chapter 3

Human activities

3.1 Introduction

This chapter provides an outline of the most important human activities that need to be taken into account in assessing the present quality status of the Greater North Sea. Economic statistics are not aggregated on geographical scales that are appropriate for this assessment report and therefore no information is presented in economic terms.

The countries bordering the Greater North Sea carry out within it major fishing activities, the extraction of sand and gravel, offshore activities related to the exploitation of oil and gas reserves including the laying of pipelines, and use it as a transport route and for dumping dredged material. The North Sea is one of the most frequently traversed sea areas of the world. Two of the world's largest ports are situated on the North Sea coast, and the coastal zone of the Greater North Sea is used intensively for recreation.

The Greater North Sea is surrounded by densely populated, highly industrialised countries. As a consequence, the area is affected by industrial, domestic and agricultural activities, which create inputs, via various pathways, of nutrients, hazardous substances and radionuclides.

In order to reduce the stress on the environment, measures have been adopted to reduce emissions, discharges and losses of hazardous substances, radioactive substances, and nutrients. Measures address point sources such as industries (land-based and offshore) or treatment plants and diffuse sources such as agriculture. In the shipping sector, mandatory routeing measures have been imposed in order to lower the risk of accidents. A number of measures have been introduced and are being further developed concerning the fisheries sector with the aim of achieving sustainable fisheries.

The Convention on the Law of the Sea recognises three areas. The 'territorial sea' generally extends 12 nautical miles offshore and is subject to coastal state jurisdiction. The 'exclusive economic zone' (EEZ) extends 200 nm (350 nm including the continental shelf) and in this zone the coastal state has the exclusive right of exploitation of resources, including fisheries, and is responsible for regulating pollution from sea-bed installations, dumping, and other activities. The 'open sea' beyond the EEZ is not subject to national jurisdiction.

Most of the North Sea States have declared an EEZ and have EEZ legislation in place. This is in preparation in The Netherlands, and the UK has an equivalent area of UK controlled waters. The North Sea States which are EU members have transferred most of their exclusive rights on fisheries to the European Commission.

Following the adoption of the Geneva Convention on the Continental Shelf (1958), the delimitations of the continental shelf were agreed *(Figure 2.1)*. The Netherlands and Belgium agreed on their mutual boundary in 1996.

The framework for the environmental protection of the North Sea has developed extensively over the past 20 years. It includes the International Conferences on the Protection of the North Sea, the OSPAR Convention as the successor to the former Oslo and Paris Conventions, the Bonn Agreement, the Trilateral Governmental Wadden Sea Conferences and also initiatives within the International Maritime Organization (IMO) and the European Community (EC). The North Sea may also benefit from measures taken under the auspices of the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area and from the experience of the Barcelona Convention for the Protection of the Mediterranean Sea against Pollution. Additionally there is co-operation in the framework of international river conventions, such as for the Elbe, Rhine, Scheldt and Meuse.

Protection and conservation of ecosystems and biological diversity of the marine area is now under the new Annex V to the OSPAR Convention, adopted in 1998.

3.2 Demography

Approximately 184 million people live within the catchment area of the Greater North Sea *(Figure 3.1; Table 3.1)*. Since the mid-eighties, international migration has influenced the size of the population, and in 1995 accounted for 80% of the growth of the population of the European Union (EU). In 1996, about 1.5 million people migrated into the catchment area (Eurostat 1997a, Fischer Weltalmanach, 1999). Extrapolating present trends in birth and death rates, and migration, the EU population is projected to reach a maximum in 2025 (Eurostat, 1997b). Considerable changes following the end of the east-west bloc division has resulted in a substantial increase in trade and road transport. The number of people in the coastal regions of Region II varies substantially on a seasonal basis due to tourism.

Figure 3.1 **Catchment area of the Greater North Sea showing the main river systems and areas of high population density. Source: from Grote Bosatlas (1988) as in North Sea Task Force (1993).**

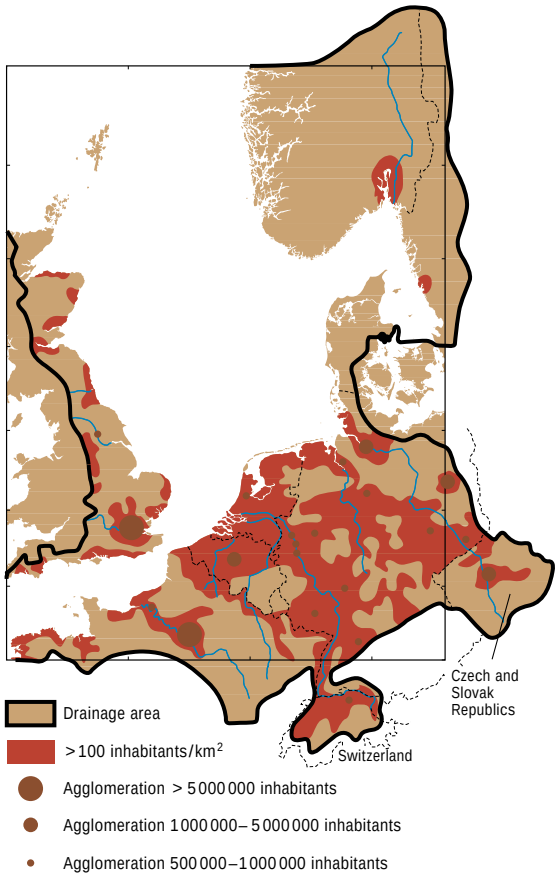


Table 3.1 Estimated population of the catchment area of the Greater North Sea and population density within the whole country. Source of data: Eurostat, Britannica (1999).

Country	Population in the Greater North Sea catchment area (x 10^6 inhabitants)	Population density (persons/km^2)
Belgium (1996)	10.1	334
Czech Republic (1996)	10.3	131
Denmark (1997)	2.2	122
France (1995)	25.3	107
Germany (1996)	72.5	229
Liechtenstein (1996)	0.16	194
Luxembourg (1996)	0.4	161
Netherlands (1996)	15.6	382
Norway (1997)	3.3	14
Sweden (1995)	2.4	22
Switzerland (1995)	5.7	172
United Kingdom (1995)	36.4	241
TOTAL	184.23	

Note: All data are calculated from Eurostat data, except for Denmark, Norway and Sweden.

3.3 Conservation

3.3.1 Ecological conservation

The Greater North Sea supports a rich coastal and marine wildlife, and has a number of important habitats *(Table 3.2)*. Since a number of species and habitats are endangered, certain areas such as the Wadden Sea have already been given the status of conservation sites in order to allow for protective measures.

Man made modifications to parts of the region have been accompanied by changes and losses of habitats and disturbed ecological functions. In The Netherlands few tidal rivers remain, in Germany a barrier is under construction in the river Ems, and in Scotland, over the years, much estuarine habitat has been lost from the major firths and estuaries, such as those of the Forth and Cromarty. Even in the Wadden Sea most estuaries have been modified. There are, however, new policy developments that aim to restore selected estuarine habitats (e.g. Harlingvliet and Scheldt in The Netherlands).

Important instruments for protecting the marine coastal environment are the EEC Council Directives on the conservation of wild birds (79/409/EEC) (which includes designation of Specially Protected Areas) and on the conservation of natural habitats and of wild fauna and flora (92/43/EEC). Within that framework a coherent ecological network of habitats is to be established (NATURA 2000), but proposed areas only range to 12 nautical miles off shore. Under the 1979 Bonn Convention

Table 3.2 Examples of important habitats, their conservation significance and international conventions.

