European Environment Agency

Europe's biodiversity - biogeographical regions and seas

Biogeographical regions in Europe

The North-east Atlantic Ocean

- huge, deep and heavily exploited

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Summary

- The North-east Atlantic Ocean is a part of the Atlantic Ocean and is dominated by deep ocean basins, except the Celtic Sea, the shelf along the Bay of Biscay and Iberian coast.
- The formation of the North Atlantic deep water is one of the driving forces for the thermohaline circulation of the world's oceans.
- The primary productivity in the open ocean is low, but is increasing from south to north and towards shore.
- The biodiversity is high, but several species in the area are endangered of which lack of sustainable fishery management is probably the most important threat.
- Main actual and potential threats to marine habitats and biodiversity in the Northeast Atlantic are:
    - Lack of sustainable regulation of fisheries: Overfishing, bottom trawling, discards, catch of non targeted species
    - Pollution from maritime transport through oilspills and TBT in antifouling paints
- There is a lack of information and/or monitoring on species, habitats and fish stocks in the North-east Atlantic Ocean except for coastal waters.
- The North-east Atlantic Ocean is protected by the OSPAR convention and some other more global conventions. Nature protection is focussed on coastal areas and poor in all other parts of the ocean.

1. What are the characteristics of the North-east Atlantic Ocean?

1.1 General characteristics

Table 1: Statistics for the North-east Atlantic Ocean

Surface Area	Catchment area km^2	Water Volume	Coastal length km	Average depth m	Surface temperature ºC	Salinity ‰
n.a.	700 000	n.a.	20 585	n.a. max in this region of the sea 5800	7-15	35

n.a. not available

Source: OSPAR 2000

This report covers the North-east Atlantic Ocean, which includes the European part of the Atlantic, also defined as area 3, 4 and 5 by the OSPAR convention. The area is limited to the south by the 36 ºN parallel, to the west by the 42 ºW, to the north by the 62 ºN and to the east by the Atlantic coast of Europe up to the British Channel and further along the west coast of England and Scotland. However, the areas Northeast of the Wyville Thomson Ridge and west of the Reykjanes Ridge are not included (Map 1).

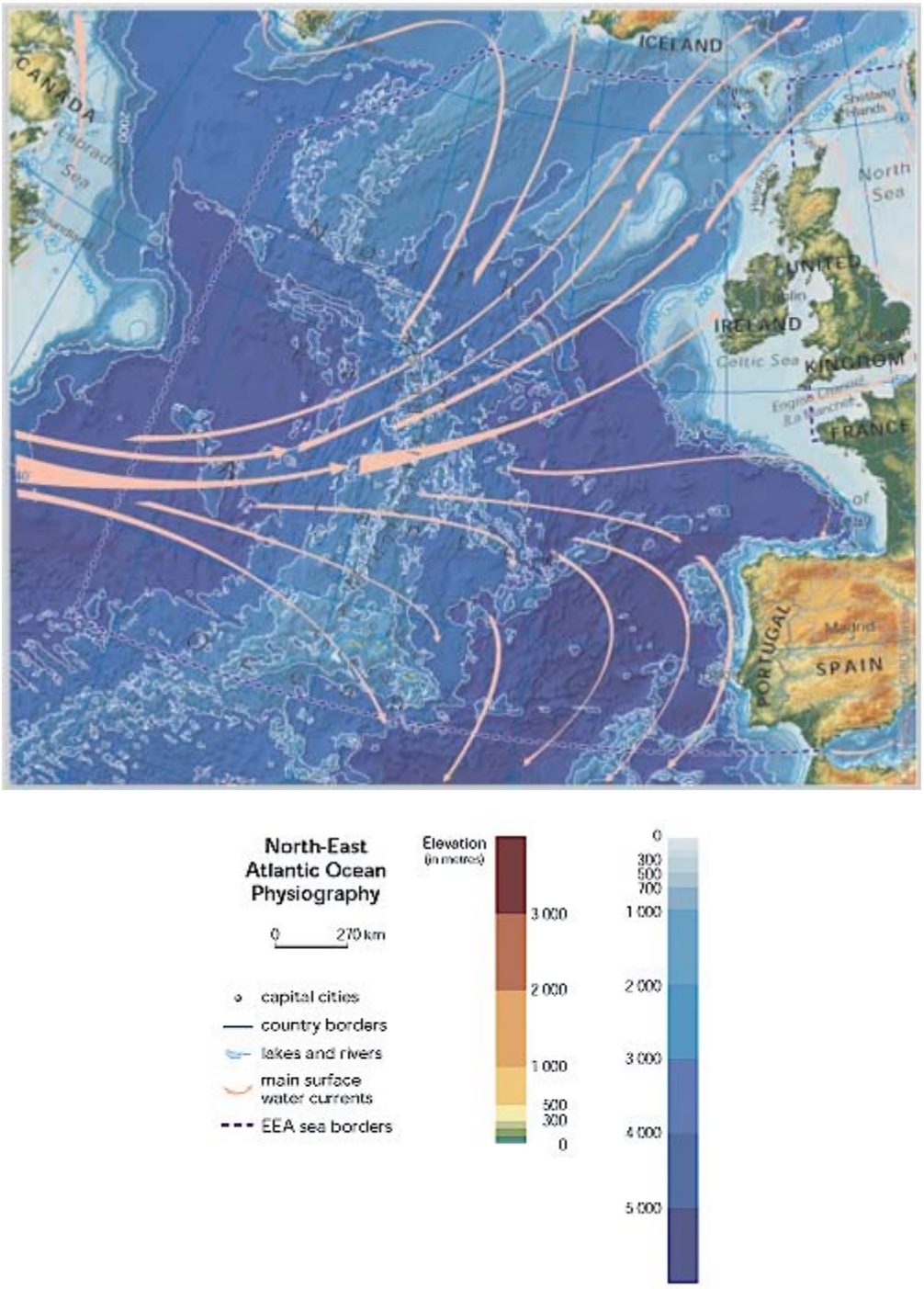
The morphology of the sea floor is dominated by two deep areas on both sides of the Mid Atlantic Ridge with depths down to 5 000 m and a shallow continental shelf along the European coast. In the deep-sea areas the sediments are composed of clay particles and calcareous scales from phytoplankton. In the continental shelf areas the sediments are sandy to muddy.

