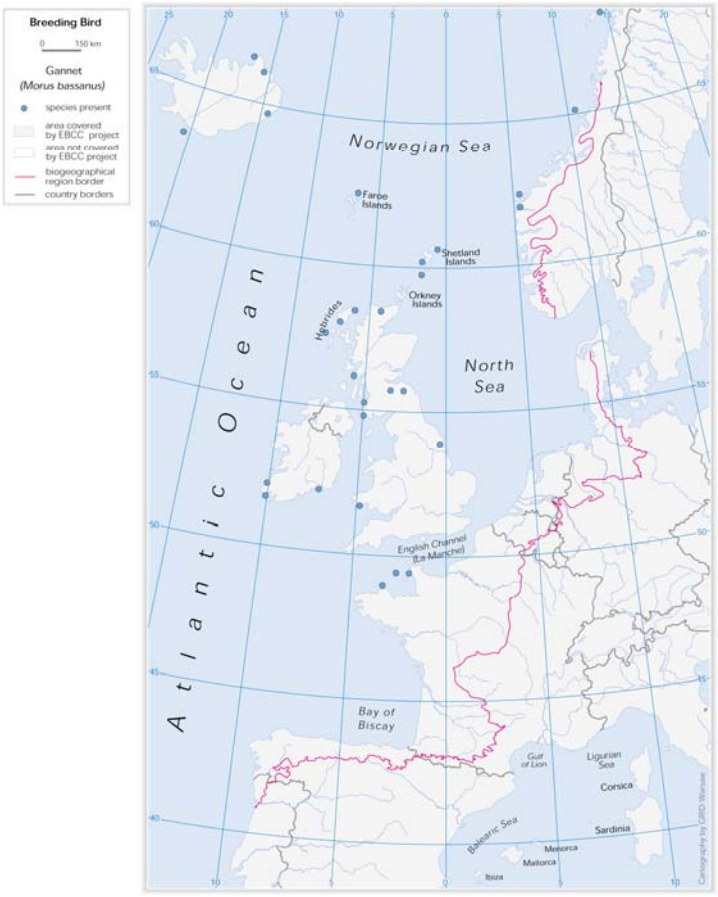
The migratory species also fall under the Convention on the Conservation of Migratory Species of Wild Animals concluded under the aegis of the United Nations Environment Programme (also known as the Bonn Convention) and under this under the African-Eurasian Migratory Waterbird Agreement (AEWA), signed to support the migratory species that are the combined responsibility of both Africa and Europe.

For several species a large part of the total world population may be found gathered in one or a few sites during the season. During such times they are extremely vulnerable of disease, pollution or weather incidents or to damage to the sites.

For other species the importance of the region lies with its capacity to provide food and resting grounds for the thousands or hundreds of thousands of migratory bird species on their trajectory. Such species are both the spectacular flocks of larger birds such as geese, swans and ducks, but also numerous other species of waders and wetland birds.

The region has the biggest colonies of seabirds in Europe (Map 4). They are concentrated to the rocky and often remote coasts in Scotland with the Shetland and Orkney Islands, the Faroe Islands and Norway. Other important colonies are connected to lagoons and coastal wetlands. The most remote and rocky coasts are European core areas for sea eagles and golden eagles. The rock colonies were formerly very valuable for local economies (eggs, birds, downs). They are now under the interest of eco- or wildlife tourism.

Map 4. Some major sea bird colonies in the Atlantic biogeographical region



Source: EEA/EUNIS.

The puffin (Fratecula arctica) *is one of the sea birds which breed in thousands on rocky cliffs in the Atlantic biogegraphic region. Photo: Michael O'Brian*

Mute swans (*Cygnus olor*), whooper swans (*Cygnus cygnus*) and bewick's swans (*Cygnus bewickii*) gather in enormous numbers in the region to feed in wetlands and shallow waters in France along the Channel to the north and north west in the British, Ireland, Belgium, the Netherlands, Germany, Denmark and Norway.