Habitat type and conservation significance	Examples and Conventions (see key below)
Sea cliffs	
Nesting seabirds (puffins, gannets, guillemots, razorbills, shags), maritime plants, and geological exposure	Lummenfelsen, Helgoland (1), Caithness Cliffs (1,2), Foula (1), St.Abbs (1,2), Fair Isle (1), Bempton Cliffs, Ile d'Ouessant, Gullmarsfjord, Sept Iles–Cap Fréhel
Sand dunes	
Distinctive flora and invertebrate fauna, geomorphological systems	Lower Dornoch Firth including Morrich More (2), Invernaver (2), Durness (2), Barry Links (2), North Norfolk coast, Marquenterre, West coast of, Jutland, De Westhoek, Wadden Sea (1,2,3,5,6), Jærstrendene, Listastrendene
Shingle banks	
Distinctive flora and invertebrate fauna, geomorphological systems	Dungeness, Havergate Island and Orfordness, Culbin Sands (2), Spey Bay (2), Estuaires du Trieux et du Jaudy, Sillon de Talbert
Salt marshes	
Breeding waders and seabirds (shelduck, red shank, black-headed gulls), distinctive flora	North Norfolk coast, Minsmere and Walberswick, Wadden Sea (1,2,3,5,6), Het Zwin, Stigfjord, Baie du Mont Saint-Michel
Intertidal mud flats	
Major internationally important feeding areas for four million wading birds and ducks such as knot and oyster catchers, fish nursery areas, harbours, common seal haul-out sites	Firth of Forth (1), Moray Basin Firths and Bays (1,2,3), The Wash, Foulness and Maplin Sands, Chichester and Langstone Wadden Sea (1,2,3,5,6), Baie de Somme, Kurefjord, Presterødkilen (3), Ilene (3)
Subtidal sediments	
Marine grass, eel grass, maerl, rare fish, invertebrate communities	Bluemell Sound, Shetland, Tamar, Lower Humber, Oosterschelde, Aalborg Bay, Gullmarsfjord, Øra, Kosterfjorden, Wadden Sea (1,2,3,5,6)
Subtidal rocks	
Rich invertebrate communities of boreal and lusitanian origin, including sea fans, cup coral	St. Abbs (2), Cap Gris-Nez, Dover to Kingsdown Cliffs, Brittany, Kosterfjorden

(1) Wild Birds Directive 79/409/EEC
(2) Habitats Directive 92/43/EEC
(3) Ramsar Convention
(4) World Heritage Convention
(5) Bonn Convention: Agreement on the Conservation of Seals in the Wadden Sea
(6) Bonn Convention: Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas – ASCOBANS

on the Conservation of Migratory Species of Wild Animals, the African-Eurasian Waterbird Agreement for the protection of migrating water birds aims to protect the most important breeding, feeding, resting and overwintering areas in the African-European region (CWSS, 1998).

Areas that are still in a natural or near natural state require special protection. The Wadden Sea Trilateral Conservation Area is an example, and areas outside the Wadden Sea could be protected under the Ramsar Convention and relevant EC Directives to the extent that they are applicable, or under Annex V of the OSPAR Convention once it enters into force.

As a consequence of the 1988 seal virus epidemic, the Wadden Sea States gave special protection to the common seal (*Phoca vitulina*) population by implementing the 1990 Agreement on the Conservation of Seals in the Wadden Sea under the Bonn Convention. All small cetaceans are protected by the Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas (ASCOBANS) under the Bonn Convention, although Norway does not subscribe to it. Protection and conservation areas will be designated in Scotland (Moray Firth, bottle-nose dolphins (*Tursiops truncatus*)) and in the Wadden Sea (near Sylt, harbour porpoises (*Phocoena phocoena*)).

3.3.2 Archaeological conservation

Part of the floor of the North Sea is submerged land, and in centuries past quite a number of villages in the Southern Bight have been submerged by the sea. Archaeological remains and shipwrecks, although usually well preserved in anaerobic bottom sediments, are subject to disturbance and destruction by mineral

extraction, navigational dredging, pipe laying, and pollution.

Special legislation for protecting marine archaeological relics exists in most North Sea countries. The 'European Convention on the Protection of the Archaeological Heritage' regulates sites of Cultural Heritage significance, both on land and in the sea. Moreover a draft Convention on the underwater cultural heritage is under discussion within the UN.

3.4 Tourism and recreation

Tourism in North Sea coastal areas and adjacent land is an important social and economic activity *(Table 3.3)* with developments creating intense pressure on the environment. The numbers of overnight stays and the number of berths in marinas has increased over the last decade. Recreation can mean more pressure on the dynamic processes of the dunes, for example because of the construction of recreational housing, and thus cause disturbances of sea bird habitats. Another effect is littering of the beaches. In order to reduce disturbance, in some areas management policy aims to avoid the development of new marinas and to impose speed limits for boats. Zones where recreational activities (including boating) are forbidden have been established in ecologically sensitive areas.

Tourism has a seasonal pattern and the stress upon the ecosystem is consequently unevenly distributed over the year. For example, in the National Park of the Wadden Sea, 75 – 90% of all overnight stays are booked for the period April-October. In some areas the number of overnight stays per year amounts to more than 20 million, for example in the North Sea area of Denmark 25 million overnight stays were counted in 1996 *(Table 3.3)*, which may be compared with the 2.2 million Danes living in this area.

Table 3.3 Estimates of visitor numbers for the North Sea coast.

Country	One day visitors (10^6/yr)	Overnight stays (10^6/yr)
Belgium (1996)	20	13
Denmark (1996)	No information	25
France	No information	No information
Germany (1996)	No information	21 *
Netherlands (1996)	8.9	13.5
Norway	No information	No information
Sweden (1997)	1.5	19.3
United Kingdom	No information	24

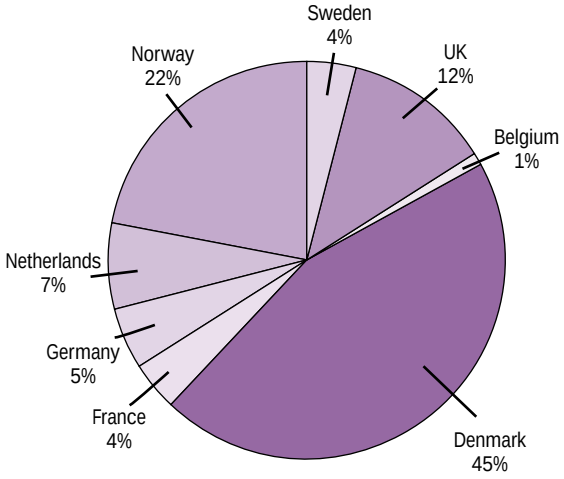
* Listed only lodgings with more than nine beds; camping places and private apartments are not included.

3.5 Fishing

3.5.1 Fish

The North Sea is one of the world's most important fishing grounds. Fishing activities vary in importance in the countries bordering the North Sea *(Figure 3.2)*. Denmark (45%) and Norway (22%) have by far the largest landings of fish and shellfish (5NSC, 1997). The combined landings of different species in 1995 amounted to 3.47 x 10^6 t *(Figure 3.3)*, 1.1 x 10^6 t more than reported for 1990.

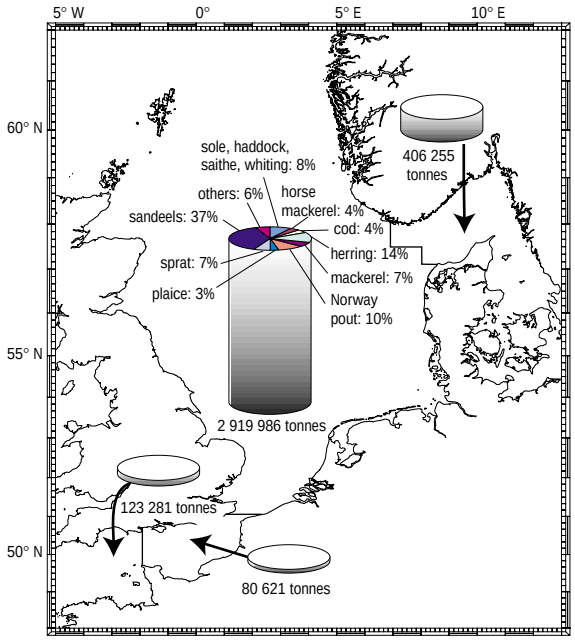
Figure 3.2 **Landings of fish and shellfish from the North Sea, Kattegat, Skagerrak and the Channel by North Sea states in 1995 (% by weight of total). Source: redrawn from 5NSC (1997).**



The species caught for human consumption can be divided into pelagic species that live mostly off the bottom, such as herring (*Clupea harengus*), mackerel (*Scomber scombrus*), horse mackerel (*Trachurus trachurus*), and demersal species living on or close to the bottom, e.g. cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), saithe (*Pollachius virens*), plaice (*Pleuronectes platessa*) and sole (*Solea solea*). Landings from industrial fisheries, which account for about 55% of the total landing weight in the North Sea *(Figure 3.4)*, mainly consist of sand eels (*Ammodytes* spp.), Norway pout (*Trisopterus esmarki*) and sprat (*Sprattus sprattus*) (5NSC, 1997). Landings of four important fish species compared to their pertinent 'total allowable catches' (TAC) for the last 14 years are shown in *Figure 3.5*.