The coastal fringe is diverse with rocky coastlines at the western coast of Scotland and Ireland, low-lying sandy areas at the French coast and a mixture of dunes, beaches, sheltered inlets and lagoons on the western side of the Iberian Peninsula.

In the Atlantic Ocean the water flow is predominantly from west to east driven by the northern and southern branches of the North Atlantic Drift. In the shelf areas currents are predominately by tidal and wind generated, but the main water flow is from south to north (Map 1). The formation of the North Atlantic deep water is one of the driving forces for the thermohaline circulation of the world's oceans.

The temperature varies between 7 and 15 °C in the sea surface water and between 5.5 and 7.5 °C in deep waters. The salinity is about 35 ‰ or higher in both surface and deep-water.

Map 1: North-east Atlantic Ocean physiography (depth distribution and main currents)



Source: EEA

The primary productivity in the Atlantic increases from south to north. South of 40 ºN the yearly production is about 45 g carbon/m2 (surface) and there is little variation through the year. North of 40 ºN the production is twice as high (90 g carbon /m^2 per year) and production takes place in the summer season.

Southwest of Iceland the primary production is even higher. However, according to definitions for eutrophication levels by Nixon (1995), most of the area is oligotrophic (<100 g carbon /m^2 per year). Eutrophication is not regarded as a problem for this sea except for some local coastal areas, mainly estuaries in the Celtic sea and some estuaries along the coast of Biscay.

1.2 Main influences

The North-east Atlantic is divided into 3 major areas according to the division by the OSPAR Commission: The Celtic Sea, the Bay of Biscay and Iberian coast and the open ocean areas. The first two areas are densely populated and have catchment areas with agriculture and industrial activity. Mariculture is important in the Celtic Sea. Fisheries and tourism are important activities in all three areas.

Table 2: Main actual and potential threats to biotopes and biodiversity in the Northeast Atlantic

Celtic Sea	Eutrophication	Sewage, agriculture, fish farming (estuaries)
	Fishing	Overfishing, bottom trawling, discards, catch of non targeted species
	Industry	Chemicals and radionuclides
	Shipping	Pollution: TBT and oilspills
Bay of Biscay and Iberian coast	Eutrophication	Sewage, agriculture (estuaries)
	Chemicals	Industry, sewage, agriculture
	Fishing	Overfishing, bottom trawling, discards, catch of non targeted species
	Tourism	Habitat destruction
	Shipping	Accidents. Pollution: TBT and oilspills
Open ocean areas	Fishing	Overfishing, bottom trawling, discards, lack of regulations, catch of non targeted species
	Shipping	Accidents. Pollution: TBT and oilspills

Source: OSPAR 2000

1.3 Main political instruments

Fisheries and pollution from human activities appear to be the largest threats to the biodiversity in the Atlantic. Therefore national designations and international conventions have been set in place to protect sea-life. Several legal instruments (conventions and directives) aim to protect and conserve the marine life in the North-east Atlantic Ocean:

- **OSPAR**

1992 Convention for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR Convention). In 1998 a new Annex V "On the protection and Conservation of the Ecosystems and the Biological Diversity of the Maritime Area" to the OSPAR Convention was adopted.

- **ICES**

A major activity of the International Council for the Exploration of the Sea (ICES), as an intergovernmental marine science organisation, is to provide information and scientific advice to member country governments,

international regulatory commissions and the Common Fisheries Policy on the protection of the marine environment and the regulation of fisheries.

• EU Birds and Habitats Directives

All countries bordering the Celtic Sea, the Bay of Biscay, Iberian coast and the open ocean areas in the Northeast Atlantic are parties to the EU Birds and Habitats Directives in creating the NATURA2000 network of sites of European importance for habitat type and species protection. Many large areas, especially along the coasts, are designated or proposed for designation as NATURA2000 areas.

• North Atlantic Marine Mammal Commission (NAMMCO)

NAMMCO, set up in 1992, is an international body for co-operation in the conservation, management and study of marine mammals in the North Atlantic, including the Arctic part.

• Bern Convention

The 1979 Bern Convention on the conservation of European wildlife and natural habitats plays a similar role to NATURA2000, particularly for non-EU countries.

There are other conventions, which cover part of the area, such as Ramsar (protection of internationally important wetlands), Bonn convention (migratory species), MARPOL 73/78 IMO convention of marine pollution from ships in addition to national laws. Also NGO organisations such as WWF are working to accelerate the process to establish no-fishing zones and offshore marine protected areas.