1.5.2.3 Reptiles and amphibians

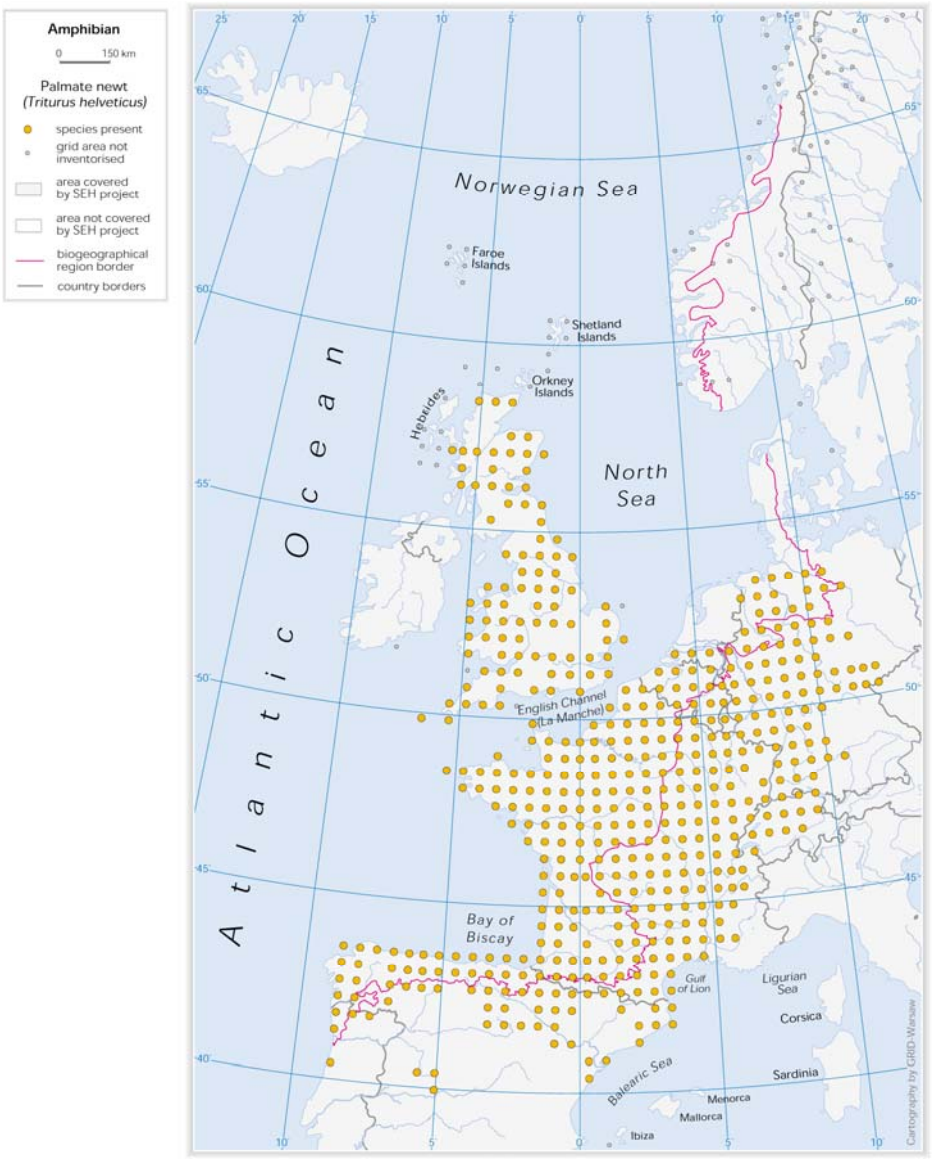
The Atlantic region has 29 amphibian and 32 reptile species. There are no large or spectacular species, and only one reptile is poisonous, the common adder (*Vipera berus*). The species of the region may be found in most of Europe.

The amphibians species occur mostly in association with the freshwater wetlands, though a few prefer coastal habitats such as the natterjack toad (*Bufo calamita*) and the European fire-bellied toad (*Bombina bombina*). Only five amphibians and four reptiles are identified in the EU Habitats Directive as priority species.