The gear types used in the North Sea fisheries are demersal active gear (otter and beam trawl, demersal seines), pelagic active gear (purse seines, pelagic trawl), and passive gear (nets, traps, lines). The capacity of

Figure 3.3 **Fish landings from the North Sea in 1995. Source: 5NSC (1997).**



demersal and pelagic fleets in the North Sea increased rapidly after the Second World War and larger ships with more powerful engines came into operation. The total increase in capacity of the fishing fleet occurred mainly in three categories: purse seiners exploiting herring and mackerel; bottom trawlers targeting small demersal and pelagic species, notably sand eel, Norway pout and sprat for fish meal and the fish oil industry; beam trawlers targeting flatfish and roundfish.

There is a general overcapacity in some segments of the fleets fishing in the North Sea. Fishing effort in the entire North Sea rose between 1983 and 1995, attributable largely to increased beam trawl effort in the southern and central North Sea *(Figure 3.6)*. The total fishing effort in 1995 was approximately 2.25 million hours (*Figure 3.7,* Jennings *et al.*, 1999).

There has been a change in the condition of some of the important North Sea stocks over recent years. The herring fishery was closed in the 1970s as the stock was near to collapse at 50 000 t. The stock rebuilt to more than 1 x 10^6 t in 1988. However, fishing mortality was too high and the stock declined rapidly to less than 0.5 x 10^6 t in 1996. Therefore, the TAC was halved in the middle of that year and measures were introduced to restrict the impact of the industrial fisheries (see section 3.5.4). Fishing rates have been maintained at a low level and the stock has increased above 1 x 10^6 t and is expected to exceed 1.5 x 10^6 t in 1999.

The mature stock size of cod was at the lowest level this century in 1993. Since then, it has experienced the highest level of recruitment (young fish) for a decade and the level of fishing mortality has reduced to the lowest level for 30 years. As a consequence, cod is now approaching a safe level of 150 000 t.

Flatfish stocks have declined over the past decade. Plaice levels are low as the high recruitment levels of the 1980s have disappeared and as fishing mortality has steadily increased. Recently, a small increase in stock size has been observed. Fishing mortality has also increased for sole, but several good years of recruitment have steadied the underlying decline (ICES, 1999a).

In addition to direct effects of fishing on target species, there are a number of indirect effects. Lost fishing gear will decay very slowly since it is usually manufactured from

Figure 3.4 **Landings of fish from industrial, demersal and pelagic fisheries and total fish landings from the North Sea from 1903 to 1995. Source: 5NSC (1997).**

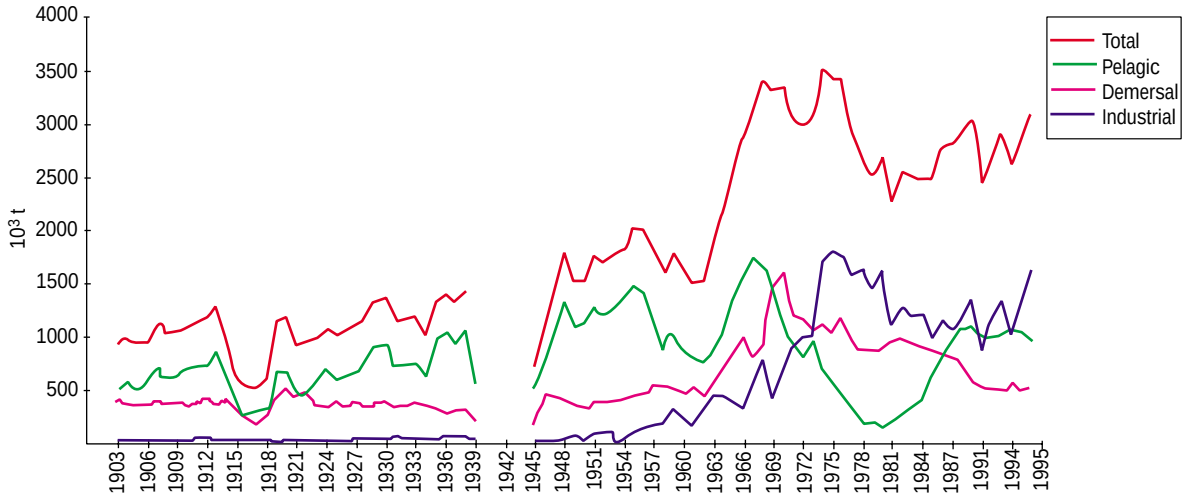
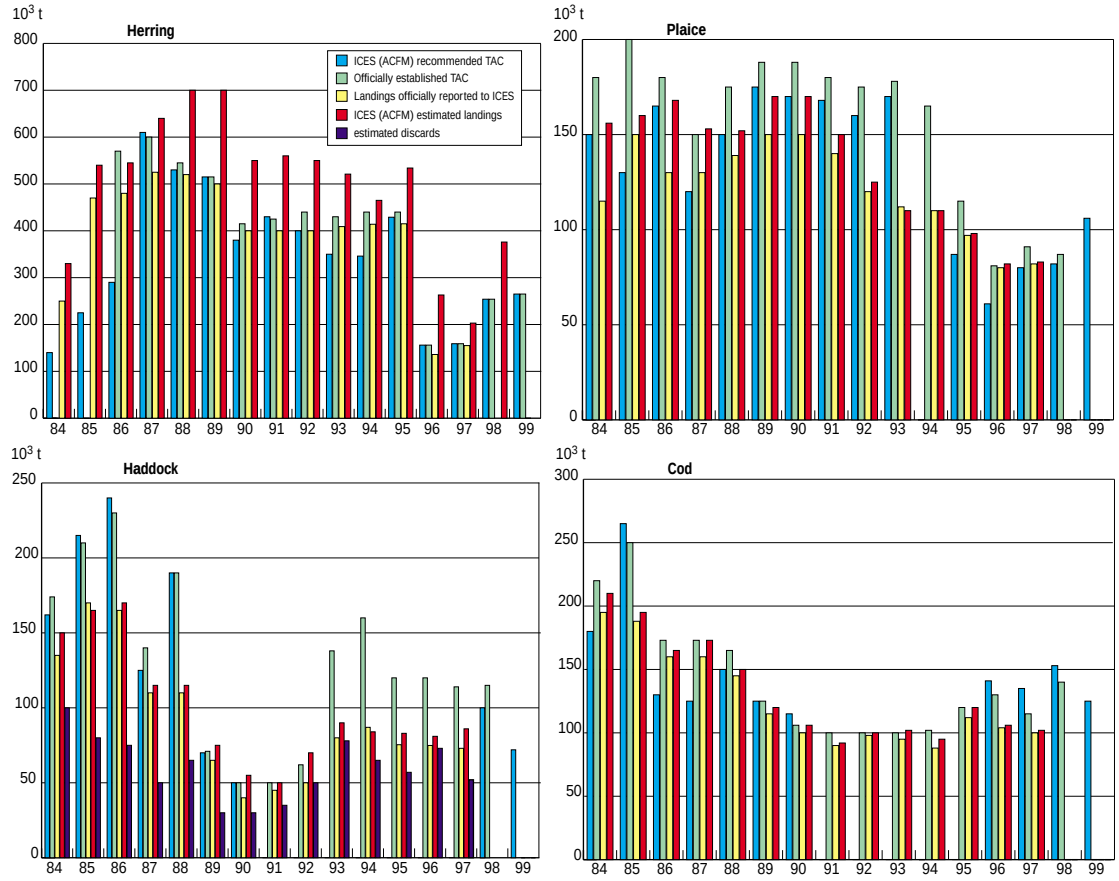
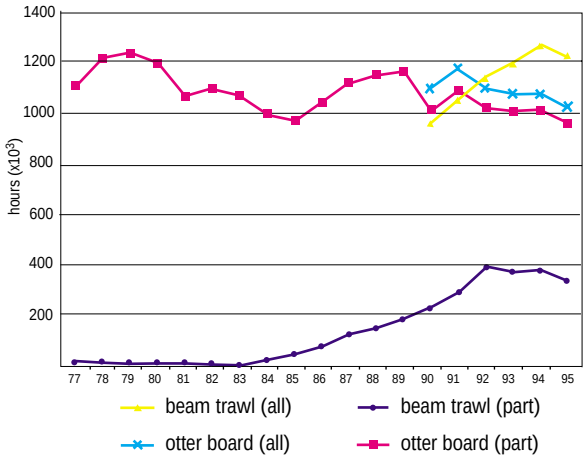


Figure 3.5 **Landings of herring, plaice, haddock and cod 1984–98. Source of data: updated from 4NSC (1995) with data provided by ICES.**



All data refer to landings from fish caught in the North Sea – ICES Division IV (see Figure 5.10)

Figure 3.6 **International fishing effort from 1977 to 1995 for different bottom trawling fishing gear. Source: redrawn from Jennings *et al*. (1999).**



non-biodegradable synthetic material, and organisms may become entangled incidentally (ghost fishing).