1.4 Present biodiversity status and trends

The Northeast Atlantic Ocean, as defined here, covers the following biogeographical sea regions (see sea introduction chapter):

- Lusitanian (Iberian coast – Bay of Biscay) sea region;
- Lusitanian-boreal sea region (Bay of Biscay – The British Channel);
- Boreal-Lusitanian sea region (The Celtic Seas);
- Boreal sea region (The Irish Sea).

1.4.1 Plankton and benthos

• Plankton

South of the 40 °N there are warm-temperate water masses, resulting in a stratification of the water column throughout the whole year. In this area the primary production is rather low (45 g carbon /m^2 per year) and there is little seasonal variation. North of the 40 °N there are cold-temperate water masses and here the water column is stratified only during summer, while there is a deep mixing zone during winter. This results in a strong seasonal primary production cycle and higher productivity due to the inter-seasonal upflow of nutrient rich water from deeper waters. In spring and autumn diatoms dominate, while in summer the plankton is dominated by picoplankton (small flagellates <2 µm). South of Iceland the coccolithophoride *Emiliania huxleyi* blooms regularly in summertime (Holligan *et al.* 1993) and the annual primary production in this area exceeds 125 g carbon /m^2 per year.

Harmful algal blooms are seldomly observed in the open ocean, but in shelf waters the frequency of such blooms has increased (OSPAR, 2000). The highest species diversity of planktonic algae (about 1000 species) is found in the Bay of Biscay and along the Iberian coast.

In the epipelagic zone (0-200 m depth) there is a dominance of small species of zooplankton ranging from protozoans to copepods, which are the most important zooplankton. The highest number of species is found at depths about 1000 m (Angel, 1997), but the maximum of biomass is found in the epipelagic zone (OSPAR, 2000). North of 40 ºN the number of species is lower, but their mean size is larger.

• **Benthos**

The benthos consists of the organisms living near, on, or in the seabed and there is a great variation in species diversity and biomass in these communities (Dauvin, J-C., 1997). The key factors controlling the diversity and biomass are primary production, sediment composition, geographical latitude, depth of water and tidal regime in the area (OSPAR, 2000). The number of species in this area is not known, but generally, the diversity decreases from south to north.

Southern habitats are more heterogeneous than northern with an increasing number of macroalgae species from north to south.

At the Azores the benthic communities (zoobenthos and phytobenthos) are isolated from their mainland counterparts. Most shallow water species show more resemblance to more northern sea areas such as Madeira, the North-eastern Atlantic Ocean region and the Mediterranean Sea because colonisation to the Azores probably took place during a period when sea current conditions were different from today (after the Pleistocene) (Morten *et al.* 1998).

Cold-water coral reefs with *Lophelia pertusa* as the main reef building species are present along the coasts of the whole area (Map 2). In deep water outside Scotland and Ireland there are large areas covered by cold water corals formed by two species, *Lophelia pertusa* (Photo) and *Madrepora oculata*, which interconnect with tubes of the worm *Eunice norvegicus* (Wilson, 1979; Rogers, 1999; Bett et al., 2001). Like tropical coral reefs the deep-water reefs have a high biodiversity. Attached to the corals are a wide variety of animals such as bryozoans, hydroids, sponges, and other corals. Several species of fish (redfish, saithe, cod, ling, and tusk), squat lobsters, other crustaceans, molluscs, starfish, brittlestars, sea pens, and sea urchins live between the coral branches. Some of these species are unique to coral reefs.

Map 2: Locations of deep water coral reefs

Source: Jan Helge Fosså (personal communication)

Photo: Lophelia

Source: Erling Svensen

- **Hydrothermal vents**

Hydrothermal vents are special ecosystems in the vicinities of underwater Volcanoes. Most of the known ones occur in deep waters, but around the Azores they can be observed in shallow waters. The characteristics of the hydrothermal vent assemblages found locally in the median valley of the Mid-Atlantic Ridge are reviewed in Gebruk *et al.* (1997). These communities occur closely clustered around the discharges of hot, sometimes superheated, fluids, which are rich in metallic sulphides, methane and carbon dioxide. The communities are large in biomass but consist of rather few species. Their organic supplies are derived mainly from the chemosynthetic oxidation of sulphides or methane by bacteria. The bacteria are either free-living or live as symbionts within the bodies of the larger animals. Most vent species are endemic to these special habitats and the community composition varies with depth. Only three vent systems, 'Lucky Strike', 'Menez Gwen' and 'Rainbow' have been found so far in open ocean waters.

1.4.2 Large fauna

- **Fish**

From the whole North Atlantic Ocean nearly 1100 species of fish are known. About 600 are pelagic, while the rest is demersal (Merrett, 1995). Small environmental variations in the deep-sea bed results in a relatively wide geographical distribution of many of the deep-water species. Due to a large range of habitats, species diversity is high in the shallow Celtic Sea. Higher variety of seafloor habitats inshore than offshore results in higher species diversity.