As in other regions, the reptiles are associated with dry habitats such as dry grassland and heathlands or areas with mosaics including exposed rocks. The main exception is the widely distributed grass snake (*Natrix natrix*), which both breeds and hunts in areas close to or even in water.

Amphibians are well-known to the public and occur in many types of habitats. Adults are visible, tadpoles may easily be found in ponds and lakes. Large numbers of amphibians are killed passing roads. Some amphibian species have high requirements on water quality, such as the newts, *Triturus spp*. (Map 6).

Map 6. The distribution of palmate newt (*Triturus helveticus*) in the Atlantic biogeographical region.



Source: EEA/EUNIS.

1.5.2.4 Freshwater fish

The Atlantic region by its proximity and dependence on the sea is a saltwater fish region and much less a freshwater fish region. However, the big rivers with catchments deep in Continent have a fish fauna with species having wide distributions as well as species with more restricted distributions. Trout, salmon and eel are widely known and important both for economic use and sport. The region hosts only 19 species of freshwater fish identified by the EU Habitats Directive, among those the endemic houting (*Coregonus oxyrinchus*).

The big rivers have for long been heavily polluted, but after many years with small populations sizes several rivers such as the Rhine, Skjern Å etc. are again showing increasing populations of salmon and trout. The condition for eel is, however, very worrying. Very few eels migrate nowadays to the spawning area of the Sargasso Sea, and only few of their offspring return as young glass-eel to mature.

Stocking with salmon, trout and eel and other species has a long history in the region,

which has led to genetic intermixing of populations. Trout and salmon species or sub-species have intermixed with the region's fish populations from other regions and also from North America. The understanding of the importance of conservation of genepools and thus of sub-species has grown during the last decade.

The houting (*Coregonus oxyrinchus*) is a salmonoid fish with a very restricted distribution range in the Atlantic region. EU has supported management actions for this species in the remaining area (Denmark).

2. What is happening to biodiversity in the Atlantic biogeographicalal region?

2.1 Climate change

The climate of the Atlantic biogeographical region is so strongly coupled to the oceanic conditions and to conditions in the central and southern Europe. It is generally expected that increases in temperature will continue, humidity will remain high and that occurrence of heavy storms and other extreme weather may increase.

As indicated above, several species have already shown changes in their behaviour which may be a result of ongoing climate change, such as migratory species moving northwards earlier and returning later than previously. Others do no longer migrate or they do not winter as far to the south as earlier. Also more visiting species come to this part of Europe from northern Asia or from the western parts of the Atlantic Ocean. The reasons are debated; factors under study include strong winds, changes in orientation systems etc.

Butterflies show a similar trend as some of the birds, appearing flying earlier (adults) and having more generations than before. There are examples of new species having quickly established in new areas, indicating great sensitiveness to warmer climatic conditions.

2.2 Agriculture and forestry

As mentioned above, the Atlantic region is characterised by its still existing extensive tracts of grasslands and grazing, but the largest part of its agricultural area is being used for intensive crop production, especially around the large urban conglomerations. This has led to clearing of hedges, removal of other small habitats etc, and some areas are now characterised by large homogenous fields. It has been estimated that the length of hedges in Britain has decreased by more 25% over a few decades. In France, between 500 000 and 600 000 km of hedges have disappeared in the last quarter of the last century: in the French Atlantic area, the situation is geographically heterogeneous; the bocage landscape has almost been destroyed in the Vendée area whilst in Brittany, only some sites have been severely affected by land change. In Denmark, the total length of open ditches and small watercourses is estimated to have decreased by 90% within the last 100 years while in contrast the length of hedges has significantly increased due to plantation. In certain areas conservation concerns and the need for hedges as wind-breakers has recently led to restoration and even new plantations.