Otter trawl boards penetrate 6 – 20 cm into soft seabed sediments and beam trawl tickler chains plough to a depth of 4 – 8 cm. Data from the Dutch beam trawl fleet, which represents approximately 80% of the total beam trawl effort in the North Sea, indicates that about 171 000 km^2 of the North Sea between the Shetland Islands and the Hardangerfjord, and the Strait of Dover (i.e. approximately 429 000 km^2) is fished by trawlers (Rijnsdorp *et al.*, 1997). Within the fished area, 70% is trawled less than once a year and, in total, about 10 % of the North Sea region specified above is fished more than once per year.

The scale of bycatches and other forms of impact varies between the different fisheries *(Table 5.5)*. About 260 000 t/yr of fish are estimated to be discarded in the beam trawl fishery. The estimates for the roundfish fishery are up to 270 000 t/yr for commercial species and 20 000 t/yr for non-commercial species (ICES, 1994). Industrial fisheries using small-mesh trawls account for

more than half of the total landings. Probably the most serious threat to the harbour porpoise population is the yearly by-catch of 7 000 individuals in the bottom-set gillnet fishery.

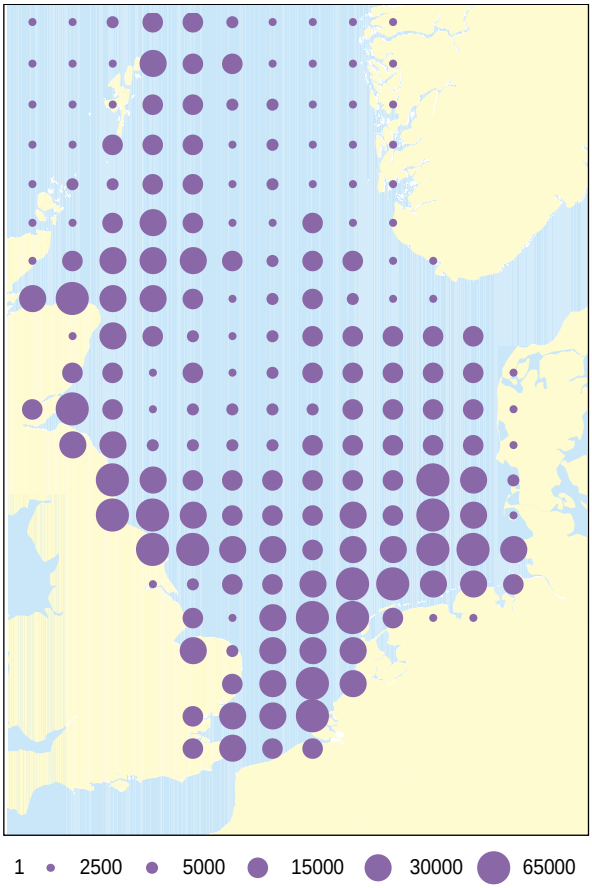
3.5.2 Shellfish

The main harvesting methods employed in directed shell-fisheries are dredges, trawls and pots.

Crustacea

The major commercial crustacean in the North Sea is the Norway lobster (*Nephrops norvegicus*) with landings between 12 000 and 20 000 t/yr. Other commercial crustacean species in the North Sea include the northern prawn (*Pandalus borealis*) with landings of about 20 000 t/yr from the Skagerrak/Norwegian Deeps, the Fladen Ground and the Farn Deep, the brown shrimp (*Crangon crangon*) with an average landing around 25 000 t, the edible crab (*Cancer pagurus*), the spider crab (*Maja squinado*) and lobster (*Homarus gammarus*). Crab, lobster and shrimp fishing activities are concentrated in the coastal zones and estuaries (IMM, 1997). The brown shrimp is caught mainly in the coastal zones in and around the Wadden Sea, along the coasts from Denmark to Belgium. Dutch landings of adult shrimp have been increasing since the mid 1970s, while German landings have largely fluctuated around a long-term average of about 10 000 t. Belgian and French landings have fluctuated too, albeit with a general downward trend, whilst Danish and UK landings have fluctuated without a clear trend.

Figure 3.7 **Spatial distribution of mean fishing effort (1990–95) for bottom trawling (in average hours of fishing per year and per square of 1 degree longitude x 0.5 degree latitude). Source: redrawn from Jennings *et al*. (1999).**



Molluscs

Fishing activities for common or blue mussel (*Mytilus edulis*), cockle (*Cerastoderma edule*), clam species (*Spisula solida, S. subtruncata*), common whelk (*Buccinum undatum*) and winkle (*Littorina littorea*) are concentrated in the coastal zones and estuaries along the entire east coast of England, the French Channel coast and the Wadden Sea *(Figure 3.8)*. Denmark, France and The Netherlands have the greatest total landings.

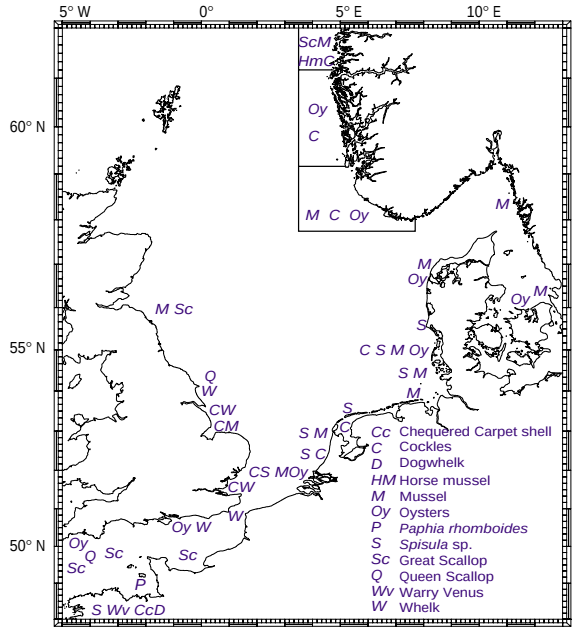
The most important mollusc species is the common mussel. Catch statistics for mussels and oysters do not distinguish between landings from cultured or wild stocks. Almost half of Denmark's total catch is from wild stocks. In Germany and The Netherlands the whole catch of mussels is obtained through cultivation. The landings of this species are listed under mariculture in section 3.6.

Mollusc seed fisheries, for redistribution of small mussels to more favourable plots, are a source for bivalve culture systems and can be complementary to natural spat falls which can sometimes fail. In the Wash, the mussel fishery collapsed at the end of the 1980s, when a period of intense exploitation was succeeded by a run of eight years without significant spat fall.

The cockle constitutes the second main catch of all mollusc species, especially in The Netherlands and in the United Kingdom. There are large fluctuations in cockle landings *(Figure 3.9)* due to natural cycles, including harsh winters. Landings of cockles in the Dutch Wadden Sea Conservation Area produced an average of 2 630 t/yr of meat between 1992 and 1996. Cockle fisheries are restricted or temporarily closed (e.g. in 1996) if stocks are low, and 26% of the intertidal area of The Netherlands is permanently closed for that reason and the number of licenses will not be increased. Cockle fisheries are not regulated outside the 12 mile zone.