- **Squids**

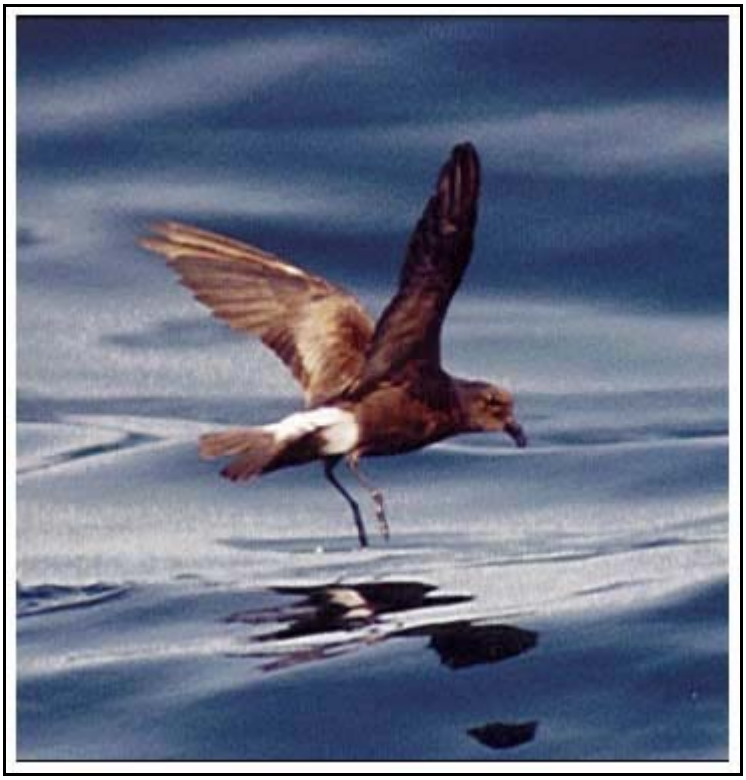
Squids play an important role in the ecosystem, both as predators and as food for whales, fish, and seabirds. They have high abundances, but sampling of squids is very difficult and therefore the biology and distribution of these organisms are poorly known. Many species have annual life cycles and very high growth rates (OSPAR, 2000).

- **Seabirds**

A large number of birds are dependent on coastal zone habitats such as beaches, sand dunes and mudflats for feeding, while other species find their food near the surface or by diving into the sea.

The highest number of breeding species (26) is found around Ireland and the west coast of the British Isles (OSPAR, 2000). Large numbers of seabirds breed at several offshore islands. More than 10 % of the North Atlantic population of breeding gannets breed at the island of Grassholm off the south Wales coast (Kelleher *et al.*, 1995). At the Azores 13 out of 14 breeding species have an unfavourable conservation status. Three of these little shearwater (*Puffinus assimilis baroli*), the Madeiran storm-petrel (also known as Band-rumped Storm-petrel or Harcourt's petrel) (*Oceanodroma castro*) and Bulver's petrel (*Bulweria bulwerii*) breed nowhere else in the Atlantic (Santos *et al.*, 1995). In addition more than 60 % of Europe's roseate terns (*Sterna dougallii*) breed in the Azores (OSPAR, 2000).

Photo: Madeiran storm-petrel (*Oceanodroma castro*)



Source: Steve McConnell

- **Mammals**

Several species of seals have been observed in the North-east Atlantic Ocean, but only two species are abundant in coastal areas of the northern Atlantic. The grey seal (*Halichoerus grypus*) is frequently found in rocky and wave-exposed areas, while the harbour seal (*Phoca vitulina*) prefers more sheltered areas. 32 different species of whales have been observed in the Atlantic Ocean (OSPAR, 2000). Many of them are rare, but since the ban of commercial whaling was introduced by the International Whaling Commission (IWC), rare species have been observed more frequently. The most common whale is the harbour porpoise (*Phocoena phocoena*).

1.5 Fisheries and other marine living resources

The large range of habitats and sediment types in the Atlantic Ocean is basis for a diverse fish fauna. Of the nearly 1100 species of fish in the region, about 10 % are caught either directly or incidentally (OSPAR, 2000). Table 3 gives the status of the stocks of the most important commercial species. Along the coast of France, Norway and Ireland seaweeds (*Ascophyllum nodosum*) and kelp (*Laminaria hyperborea, L. digitale*) are harvested for use in alginate and fertiliser production.

Table 3: Most important commercial species for the fisheries, status of stock and habitat

Fish species	Latin name	Status of stock	Habitat
Anchovy	*Engraulis encrasicholus*	Wsbl	pelagic
Blue whiting	*Micromesistius poutassou*	Wsbl	pelagic
Whiting	*Merlangius merlangius*	Wsbl	demersal
Megrim	*Lepidorhombus boscii* *L. whiffiagonis*	Wsbl/osbl	demersal
Plaice	*Pleuronectes platessa*	Wsbl/osbl	demersal
Anglerfish	*Lophius piscatorius*	Osbl	demersal
Cod	*Gadus morhua*	Osbl	demersal
Haddock	*Melanogrammus aeglefinus*	Osbl	demersal
Hake	*Merluccius merluccius*	Osbl	pelagic
Herring	*Clupea harengus*	Osbl	pelagic
Horse mackerel	*Trachurus trachurus*	Osbl	pelagic
Mackerel	*Scomber scombrus*	Osbl	pelagic
Saithe	*Pollachius virens*	Osbl	pelagic
Sardine	*Clupea pilchardus*	Osbl	pelagic
Sole	*Solea solea*	Osbl	demersal
Elasmobranchs (sharks, skates, rays)		?	pelagic

osbl=out of biological safe limits
wsbl=within biological safe limits

Source: OSPAR 2000

In Ireland and Scotland mariculture is the major industry with production of salmon (*Salmo salar*) and rainbow trout (*Onchorhynchus mykiss*) as the main species. Other important species are sea bass (*Roccus labrax*) and sea bream (*Pagellus centrodontus*). For the future, species like halibut (*Hippoglossus hippoglossus*), arctic char (*Salvelinus alpinus*), cod (*Gadus morhua*) and turbot (*Psetta maxima*) are likely to become important in intensive aquaculture (OSPAR, 2000). Mariculture also includes cultivation of bivalves. Blue mussels (*Mytilus edulis*) and oysters (*Ostrea edulis*) are the most important species, but also clams and cockles are produced.