Except for the southernmost parts wich host e.g. significant wine-growing areas the most widely used crop types do not vary much over the Atlantic biogeographic region, though crop varieties may differ. However it is noteworthy that with increased temperatures and development of new varieties, wine growing is spreading to the north and west at a

considerable rate, thereby also changing the landscape. Farming is based on a large crop production and production of animals. The most important animals are pigs, cattle and sheep. The region has some of the sheep-richest areas in all Europe. Sheep are managed as open-land grazers and maintain the open countryside also in remote areas.

The structure of areas on the Faroe Islands and the islands north and west of Scotland and in many areas of Scotland, England, Cornwall and Wales are heavily influenced by sheep grazing and would change drastically if grazing would be discontinued. For a period the breakout of the Creutzfeldt-Jacobs brain disease in humans virtually emptied large tracts of the British Isles of grazing animals, resulting in a rapid invasion of woody species into grasslands.

The number of cattle in the region is large. In some areas the numbers are so high, that the soil is severely contaminated and compacted. The number of pigs is very high, especially in the north and northwestern parts, especially so in the Netherlands, Germany and Denmark. Though the vast majority of pigs are raised in stables, a growing number are raised on open land. This locally influences both soil and groundwater. The enormous total amount of manure from animals of the region gives an increasing environmental problem. Manure has to be managed so that the resource is used properly and at the same time does not contaminate soil, groundwater and air. Leaching nitrogen and fertilizers have a strong impact on the ground water and on lakes and rivers, but also on neighbouring habitats such as heathlands or grasslands, bogs and mires as well as dunes.

Forestry is generally intensive in the region. Forest plantations, often with exotic or not site-native species, have being actively promoted during recent decades in several of the countries. This policy, together with planting to promote game, has added new elements to the open landscapes.

2.3 Other major pressures on biodiversity

2.3.1 Urbanisation and tourism – the coasts are under heavy pressure

More than 5 % of the land of the Atlantic region is covered by urban areas and infrastructure. It is very densely populated, except for Ireland where population density is 60 inhabitants/km^2. The extreme is the Netherlands with 480 inhabitants/km^2 in 2005, UK has a population density approaching 250 inhabitants/km^2 and Belgium 345 inhabitants/km^2.

Coastal ecosystems are still under the threat from urban land reclamation in the Atlantic region. Intensive tourism and leisure are threats for many coastal habitats such as the sand dunes in Belgium and Germany as well as sub-littoral areas of stagnant or flowing waters as well as water-logged grounds and salt-marsh grass meadows. Tourism is also a problem for coastal ecosystems of Great Britain and Ireland, some of them having a very high conservation value. Urban development has also damaged the Atlantic French coast and high pressure from tourist facilities has put some vulnerable habitats under threat, for example the coastal heaths of Brittany and some national parks in Asturias.

The fragmentation of landscapes is occurring in most habitat types in the Atlantic region, its intensity being particularly high along the North Sea. Over the last 20 years, the length of roads has increased by more than 30 %. The main road network is highly developed with densities above 0.1 km/km^2 and reaching 0.47 km/km^2 in Belgium. This has caused a severe fragmentation of natural and semi-natural habitats including mires, heaths and forests.

Grassland species are clearly affected by habitat fragmentation. In the same way, tree

line landscapes (bocage, dehesa, montados) have been fragmented over the last decades. Heathlands have declined rapidly. Studies show clear negative effects for many species groups: plants but also grasshoppers, carabid beetles and for other species it is assumed that fragmentation is also a cause of decline (reptiles, mammals).

2.3.2 Invasive alien species

There is a long history of introduction of species to the fauna and flora of the Atlantic region. Alie species either arrive as the result of deliberate introduction by man, as accidental escapes from horticultural or zoological collections, or accidentally as a result of the import of other materials containing specimens or seeds. Many species have become naturalised members of the fauna and flora not creating significant problem and are thus now hardly noticed as being 'alien'. The pheasant *Phasianus colchicus* and many medicinal herbs are examples. Several widespread tree species are also not strictly native, but are now accepted components of the landscape. The problems with alien species arise when they impact native biodiversity e.g. by successfully out-competing with native species. Such alien species are classified as invasive according to the Convention on biological diversity. It is, however, not always possible to predict how a newly arrived alien species will spread and whether it will eventually become a nuisance. In particular a number of invasive alien plant species have established over large areas, out-competing and replacing native species and changing the habitats where they occur. The rhododendron (*Rhododendron ponticum*) which in some areas totally dominates the forest understorey is an example.