In the Thames estuary cockle fishing has increased markedly since 1990, and landings have risen to between 10 000 and 25 000 t/yr, making it the largest cockle fishery

Figure 3.8 **Main mollusc fishing areas in the Greater North Sea. Source: redrawn from OSPAR 1998a.**



in Britain. In the Wash landings between 1970 and 1993 ranged from 1 000 – 10 000 t/yr, but since then they have declined due to a run of poor recruitment. In 1996–7 stocks were low and landings were restricted by seasonal and bed closures, but a modest recovery in stocks began in 1998–9. In Denmark and Germany cockle fishing is negligible.

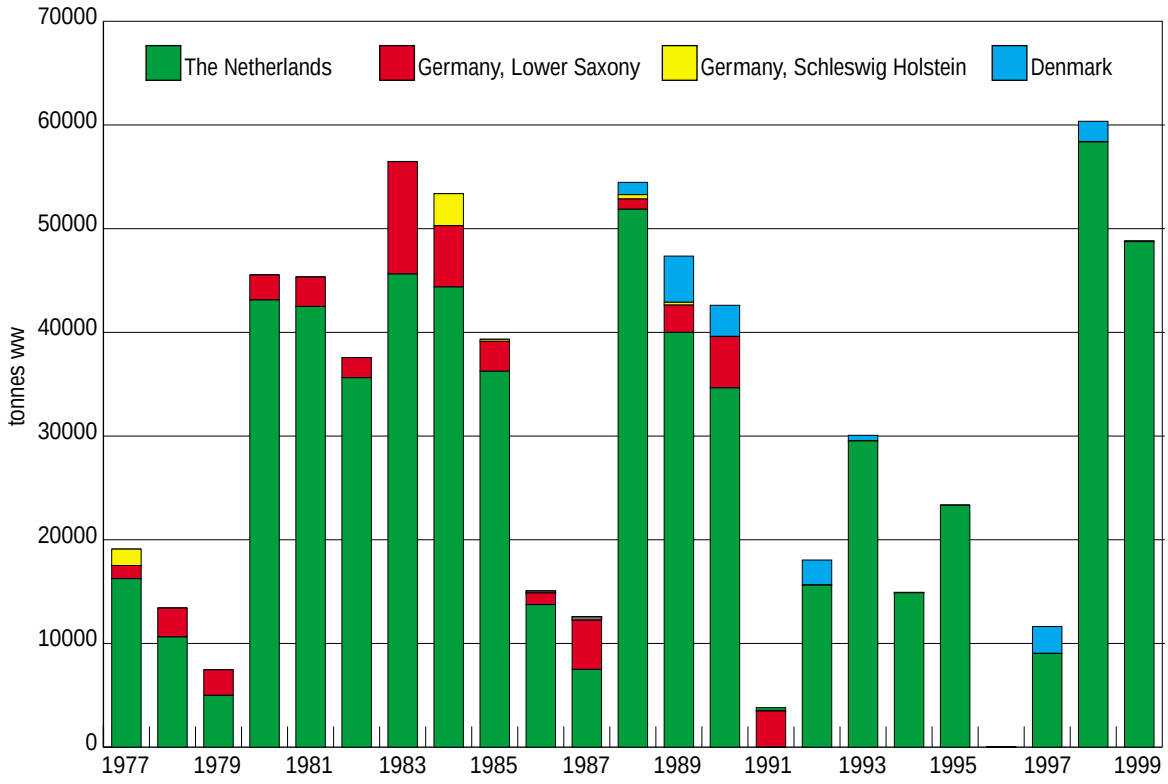
The fisheries for *Spisula* sp. started in the 1990s in Denmark and The Netherlands and have increased. Extremely low temperatures in the winter of 1995/96 led to mass mortality of *Spisula solida*. and it is not currently possible to fish for *Spisula* sp. in the area north of the Wadden Sea Islands (5NSC, 1997).

Scallops, mainly the great scallop (*Pecten maximus*), have been fished around Shetland and Orkney and in the Moray Firth with landings ranging up to a maximum of 4 527 t in 1996. Landings from the east of Scotland reached 1 900 t in 1995 before falling sharply to 678 t in 1996. In Norway, landings of scallops reached about 7 700 t (1994–5). Scallops are also fished in the Baie de Saint-Brieuc as well in the Channel where landings are rapidly increasing.

3.5.3 Seaweeds

Seaweeds, and in particular large brown algae such as the knotted wrack (*Ascophyllum nodosum*) and kelp

Figure 3.9 **Total landings of cockles (tonnes wet weight) in all regions of the Wadden Sea from 1977 to 1997. Source: De Jong *et al*. (1999).**



(*Laminaria hyperborea, L. digitata*), are occasionally harvested for alginate production, fertilisation and pharmaceutical use along some parts of the United Kingdom coast, along the French coast of the Channel and along the Norwegian west coast. The total amount of *L. hyperborea* harvested in the Norwegian part of the North Sea was on average 77 000 t/yr from 1995–7. In France in 1996, 57 000 t of kelp and 15 000 t of wrack (*Fucus* sp.) were harvested.

3.5.4 Fisheries management

Management of North Sea fisheries is regulated within the waters of EU Member States by the EU Common Fisheries Policy, and within Norwegian waters by national policy.

The most obvious tool in fisheries management is the TAC. International TACs, and national allocations within the TACs are agreed annually for the main fin-fish stocks of commercial importance but also for Norway lobster and prawn. TACs are agreed by the EU and Norway on recommendation by ICES. Other measures include, for example, the control of mesh size and net geometry, regulation of the minimum landing size and the by-catch limit and closures by season and area. Enforcement is undertaken nationally through the use of, for example, vessel lists and licences, log-book regulations and satellite monitoring. The EU Multi-annual Guidance Programme (MAGP) regulates the size of EU fleets.

Since 1998, advice, provided by the ICES Advisory Committee on Fishery Management (ACFM) and the EU Scientific, Technical & Economic Committee on Fisheries, strives towards consistency with a precautionary approach to fisheries management. In particular, ACFM has identified limit reference levels for mature stock biomass and fishing mortality and suggested precautionary reference levels. The methods are constantly being revised and improved in the internationally appointed working groups.

Data quality remains a concern. The accuracy of the annual TACs depends on the estimate of stock abundance. This is dependant on the availability of good quality catch data and information on stock abundance from surveys. Black fish or illegal landings can therefore undermine the system of management by TACs. Discards (see below) which are not monitored on an annual basis by most countries also affect the accuracy of stock assessments and TACs.

Discarding is the practice of throwing fish (and other marine organisms) back into the sea. In EU waters undersized fish, or fish over quota, have to be discarded. In contrast, in Norwegian waters no discarding of main commercial species is permitted. Most discarded fish die. Discarding of young flatfish is high on inshore nursery grounds, mixed roundfish discards are also high. Levels of discarding vary, however, by species, areas, fleets and seasons (Cotter *et al.*, 1999). ICES summarised 1998 statistics on discards in the North Sea (ICES, 1999b, see also chapter 5).

Specific measures recently introduced include:

- a revised regulation for the conservation of fishery resources through technical measures for the protection of juvenile marine organisms;
- an amendment to the control regulation requiring larger vessels to carry satellite monitoring equipment;
- new North Sea TACs for sandeels, anglerfish (*Lophius piscatorius*), megrim (*Lepidorhombus whiffiagonis*), dab (*Limanda limanda*) and flounder (*Platichthys flesus*), lemon sole (*Microstomus kitt*) and witch (*Glyptocephalus cynoglossus*), skates and rays (e.g. *Raja* sp., D*asyatis* sp.), turbot (*Psetta maxima*) and brill (*Scophthalmus rhombus*);
- the reduction of over-capacity of the EU fishing fleet by the ‘Multi-Annual Guidance Programme’ (MAGP).

The MAGP III (1992–6) aimed to reduce the capacity of fishing fleets by reducing tonnage and engine power. The level of reduction was dependant on the species caught and varied from no change up to a maximum of 20% in terms of 1991 fleet capacity.

In the ‘Annual Report to the Council and to the European Parliament on the results of the multi-annual guidance programmes for the fishing fleets at the end of 1997’, the European Commission noted that the implementation of the MAGP III had been successful in restructuring the European fleet. Between 1991 and 1996 the EU fleet tonnage and engine power was reduced by more than 10%. But it is noted that the degree to which programmes have been respected varies significantly between Member States. Two countries had failed to meet the objectives of MAGP III by the end of 1997, The Netherlands and, to a lesser degree, France. Other countries achieved greater reductions than MAGP III had required. The Danish and German fleets are now more than 20% below their target tonnage.