2. What is happening to biodiversity in the North-east Atlantic Ocean?

Anthropogenic activities in the coastal areas and in the open sea will in different ways affect marine ecosystems. Around the North-east Atlantic Ocean the human population is concentrated in the coastal area. An increasing human population in this area has led to an increase in sewage discharge, in maritime transport, use of the sea for tourism and recreation and exploration of the natural resources in the sea. Over-fishing, eutrophication, dumping, direct discharges and spills of contaminants are all threats to the biodiversity in the ocean.

2.1 Climatic changes

Global circulation models predict a 1.5 ºC increase in the surface air temperature and a sea level rise of 25-95 cm by 2100 (OSPAR, 2000). This may influence the deep-water formation: Heavy cold water in the northern oceans sinks below the lighter warm water coming from the south and further into the deep sea and pushes lighter water in front of it. By this, it is functioning as a circulation pump in the Labrador Sea and cause changes in currents and the coastal up-welling regimes. Changes will affect the abundance and distribution of many ocean species, and have significant effect on ecosystems and fisheries. Appearance of several species of tropical fish on the Iberian coast and on the southeast shelf of the Bay of Biscay, may already be interpreted as an effect of climate change.

In the North-east Atlantic and European seas, maps of the mean number of species for all plankton associations in the area have been obtained from results of the Continuous Plankton Recorder. These results demonstrate that major biogeographical shifts for all species assemblages have taken place since the early 1980s to the south-west of the British Isles (Beaugrand, 2002.). The number of southern and temperate species has increased northwards, while the diversity of colder temperate, sub-arctic and arctic species has decreased. All biological associations show consistent long-term changes, which may reflect a movement of marine ecosystems towards a warmer dynamical equilibrium. These trends are in agreement with biological modifications expected under global warming conditions (Hughes 2000).

Sea level rise will affect low-lying areas by coastal erosion and saltwater intrusion into estuaries, coastal lagoons, wetlands and groundwater bodies (OSPAR, 2000).

2.2 Fisheries

ICES (1996) indicates that there is a need for a 40 % reduction in the fishing fleet to avoid over-fishing and match available fish resources. As an example of over-fishing, intensification of fishing in southern Bay of Biscay has led to the virtual extinction of elasmobranchs (e.g. rays, skates, sharks), which have a long reproduction time. Most of the commercial fish stocks are outside 'safe biological limit' in the Atlantic area (OSPAR, 2000; EEA, 2002) including cod, hake, saithe, plaice, sole, sardine, anglerfish, and megrims (Table 3).

Another problem is discarding (unwanted fish or other organisms, most of them dies before they are thrown back into the sea) which introduces a heavy organic load to the fishing areas giving favourable conditions for smaller opportunistic species and scavengers. Catch of undersized fish and non-targeted species (e.g. sharks, dolphins and turtles) is a serious threat to such stocks. Bottom trawls generate the highest discards due to their use in mixed species fisheries and the low selectivity of the gear. The average discard rate for this fishery is about 50%. Gillnets have an average discard rate of 25% and long lines only 9%. Pelagic trawl fisheries are mainly conducted by French vessels and the target species (anchovy, sardine, hake) usually represent a large proportion of the catch, although discard rates are consistently high, average 50 % and up to 100%. Economic forces contribute to increased discarding. In the Bay of Biscay and outside the Iberian coast French pelagic trawl fisheries discard 100 % of Atlantic horse mackerel due to its low value in France, despite its high value in Spain and Portugal.

Deep-sea fisheries are an increasing activity. Most of these deep-sea species have a long lifespan e.g. deepwater redfish 70-75 years and reach maturity around age 30. Exploitation of these fisheries needs

thorough understanding of their ecology and the need for a strong regulation following the precautionary principle for management should be obvious.

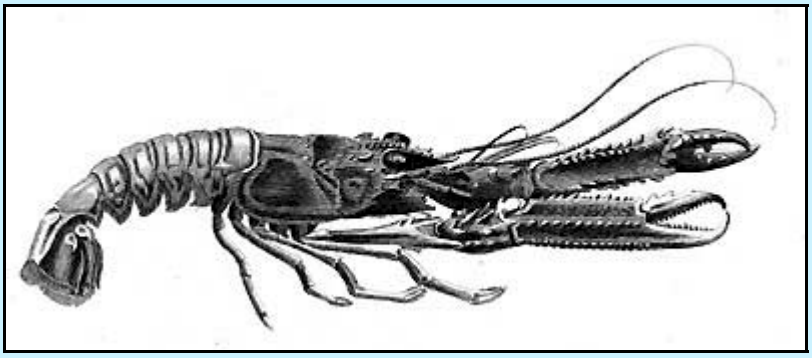
Trawls and dredges towed along the seabed can displace, kill or injure animals living on or in the sediments, and the sediments themselves are disturbed. Despite lack of data, the most heavily trawled bottom areas containing deepwater corals outside Ireland and Scotland are assumed to being damaged in the same way as off the coast of Norway and Shetland (see chapter about biodiversity in the Arctic).