The common racoon (*Procyon lotor*) and the muskrat (*Ondatra zibeticus*) are invasive alien species in a steady spreading, while others disperse even more quickly. The lusitanian slug (*Arion lusitanicus*) and the ruddy duck (*Oxyura jamaicensis*) are examples of very quickly spreading invasive alien species, which are difficult to successfully eradicate.

Box 9 An invasive alien species which took less than 30 years to spread and become a problem – ruddy duck genes to eradicate the white-headed duck

The North American ruddy duck (*Oxyura jamaicensis*) was introduced to England in the 1940s. It escaped from captivity and bred in the wild first in the 1960s. By 2003 more than 6 000 birds had spread to more than 1 000 sites in England and began to colonise western Europe. More than 1 500 ducks were observed in 21 European (including to Dutch Ijsselmeer) and North African countries during 2002. It is already observed in areas where it can threaten for instance the white-headed duck (*Oxyura leucocephala*) with extinction through hybridisation and competition. The white-headed duck is threatened throughout the world (around 16 000 individuals). It is a native to the Mediterranean area. It lives in wetlands that contain at least 40–50 centimetres of fresh or brackish water and are associated with abundant emergent vegetation, preferably reeds or bulrushes. Nearly all the ca 2 500 Spanish birds live in an area in southern

Spain. Here they are threatened by damage to the habitat, lead poisoning and illegal hunting and by interbreeding with the ruddy duck. Spanish intervention and a EU LIFE-Nature project are been aimed at controlling the ruddy duck in the area. A United Kingdom trial eradication plan has been launched. This will however not control the duck in other countries where it is now established. The problem was recognised already before 1997 by the Bern recommending all countries to set up national eradication programmes.

Arion lusitanus *is spreading rapidly in several biogeographical regions. The species is posing a severe threat to gardening and agriculture.*
Photo: Tor-Bjorn Larsson.

Box 10. Hybrids causing problems – cord-grass in the Atlantic region

Along European coasts grasses and sedges and other species function as natural land reclaimers by binding the sediment. They occur in complex interaction with water movement and level, salinity, exposure and sediment. Some of these and other species have been cultivated and planted in large land-reclamation projects in Europe during several centuries such as along the British coasts, in France, the Netherlands, Germany and in Denmark.

However, problems may later occur in such projects: a hybrid from a native European and an introduced North American species turned from wide successful use into a global problem. The North American smooth cord-grass (*Spartina alterniflora*) was accidentally introduced to southern England in the first half of 1800s. An infertile hybrid with native glasswort (*Salicornia europaea*), Townsend's cord-grass (*Spartina x townsendii*), arose some 50 years later, from which only decades later the fertile polypoid common cord-grass (*Spartina anglica*) emerged. It was first used in England and from there was exported to numerous projects around the world, but it also started to take over, where it was planted, and to spread by water to areas, where it was not foreseen and often not wanted as an highly productive and monopolising element = it became highly invasive, settling deeply by means of rhizomes. It has invaded many areas with lower vegetation, used by wading birds in for instance coastal wetland. In some areas, however, natural

disease or pollution has culled stands. It may thus be an example of an invasive species that after invasion into fiend-free areas may be beginning to experience natural controls.

3. Policies at work in the Atlantic biogeographicalal region

3.1 Nature protection

3.1.1 International agreements

The Atlantic biogeographicalal region is not covered by any special types of international collaboration on biodiversity, but by the general international, pan-European and European Community collaboration. Below some of the most important relevant agreements and processes are briefly mentioned[3].

The UN Convention on Biological Diversity is signed by all countries of the region as well as by the European Community[4].

The Convention on Wetlands (The Ramsar Convention) is signed by all countries of the region[5].

The Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn Convention) is signed by all countries of the region and by the European Community[6].