Although fleets have been reduced, the criticism from IMM 1997 was that ‘the reduction has been compensated for by an increase in efficiency, with the result that no reduction in fishing pressure has been achieved’. This may have happened through an increase of fishing days.

On account of this, the European Commission adopted MAGP IV for the period 1997 – 2001, with the aim of reducing fishing effort by 30% on stocks considered at risk of depletion and by 20% on over-fished stocks.

In 1998, Norway introduced a decommissioning scheme for coastal fishing vessels, similar to that for purse seiners in 1996. Regulations were aimed at prohibiting access of new trawlers to the shrimp fisheries.

Various national conservation measures have also been introduced. The UK introduced nursery areas for sea bass (*Dicentrarchus labrax*), designated ports of landing

and restrictions to prevent fish from being discarded after they had been entered in a ship's log-book and placed in the hold. Improvements have also been made to the selectivity of *Nephrops* twin-rig trawls and in net geometry more generally. In Norwegian waters no discarding is permitted. Germany introduced a temporary closed area in 1996 to protect juvenile cod in the German Bight. A Danish action plan for reducing incidental by-catches of harbour porpoises includes measures such as the use of acoustic alarms, modifications to fishing equipment and regulation of certain types of fisheries.

Within EC legislation areas have been defined with limited fishing activities for the protection of juvenile fish, e.g. the plaice box in the south-eastern North Sea, and a box for Norway pout in the central North Sea.

Legislation related to shellfish fisheries has to ensure the proper management both of the sector and the ecosystem. However, many shellfish stocks e.g. *Spisula* sp., are localised and are therefore managed at national rather than EU level. Legislation for shellfisheries comprises TACs for Norway lobster and for northern prawn from the Skagerrak/Norwegian Deeps. Regulation EC/850/98 (EC, 1998), which came into force on 1 January 2000, specifies minimum sizes, mesh size bands and other gear restrictions. Minimum sizes are defined for Norway lobster, edible crab, velvet crab (*Liocarcinus puber*), crawfish (*Palinurus* spp.), whelk, and scallop. Other regulations may apply to the modernisation of fishery techniques, a reduction of fishing effort (either by absolute, or by selected restrictions for certain areas or periods), a minimum landing size, or a combination of all these.

3.6 Mariculture

Mariculture is undertaken in many of the North Sea states, but on a negligible scale in Belgium and Sweden. The Netherlands and Germany practise commercial shellfish farming only in the marine area. Mariculture may introduce to the environment nutrients (only 25% of the nutrients found in fish feed are converted into biomass (UBA, 1996)), organic matter, antifouling agents, biocides, antibiotics and other pharmaceuticals and colouring agents. Farmed individuals may escape, resulting in potential threats to native species.

3.6.1 Fish

Salmon (*Salmo salar*) is the main product of Norwegian and Scottish mariculture *(Table 3.4)*. In Norway, between 1995 and 1996, the production of salmon increased by 32% to 120 000 t. In Orkney and Shetland in 1997 salmon production was 27 700 t, five times higher than in 1991.

The second main product in mariculture is the rainbow trout (*Onchorhynchus mykiss*). In Norway, the production of rainbow trout decreased by 28% in 1995. In Denmark, 10 land-based facilities for trout production are situated within in the North Sea catchment area. In Scotland in 1996 only 647 t was produced at six seawater sites, representing 14% of total Scottish rainbow trout production.

Other less important species cultivated in Norway are halibut (*Hippoglossus hippoglossus*), arctic char (*Salvelinus alpinus*), cod, turbot and eel (*Anguilla anguilla*). Sea trout (*Salmo trutta*), cod, halibut and turbot, sea bass and eels are being considered for production in the UK.

3.6.2 Shellfish

Farming of mollusc species includes blue mussels, oysters (*Ostrea edulis, Crassostrea gigas*) and scallops *(Figure 3.8; Table 3.4)* (OSPAR, 1998a).

Blue mussels are cultured in Denmark in the North Sea and in the Limfjord, in the Dutch and German Wadden Sea, in the Eastern Scheldt, along the coast of Brittany, in Norway, Sweden and the UK. Orkney and Shetland produce small but increasing quantities of mussels (107 t in 1997).

Oysters are cultured in the south-west of The Netherlands, in Norway, along the coasts of Normandy and Brittany, in Germany, on a small scale in Orkney and Shetland and in several estuaries on the south-east coast

Table 3.4 Mariculture production.

	Rainbow trout (t)	Salmon (t)	Blue mussel (t)	Oysters piece (p) or tonnes (t)	Scallops piece (p)	Clams (t)
Denmark (1996)	667	–	59 602	–	–	–
France	589	650	41 000	48 000 t	–	–
Germany (1996)	–	–	38 028	75 t	–	–
Netherlands	–	–	95 000	17 000 000 p	–	–
Norway (1996)*	12 000	120 000	180	530 000 p	90 000	–
United Kingdom (1996)	11 400	27 700	7 700	14 000 000 p	3 000	12
Sweden (1996)	< 100	–	1 800	–	–	–

* Preliminary data from 1996 published by Directorate of Fisheries 1997

of England.

Research has shown that it is technically feasible to rear native lobsters. In the UK, attempts are now being made to produce young lobsters for release into the sea, for restocking purposes.

To avoid the introduction of non-native species into Dutch coastal waters a new policy on the importation of shellfish and crustaceans was developed in 1996. By the year 2001 the introduction of native species from populations outside the North Sea area (boreal) into Dutch coastal waters will no longer be allowed.

3.7 Coastal engineering and land reclamation

Damming of rivers, for hydroelectric power generation for example, can cause drastic changes to the seasonal outflow of fresh water, with negative impacts on the productivity of coastal waters. Coastal land reclamation and dykeing change the physical environment which may affect spawning areas, biological diversity and wildlife.

3.7.1 Coastal defence

Coastal defence work and land reclamation is a common activity in the Greater North Sea, particularly around its shallow southern and eastern margins. Settlements along the Wadden Sea coast and on islands are especially vulnerable to storm surges and sea level changes. In view of a predicted sea level rise due to climatic change, countries revise their plans for coastal protection on a regular basis, for instance Germany does so every 10 – 15 years.

On sandy coasts, natural dunes play a major role in coastal protection. In several cases, dunes are protected against erosion by hard structures. However, this may lead to destruction of the natural beach through increased sediment deposition at some locations and enhanced erosion elsewhere. The present tendency is to use soft engineering approaches, such as artificial beach replenishment.

In 1996, The Netherlands processed 7.7 x 10^6 m^3 of sand for beach nourishment. With a predicted sea level rise of 60 cm in one century along the Dutch coast it is estimated that twice the present quantity of sand will be needed. In Germany, beach replenishment is carried out on the island of Sylt (1996: 1.03 x 10^6 m^3, 1997: 0.7 x 10^6 m^3 and 1998: 0.07 x 10^6 m^3) and at the islands of Langeoog, Norderney and Borkum. The major Danish beach nourishment activity is on a 110 km stretch along the west coast of Jutland (1996: 3.3 x 10^6 m^3). In the UK, on the Lincolnshire coast, beaches are recharged with sand.

Within the UK, future policies on risks of coastal flooding and erosion have been drafted in Norfolk County Council's *'Norfolk to 2006'*. Coastal protection schemes have been designed to include allowances for relative sea level rise up to 2030. These allowances, which also take account of long term geological tilt, vary between 4 mm and 6 mm/yr, depending on the location. An alternative option for the protection of beaches is to deploy (permanently submerged) offshore breakwaters parallel to the coast, as it is envisaged for example in Koksijde (Belgium).

3.7.2 Land reclamation

Most land reclamation projects have been carried out over previous centuries, and major activities have been conducted along the Dutch and German coasts (e.g. in the Wadden Sea and Rotterdam port area). Plans on the further expansion of the port of Rotterdam area through land reclamation are at an advanced state of development.

3.7.3 Power generation

Generation of electricity from tidal energy requires a minimum tidal amplitude of about 3 m. Due to the relatively low tidal excursion in the North Sea *(Figure 2.19)* opportunities for tidal power generation are very limited. The only tidal power station in the region has been operational since 1967 on the Rance estuary, near St Malo in Brittany, generating 240 MW (nominal).