Commercial fishing removes target and non-target species from the ecosystem. The non-target species in the Nephrops fishery is juvenile whiting. These fisheries may therefore have contributed to the fact that whiting is a threatened species in the Irish Sea. Fisheries have also influenced the common skate (*Raja batis*) and disappearance of this species in the Irish Sea is attributed to non-target mortality.

Case study - Nephrops-trawling

Intensive Nephrops-trawling in the Irish Sea has resulted in destruction of the burrows, and filling in of the openings, leading to a flattening of the seabed and serious disturbance of the benthic ecosystems.

Illustration: Norway lobster (*Nephrops norwegicus*)



Source: NIVA

2.3 Mariculture

Mariculture normally implies high densities of finfish or shellfish in highly restricted areas in inshore waters. The cultivation results in increased local sedimentation of organic waste due to food spill and/or faeces. Increased organic content of sediments may lead to prominence of opportunistic species (often polychaetes), but may finally result in a decrease of the faunal diversity. Some chemicals like antibiotics, pesticides and antifoulants used in fish-farming has been found in the sediments close to fish-farms. Bottom-living organisms may absorb some of these chemicals and the potential effects on biodiversity are unknown.

High densities of farmed species increase the possibility of transmission of diseases and parasites between farmed and wild stocks. Increased occurrence of sea lice on salmon and sea trout is one of the greatest controversy at the moment. Infection by sea lice (*Lepeophtheirus salmonis*) associated with salmonid fish is found in most marine salmon farms. Sea lice, which is a copepod ectoparasite, is often reinfected within the farm stocks, giving rice to heavy infection in the fish-farm. There is a suggestion that post-smolt of sea trout (*Salmo trutta*) has been infected by sea lice from fish-farms, resulting in a collapse of sea trout population in the west of Ireland, Scotland and Norway (OSPAR, 2000).

The genetic quality in farmed salmon in an area is normally different from the wild salmon from the same area. In rivers close to fish-farms there has been found escapees of farmed salmon and now there is a concern of genetic interactions between wild and reared salmon. To what extend this genetic mixing may represent a problem is uncertain.

2.4 Introduced species

Species can move or be moved to a new area naturally by water currents, but very often they arrive as a result of human activities e.g. ballast water, fouling and aquaculture. If it establishes itself it often outcompetes or seriously disturbs the ecosystem. The costs can be huge and is regarded as a threat on the same line as pollution and climatic changes. Example of an intentionally introduced species is the pacific oyster (*Crassostrea gigas*) which has been imported from Japan because it is large and fastgrowing. Fouling and aquaculture have unintentionally introduced other species such as Japanese seaweed (Sargassum muticum), common cord grass (Spartina anglica), the barnacle (*Elminius modestus*), slipper limpet (*Crepidula fornicata*), soft-shelled clam (*Mya arenaria*) and the oyster parasite (*Bonamia ostrea*). No assessments of the environmental costs of the introductions of these organisms are available.

2.5 Eutrophication

Eutrophication is excessive nutrient enrichment, usually due to increased discharge of nitrogen and phosphorous, that results in high growth rates of phytoplankton and macroalgae. This increase in primary production may lead to an increase in benthic biomass which is followed by a change in species composition of communities, and then by a reduction in number of species (Rosenberg, 2001) as oxygen concentrations begins to fall following the decomposition of primary producers.

Eutrophication has been a major problem in many European coastal areas, but to a lesser degree in the Atlantic region. However, the concentrations of nitrogen and phosphorus have been anthropogenically enhanced for some estuaries within the Celtic Sea. Signs of eutrophication with increased organic load and reduced oxygen concentrations in the bottom water are mainly apparent in the Mersey estuary/Liverpool Bay, Belfast Lough and inner Cork Harbour (OSPAR, 2000; Ærtebjerg *et al.*, 2001). Also from restricted areas of estuaries and coastal lagoons (Bay of Vilaine, Arcachon, Ria Formosa, Huelva) in the Bay of Biscay and the Iberian Coast available data on nutrients, dissolved oxygen and abundance of benthic fauna gives some evidence of eutrophication of the coastal zones in this region (OSPAR, 2000). For example, in the Bay of Vilaine, LeBris & Glemarec (1995) has shown a spreading of the Haploops tubicola muds community over a period of 20 years of monitoring, which they linked to an increasing nutrient discharge and a growing eutrophication of this area.

Although lower oxygen concentrations are observed in several smaller areas in the North-east Atlantic, the spatial scale of the impact or its biological effects is not of main ecological concern.

2.6 Oil spills

Offshore oil exploration causes accidental oil spills from platforms and maritime transport. On 11 December 1999 the oil tanker ‘Erika’ broke in half and sank in the Bay of Biscay, just south of Brest. The ship was carrying 20 000 tonnes of persistent heavy grade oil which was released into the sea.