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, Washington Convention) is signed by all countries of the region and CITES is implemented in European Community legislation[7].

The Convention on the Conservation of European Wildlife and Natural Habitats (Bern convention) under Council of Europe) is signed by all countries of the region and by the European Community[8].

The Pan-European Biological and Landscape Diversity Strategy (PEBLDS) facilitates cooperation among countries of all Europe in order to stop and reverse the degradation of biological and landscape diversity values[9].

The UNESCO World Heritage Convention[10] aims at protecting the world's cultural and natural heritage.

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[3] For an update of the EU biodiversity policy and legal measures see http://ec.europa.eu/environment/nature/index_en.htm
[4] See further http://www.cbd.int/
[5] See further http://www.ramsar.org/
[6] See further http://www.cms.int
[7] See further http://www.cites.org/ , http://europa.eu/index_en.htm
[8] See further http://www.coe.int/t/dg4/cultureheritage/conventions/bern/default_en.asp
[9] See further http://www.peblds.org/
[10] See further http://whc.unesco.org/en/about/

3.1.2 Protected areas

Areas designated for nature protection may be protected by national legislation as well as under international instruments.

3.1.2.1 Internationally protected areas

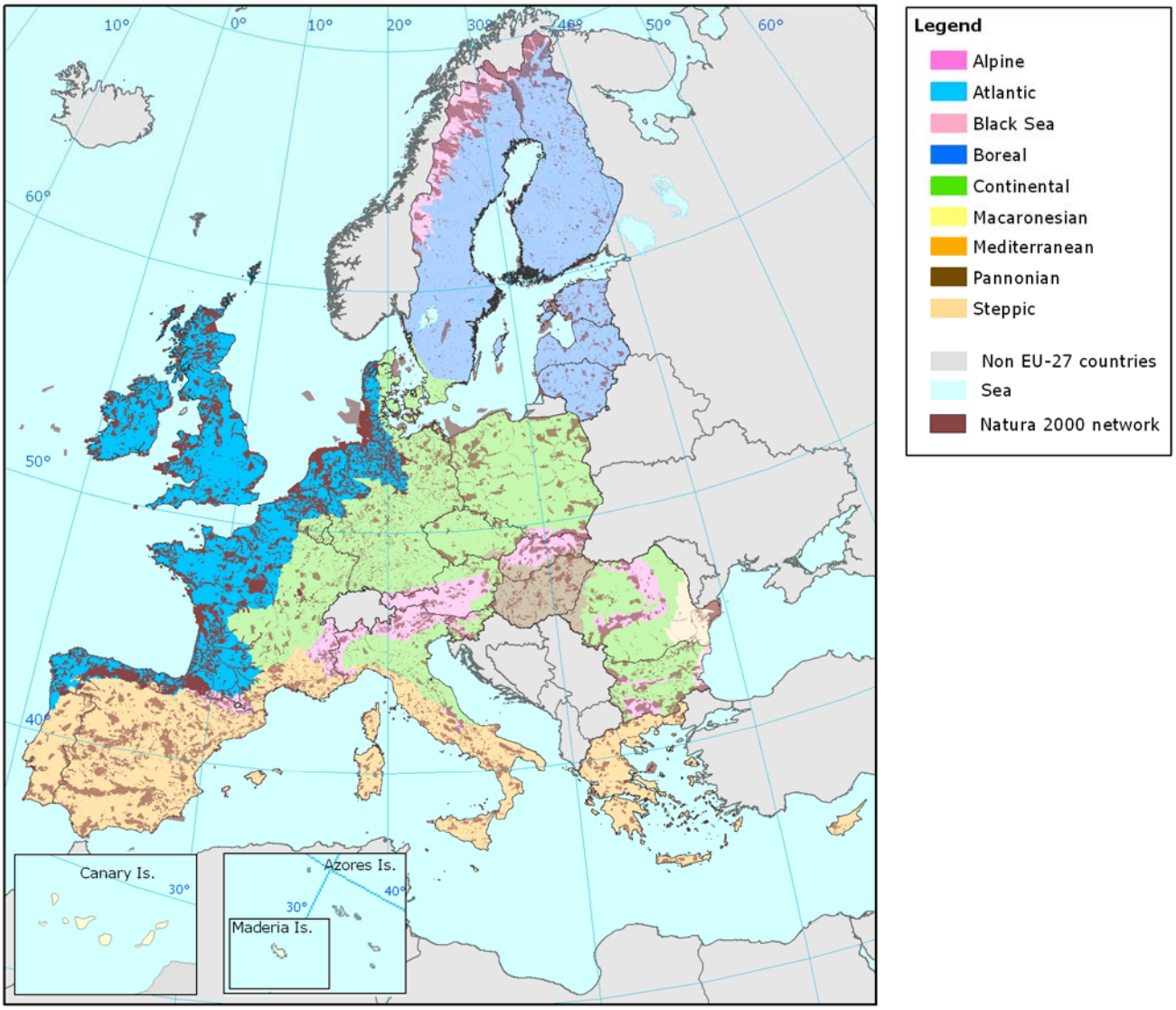
Several of the international and European Community instruments lead to area based protection of nature.