At present, no power is generated from wave energy in the North Sea.

As wind is a cheap source of renewable energy there are intensive efforts to find convenient sites with sufficient wind energy and low population. The economic generation of electricity from wind, requires an average wind speed (at 10 m) greater than 5 – 6 m/s. The problems associated with wind power generators include the need for space, the unsightliness of the turbines, the direct mortality of birds caused by rotating blades and the noise impact especially on birds. The construction of wind turbines in the Wadden Sea Conservation Area is prohibited by national legislation, and is only permitted outside the Conservation Area if ecological and landscape characteristics are not negatively affected.

Plans are being developed for wind parks off shore. Legislation for offshore wind parks is under development in Belgium. In Denmark, current plans for offshore wind power generation in Region II include two large scale parks, one situated off the Danish west coast and one off the island of Laesø in the Kattegat. In The Netherlands, a plan for an off shore wind park, with 100 wind turbines generating 100 MW, is under discussion. Offshore wind power generation is also being seriously considered at a number of locations off the English coast.

3.8 Sand and gravel extraction

The marine aggregate extraction industry is well established and growing in a number of countries in Region II, providing up to 15% of some nation's demands for sand and gravel (ICES, 1992). Most commercially workable deposits of sand and gravel occur in the shallower regions of the North Sea. In 1996, about 40 x 10^6 m^3 were extracted from the sea *(Table 3.5)*, compared to 34 x 10^6 m^3 in 1989. The exploitation of sand and gravel often has negative impacts on fishing interests, the benthic flora and fauna, coastal protection and on the physical properties of the seabed. The exploitation of shallow banks close to the shore increases the potential for coastal erosion by enhancing wave activity and, therefore, careful assessment of the potential impact is needed. Most countries report increasing concerns about the extraction of aggregates (ICES, 1997). The ICES Code of Practice for the Commercial Extraction of Marine Sediments provides step-by-step advice on how marine dredging should be conducted in order to minimise conflicts with other users of the sea and to optimise the use of marine resources.

Exploitation of calcium carbonate shell aggregate is licensed in the Dutch part of the Wadden Sea and in areas outside the tidal inlets, with annual extractions of 140 000 m^3 in the Wadden Sea and 60 000 m^3 in the areas outside the tidal inlets (ICES, 1997). In 1996, off the French coast, 562 000 t of calcareous material (shelly sands and *Lithothamnion* banks) were extracted. In 1996, deposits of calcareous algae (maerl) were exploited in the Orkneys (4 000 m^3/yr licensed).

Table 3.5 Quantities of sand and gravel (m^3) taken from marine sources in 1996 and average for 1992–7. Source of data: ICES (1997), OSPAR (1998b).

Country	1996	Average per year (1992–7)
Belgium	1 444 629	1 833 333
Denmark	3 700 000	5 083 333
France *	590 000	2 200 000
Germany	1 100 000	
Netherlands	23 200 000	17 366 666
Norway **	86 111	118 333
Sweden #	0	5 917
United Kingdom **	9 500 000	13 600 000
TOTAL	39 620 740	

1996 data from ICES (1997).

* Data from France.

** m^3 estimated from tonnes.

\# Since 1992 no sand and gravel extraction occurs in the Swedish part of the Kattegat and Skagerrak area due to environmental reasons.

3.9 Dredging, dumping and discharges

Dumping of waste or other matter is prohibited by the OSPAR Convention, with the exception of dredged material, waste from fish processing, inert material of natural origin and, until the end of 2004, vessels or aircraft. The annual OSPAR Reports on Dumping of Wastes at Sea present an overview of the number of permits issued for most of the dredged materials concerned.

A wider range of material, including sewage sludge and industrial waste has been disposed of in the past. The dumping of industrial wastes was phased out in 1993 when the last few UK licences for disposal at sea of liquid industrial waste and fly ash expired. Incineration of liquid industrial waste on special incinerator vessels in the North Sea was terminated in 1989. The dumping of waste from the production of titanium dioxide was terminated in 1989. Discharges from the titanium dioxide industry are permitted under Council Directive 92/112/EEC (EC, 1992) and are mainly confined to French and UK estuarine waters (Seine, Humber and Tees).

3.9.1 Dredged material

Dredged material dumped at sea consists primarily of material removed to keep navigation channels clear or removed in the course of coastal construction engineering projects. Dredged material may be used e.g. for beach nourishment, land reclamation or for salt marsh preservation.

A total of 88 x 10^6 t (dw; from internal and external waters) were dumped in the Greater North Sea in 1996 *(Figure 3.10, Table 3.6)*. In comparison with previous years, no trend is observed. The need for maintenance dredging is determined by natural variation in transport and sedimentation of fluvial and marine sediments, and is not expected to increase in the long term. Changes are anticipated in the shipping fleet with the use of larger draught ships, which will mean a significant increase in the amount of capital dredging (in the short term) for some ports. This creates a problem of volume rather than of contamination (deeper layers of sediment are usually from pre-industrial times).

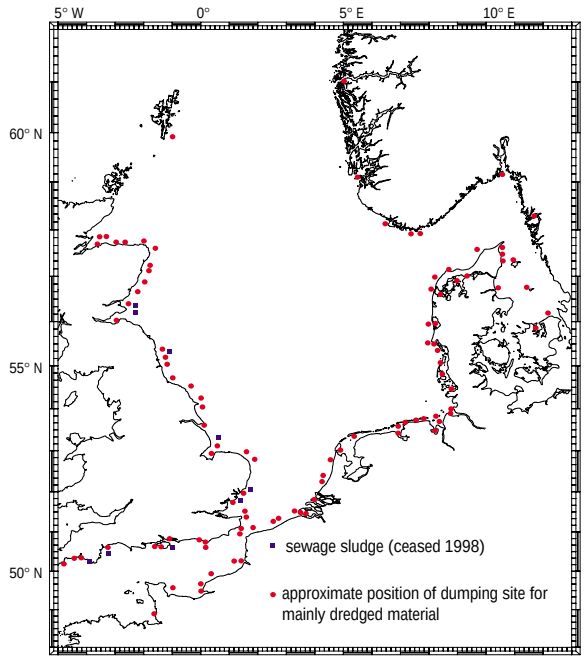
3.9.2 Sewage sludge

The dumping of sewage sludge has been banned under the OSPAR Convention since 1 January 1999. Only two countries dumped sewage sludge in the North Sea, and Germany ceased this practice in 1981 and the UK in 1998. Quantities dumped by the UK in 1996 amounted to about 5.9 x 10^6 t ww (or 142 000 t dw).

3.9.3 Inert materials of natural origin

In 1994, although no inert material was dumped at sea,

Figure 3.10 **Dumping areas in the Greater North Sea in 1996 (1994 for France). Source of data: OSPAR (1997a and 1999a).**



300 000 t were deposited from land onto the foreshore: 230 000 t by Norway and 70 000 t by the UK. Overall the disposal of such material has decreased considerably, as the amount for 1994 was less than 10% of that for 1990.

3.9.4 Ships and bulky wastes (iron scrap)

In 1996, Norway dumped 6 vessels in the North Sea, mainly wooden fishing vessels, but also some iron vessels. Chemicals and loose parts were removed before dumping. Dumping of iron/steel hulled vessels is now forbidden, and dumping of all other ships will be forbidden after 2004.

Table 3.6 Dredged material (in tonnes dry weight) dumped in 1996. Source: OSPAR (1999a) and national data(*).

Country	
Belgium	29 264 498
Denmark *	1 536 000
France *	13 360 000
Germany	19 123 000
Netherlands	8 016 381
Norway	42 196
Sweden	3 308 608
United Kingdom	14 130 219
(United Kingdom dumped sewage sludge)	(142 045)
Total dredged material dumped	88 780 902

In consideration of an initiative of the 4th International Conference on the Protection of the North Sea (4NSC, 1995), the 1998 Ministerial Meeting of the OSPAR Commission adopted Decision 98/3 on the Disposal of Disused Offshore Installations which prohibits dumping or leaving wholly or partly in place within the marine area, disused offshore installations. Subject to assessment and consultation under agreed procedures, derogations are possible for the footings of steel installations weighing more than 10 000 t and for concrete installations.