The tanker 'Prestige' suffered hull damage and finally sank on 13 November 2002 in heavy seas off northern Spain, carrying a cargo of some 77 000 tonnes of heavy fuel oil. The coast, which is affected by the oil, supports a rich and diverse fishing and aquaculture industry, including the cultivation of mussels, oysters, turbot and several other species, and the harvesting of various 'wild' species of fish and shellfish and has sites of international importance for birds.

Accidental oil spills like these impact seabirds, mammals, fishing and mariculture, and the marine life at the polluted seashores.

Case study - Impact of Erika oil spill

More than 63 000 oil-polluted birds were collected by volunteers, more than 61 000 birds were dead. This pollution affected birds wintering in the sea, coming from several European countries. Percentage of oiled birds:

- 1. Guillemot (Uria aalge) 82 %
- 2. Common scooter (Melanitta nigra) 5 %
- 3. Razorbill (Alca torda) 3.5 %
- 4. Gannet (Sula bassana) 2.6 %
- 5. Others 6.9 %

Only very few mammals (seals) were affected.

Source: French Ministry of Environment and French Ministry of Transport

2.7 Contaminants

The ecological effects of contaminants are often very difficult to assess, with the exception of organotin compounds. Tributyltin (TBT) used as an antifouling component in boat paint cause serious endocrine disruption (imposex) in snails and oysters. The use of TBT has only been regulated for boats smaller than 25 m, which are not allowed to use paint with TBT and investigations after the introduction of restrictions still indicate biological effects, but at a lower level. The effects of TBT are located in patchy local areas, such as inshore harbours, marinas and shipyards and close to shipping routes. A general ban on use of TBT in antifouling paints is planned by the International Maritime Organisation (IMO) from 2003 and it will be totally forbidden on ship hulls by 2008 (OSPAR, 2000).

OSPAR 2000 states that other hazardous substances like heavy metals and a few organic substances like PAH and PCB are no problem to biodiversity in the North-east Atlantic Ocean.

Radionuclides (Technetium) show an increasing trend (10-15 times increase from 1994-1998) in bladder wrack downstream the Sellafield operations. The concentrations are at present not regarded to produce adverse effects at population level.

3. What policies are at work in the North-east Atlantic Ocean?

3.1 Nature protection

3.1.1 Protected areas

In the North-east Atlantic there is a large diversity of ecosystems. The benthic marine ecosystems in the different countries are well described by Hiscock (1998). To protect ecologically valuable areas, all countries have established some form of Marine Protected Areas (MPAs). The degree of protection of wildlife and habitats within the protected areas varies from country to country and with protection instruments (Table 4).

Most of the MPAs so far established are close to or adjacent to shores. However, many offshore areas are important spawning areas and nursery grounds that need protection, thus a considerable increase of offshore MPAs could be considered. The introduction of No-Fishing Zones (NFZs) may be useful to protect some species of fish and ecosystems. Under the global Ramsar Convention, the European Bern Convention and the EU Birds and Habitats Directives countries are designating main coastal and some marine areas for protection, but mainly close to the shore (see map on designated areas in introduction chapter).

Table 4: Nationally marine protected areas in the region of North-east Atlantic

Country	Name	Position	Comments
France	Iroise	48°25'N, 5°W	Regional Nature Park. Biosphere Reserve and EC Birds Directive site. Archipelago. Rich algal communities, nesting seabirds, common and grey seal, seagrass. Fish and birds on the national red list
	Lilleau des Nigres	46°18'N, 0°25'W	Nature Reserve. EC Birds Directive site. Saltmarsh. Migrating and overwintering birds
	Moeze	45°50'N, 0°25'W	Nature Reserve. Inlet
	Pres Sales d'Ares Lege, Cap Ferret	44°45'N, 1°15'W	Mud and sandflats. Seagrass. Fish nursery area
	Banc d'Arguin	44°46'N, 1°17'W	Regional Nature Park
Ireland	Lough Hyne	51°31'N, 95; 9°18'W	Landlocked sealock. Rich algal communities
Portugal	Berlenga	39°25'N, 9°35'W	Nature Reserve. Biogenetic Reserve. Proposed Biosphere Reserve. All invertebrate species protected
	Costa Vicentica e Sudeoeste, Alentejano	37°35'N, 8°55'W	
Portugal, Azores	Bays of Maia, South Lourenco, Anjos and Praia around the	36°55'N, 25°10'W	Nature Reserve. Representative of littoral habitats of the region