Ramsar sites: In the Atlantic region many sites have been designated under the Ramsar convention, mostly focused on larger wetlands such as lakes and deltas (Ramsar database). As mentioned above, most Ramsar sites in the EU countries are also NATURA2000 sites.

UNESCO World Heritage sites and Biosphere reserves: Nearly all countries have sites designated in the UNESCO list of World Heritage sites as well as Biosphere reserves under UNESCO's Programme on Man and the Biosphere. The Biosphere reserves in this region, which must 'encompass a mosaic of ecological systems' comprise – in addition to marine areas- mostly wetlands, undisturbed grasslands or mountains.

European Community NATURA2000 Network: . The Atlantic list of sites of Community Importance was adopted in 2004 and further updated in 2007. By the end of 2008 the EU-27 Member States in the region had designated 882 Special Protected Areas (SPAs under the Birds Directive, Map 5), and 2747 Sites of Community Interest (SCIs under the Habitats Directive) were put forward, to become part of the NATURA2000 network. These sites are often based on existing national parks, biosphere reserves and nature reserves.

Map 5. NATURA 2000 network in the Atlantic region



Source: EEA/ETC BD compiled fromNATURA 2000 database. November 2008

The EMERALD Network: The designation of sites under the EMERALD Network of the Bern Convention is based on the same principles as Natura 2000, and represents its *de facto* extension to non-EU countries.

3.1.2.2 Nationally protected areas

All the countries in the region have a wide number of areas under national protection. Data on nationally protected areas is a priority dataset for countries collaborating with the European Environment Agency. It is updated annually. The information is not available for the region as such, but all data for the EEA countries can be found in the web based EUNIS database and EEA data service.

4. Bibliography

The bibliography contains information about most of the reports and publications used. More information has, however, been received from the web sites. Since these are unstable in that reports and information changes or disappear, it poses difficulties to cite with full accuracy. To ensure the most stable referencing, institutions are everywhere mentioned, and the users may then consult these via the links list below.

4.1 National reports and information

For general national information the main sources are the national environment reports and reports is referred to the website of the Convention on Biological Diversity: http://www.cbd.int/default.shtml which has a page per country with reports and links.

4.2 Reports

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http://www.unece.org/trade/timber/Welcome.html

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4.3 Internet addresses

AEWA (African-Eurasian Migratory Waterbird Agreement): see Bonn Convention

Bern Convention (Council of Europe):
http://www.coe.int/T/E/Cultural_Co-operation/Environment/

BGCI (Botanic Gardens Conservation International):
http://www.bgci.org/worldwide/home/

BirdLife International: http://www.birdlife.org

Bonn Convention:
http://www.cms.int/

AEWA (African-Eurasian Migratory Waterbird Agreement 1999):
http://www.cms.int/species/aewa/aew_bkrd.htm
Waddensea Seals: http://www.cms.int/species/wadden_seals/sea_bkrd.htm

Bundesumweltamt für Naturschutz, Germany:
- NeoFlora Invasive gebietsfremde Pflanzen in Deutschland
  http://www.floraweb.de/neoflora/handbuch/prunusserotina.html.