	island of Santa Maria		
	Vila Franca Islet, Sao Miguel Island	37°25'N, 25°30'W	Small islet close inshore. Exceptional density of nesting Cory's shearwater.
	Formigas Islets and Dolabarat Bank	Approximately 50 miles from South Miguel	Nature Reserve. Shallow and deep-water rocky habitats
	Topo Islet, Sao Jorge Island	38°25'N, 27°45'W	Nature Reserve. Rocky seabed
	Lagoon of Santo Cristo, Sao Jorge Island	38°30'N, 28°W	Special Ecological Area. Unique clam beds
	Monte da Guia, Faial Island	38°30'N, 28°40'W	Protected landscape. Rocky and sandy seabed
Portugal, Madeira	Selvagem Grande	30°9'N, 15°52'W	Strict Nature Reserve. EC Birds Directive site. Rocky. Important *Procellariidae* colonies
	Selvagem Pequena and Ilheu de For a	30°2'N, 1°2'W	Strict Nature Reserve. Rocky stacks and sand dunes. Important for breeding seabirds
	Garajau	32°30'N, 1°55'W	Boundary of reserve approximately 0.75 km offshore to 50 m depth
	Ilheu Chao and Deserta Grande	32°32'N, 1°31'W	Rocky islands. Breeding seabirds. Localities used by Mediterranean Monk Seal
	Ilheu do Bugio	32°25'N, 1°26'W	Rocky islands. Breeding seabirds. Localities used by Mediterranean Monk Seal
Spain	Acantilado de Barbate	36°11'N, 5°57'W	National Park. Rocky sea bed with kelp forest
United Kingdom	Lundy	51°11'N, 4°40'W	Marine Nature Reserve. Offshore island. Good variety of marine habitats and species
	North Devon	51°12'N, 4°6'W	Voluntary Marine Conservation Area. Moderate exposed rocky shore. Rich intertidal communities
	Isles of Scilly	°56'N, 6°18'W	Voluntary Marine Protected Area. Archipelago of granite islands. High diversity of marine habitats and communities. Seagrass beds. Rich infauna.Breeding seabirds
	Skomer and the Marloes Peninsula	°44'N, 55; 5°5'W	Marine Nature Reserve. Wide variety of habitats. Submarine cliffs, reefs and boulders

Source: IUCN, 1995

3.1.2 Red List species

The International Union for Nature Conservation (IUCN) has published lists of threatened species for the whole world (IUCN, 2001). These lists include all threatened species in the Northeast Atlantic Ocean.

The threatened species categories used in the IUCN-red lists are broad and thus not always convenient for use within a limited region or within a country. Therefore, guidelines for regional use are being developed. In these guidelines the setting of conservation priorities will be important.

In the existing red books from countries bordering the North-east Atlantic Ocean a small number of species are included (mostly mammals, birds and fish).

3.2 Protection of marine resources by restrictions on fishing and hunting

Fisheries regulations for the Celtic Sea are covered under national laws. However, several commercial fisheries are at an unsustainable level.

Catch restrictions for the Bay of Biscay are recommended on the basis of scientific advice from ICES. Total allowable catches are shared between the countries active in the fishing of any regulated species. There is no regulation regarding by-catch and discharges and several commercial fisheries are at an unsustainable level.

The open waters of the North-east Atlantic are subject to international fisheries agreements: North East Atlantic Fisheries Commission (NEAFC), North Atlantic Salmon Conservation Organization (NASCO), and the International Convention for the Conservation of Atlantic Tunas (ICCAT), who is setting total allowable catches for tuna and tuna-like species. Non-European nations fish in these areas as well as the European fishing fleet. Lack of data on actual catch of fish and other organisms as well as lack of monitoring programmes is a major problem for sustainable management of fish stocks.

Whales are protected from commercial whaling under the International Whaling Commission (IWC), but aboriginal subsistence whaling is permitted from Denmark-Greenland. Other mammals and turtles are red listed under the IUCN.

3.3 Research projects and monitoring programmes

- **The Continuous Plankton Recorder (CPR)**

CPR is a standardised instrument for plankton sampling in the seas. The instrument is towed behind ships and the samples are preserved for later laboratory analysis. A CPR was first used in 1931 and since then they have been towed along a track length of four million miles by ships of 10 nations. The data are background data for many assessments. (see Continuous Plankton Recorder web site)

- **National monitoring and research**

Many countries have worked out their own action plans for protecting and conserving their own biodiversity. In these plans strategies for long term monitoring of biodiversity and environmental changes have been developed. Small-scale research and monitoring projects have been developed in the countries along the coasts of the Northeast Atlantic Ocean.

- **BioMar**

A survey of marine habitats and their communities, of the seabed of England, Scotland and Wales has been carried out by the Marine Nature Conservation Review (MNCR). In addition, existing information on marine biotopes is being gathered to help identify sites of high marine conservation value. The programme has been in progress since 1987. MNCR is developing a detailed structured classification of marine biotopes that will include all marine and brackish-water habitats, which occur around the coasts of the United Kingdom (UK), and Ireland. The classification will be an integral part of the European EUNIS Habitat classification (see EUNIS web site).

- **JAMP – Joint Assessment and Monitoring Programme**

In the North-east Atlantic, OSPAR's JAMP provides a scientific basis and assessments for identifying, prioritising and evaluating issues of concern and the success of remedial action taken. In this regard JAMP has provided guidelines, workshops, and assessment reports in cooperation with the International Council for the Exploration of the Sea (ICES) for investigating biodiversity, contaminants, nutrients and influences of offshore activities.

- **ICES fish stock monitoring**

The Advisory Committee on Fishery Management (ACFM) is responsible, on behalf of the Council, for scientific information and advice on living resources and their harvesting. In formulating its advice on the management of ca. 135 stocks of fish and shellfish, ACFM utilizes information prepared by numerous stock assessment working groups. ACFM meets twice a year (summer and late autumn) to prepare its advice, which is published annually in the ICES Cooperative Research Report(s) series.

- **EC research programmes**

Ocean Margin Exchange (OMEX) Programme: OMEX is a large-scale multidisciplinary project bringing together scientists from 40 universities and research institutes throughout Europe. This major oceanographic initiative carried out within the framework of the Marine Science and Technology (MAST) Programme of the European Eunion aims to study the biogeochemical fluxes and processes occurring along the European continental shelf (see web site).

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