Convention on Biological Diversity: http://www.cbd.int/default.shtml
- Alien species: http://www.cbd.int/invasive/default.shtml

European Commission, DG Agriculture:
- Forestry measures: http://europa.eu.int/comm/agriculture/fore/index_en.htm
- Forest protection against fires:
  http://europa.eu.int/comm/agriculture/fore/fires/index_en.htm)

- FIRE project (former): http://www.fire.uni-freiburg.de/programmes/eu-comission/Eu-Commission.htm
- CAP measures, studies: http://europa.eu.int/comm/environment/agriculture/studies.htm

European Commission, DG Environment: http://ec.europa.eu/environment/
- Nature and biodiversity http://ec.europa.eu/environment/nature/index_en.htm
- Atlantic region information: http://ec.europa.eu/environment/nature/natura2000/sites_hab/biogeog_regions/index_en.htm#atlantic
- Life+ : http://ec.europa.eu/environment/life/themes/seas/index.htm

European Community Biodiversity Clearing-House Mechanism (EC CHM): http://biodiversity-chm.eea.europa.eu

EEA (European Environment Agency): http://www.eea.europa.eu
search via themes: biodiversity change and nature , maps and graphs

ETC/BD (European Topic Centre on Biodiversity of EEA): http://biodiversity.eionet.europa.eu/

EUNIS database (EEA): http://eunis.eea.eu.int/index.jsp

European Landscape Convention: http://www.coe.int/T/E/Cultural_Co-operation/Environment/

European Rivers Network: see RiverNet

EUROSTAT: http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1090,30070682,1090_33076576&_dad=portal&_schema=PORTAL

FAO (Food and Agriculture Organization of the United Nations): http://www.fao.org

Faroe Islands: http://foa.danmark.dk/portal/page?_dad=portal&_schema=PORTAL&_pageid=33,23732&entiId=11421500&ettyName=MYNDIGHED choose: Færøerne

Fishbase: http://www.fishbase.org/search.cfm

ICP Forests (UNECE): http://www.icp-forests.org/

ILEC (International Lake Environment Committee): World Lakes Database - Survey of the State of World Lakes. ILEC, UNEP (United Nations Environment Programme) and Environment Protection Agency, Government of Japan: www.ilec.or.jp/database/database.html

IUCN (World Conservation Union): http://www.iucn.org
Red Book 2007: http://www.redlist.org search database per country or species

Les Landes
http://www.parc-landes-de-gascogne.fr/)

NCCPG (National Council for the Conservation of Plants and Gardens) (Plant Heritage, UK): http://www.nccpg.com/

Norwegian Ministry for the Environment:
Biodiversity: http://www.regjeringen.no/nb/dep/md/tema/Naturmangfold.html?id=1298

PEBLDS (Pan-European Biological and Landscape Strategy):
http://www.strategyguide.org

Ramsar Convention: http://www.ramsar.org
- Ramsar database at Wetlands International: http://www.wetlands.org/rsis/

RiverNet (European Rivers Network): http://www.rivernet.org/

Thames web: http://www.thamesweb.com/

UNEP/Grid Arendal: http://www.grida.no/
Vital climate graphics and special reports on climate change:
http://www.vitalgraphics.net/

UNEP-WCMC (World Conseervation Centre): http://www.unep-wcmc.org/

UNESCO Biosphere Reserves: http://www.unesco.org/mab/

UNESCO World Heritage list: http://whc.unesco.org/

Wadden Sea Secretariat (The trilateral cooperation on the Wadden Sea between the Netherlands, Germany and Denmark): http://www.waddensea-secretariat.org/index.html

Wetlands International (WI): http://www.wetlands.org/

WWF (Global Environmental Conservation Organisation):
http://www.panda.org/index.cfm