3.9.5 Discharges from offshore installations

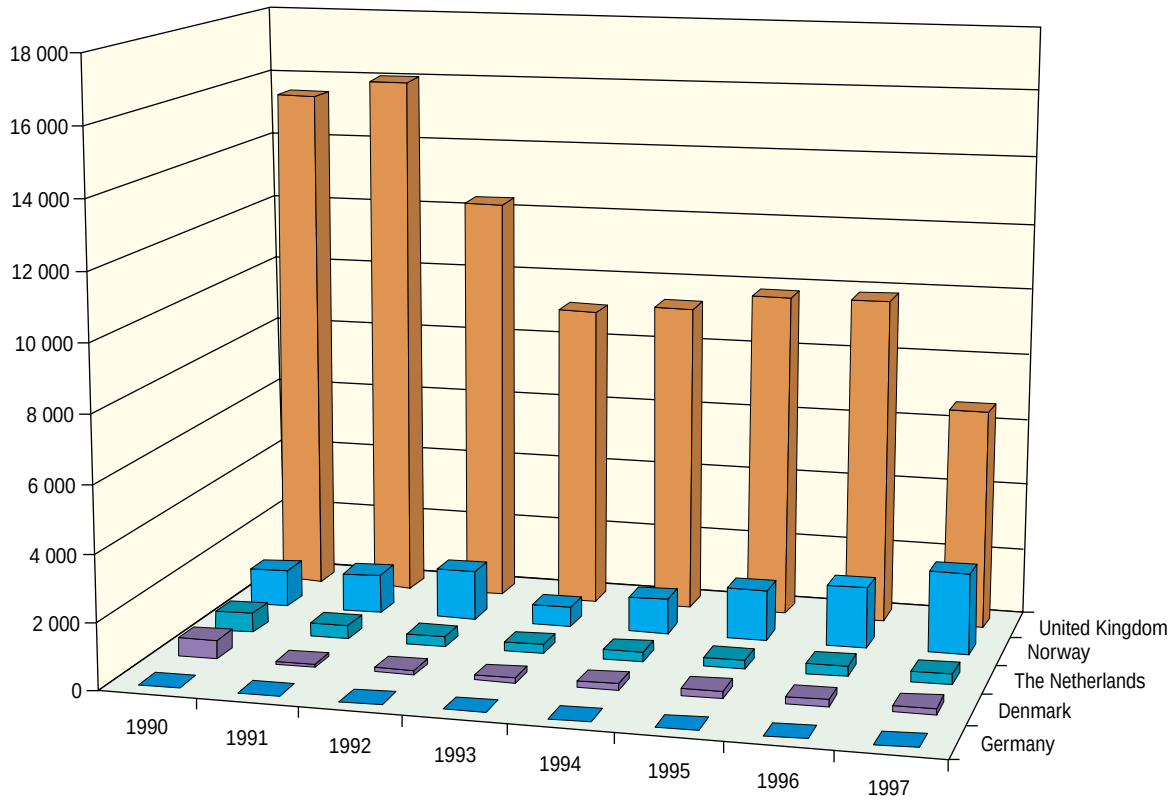
Offshore oil and gas installations are significant sources of hydrocarbons. Variations in annual discharges of oil from offshore installations in the OSPAR Convention area are shown in *Figure 3.11* (not taking into account synthetic muds which fall into a different category and, for those which degrade poorly, should be phased out by the end of 2000).

Heavy metals, PAHs and production chemicals are discharged via produced water *(Table 4.17)* which is only treated to remove oil. These inputs have increased substantially (OSPAR, 1999) which is attributed to the increasing age of the fields. The amount of discharged produced water can be reduced by methods such as re-injection into the reservoir or by downhole separation, which is largely experimental at present. Operational discharges, comprising produced water and cuttings are discussed in Chapter 4, as are any chemicals associated with those discharges. All waste from offshore installations is returned to land.

OSPAR adopted on a trial basis Decision 96/3 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals. It aims to reduce the impact from hazardous chemicals used by the offshore industry. Lists of compounds that may or may not be used are compiled on the basis of (ecotoxicological) risk assessment models including, for example, the 'Chemical Hazard Assessment and Risk Management Model' (CHARM). Another decision (1997) provides a list of substances or preparations (composed of two or more substances) which shall be subject to strong regulatory control. So far no substances have been identified which must not be discharged.

When drilling bore holes during the exploration phase, use was often made of oil- and water-based muds. Contaminated cuttings were regularly discharged overboard. At the 4th NSC, ministers invited OSPAR to ban discharges of oil contaminated cuttings by 1997. In exceptional cases the discharge of oil contaminated cuttings could be allowed only when essential for safety or geological reasons, and if consistent with PARCOM Decision 92/2.

Figure 3.11 **Total discharges of oil (in tonnes) from offshore installations to the OSPAR Convention area. Source: OSPAR (1999b).**



3.9.6 Litter

Despite pertinent laws and regulations, litter is still a considerable problem for the marine environment and the coastal communities in Region II. Potential sources of litter are mainly related to waste generated by shipping (fishing, commercial) on the North Sea and touristic and recreational activities *(Table 3.7)*. The offshore industry is not considered to be a source of waste pollution at sea thanks to improvements in its waste management practice. Some waste may be depositied illegally and some by accident. Litter may also be transported into the sea by winds, currents and rivers. It has been estimated that the North Sea has to cope with about 70 000 m^3 of litter per year, and some 6.6 million pieces (or 8 600 t) were estimated to be present in the Dutch sector alone.

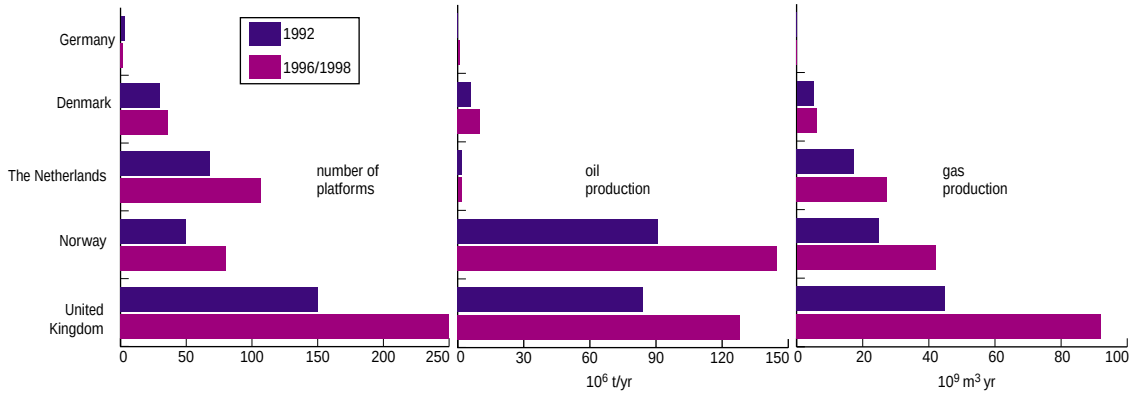
Non-degradable plastics may constitute 95% of the total amount of litter in many areas of the OSPAR region. Litter, including drifting fishing nets and ropes, may entangle and drown mammals and seabirds. It has also been found to carry a variety of epiphytic organisms to sea areas that these organisms would not normally reach. Economically, the recreation sector is likely to be most affected by litter. Remains of plastic nets can easily get caught in ship's propellers.

The North Sea (1991) and the Baltic Sea (1988) have both been designated as MARPOL Special Areas (Annex V) where the dumping of garbage and litter from ships (e.g. household waste, cargo waste, wire straps, covering material, fishing equipment) is prohibited. Dumping of waste is also prohibited under the OSPAR Convention. So far, however, there is no indication of any improvement with regard to litter.

3.10 Oil and gas industry

The offshore oil and gas industry has become a major economic activity in the North Sea since the late 1960s. Between 1990–92 and 1996–98, the number of platforms increased from 300 to 475, and oil production almost doubled *(Table 3.8; Figure 3.12)*. The major oil developments have been in the northern parts of the North Sea in the United Kingdom and Norwegian sectors *(Figure 3.13)*. Gas deposits are exploited mainly in the

Figure 3.12 **Comparison of offshore activities in 1990–92 (North Sea Task Force, 1993) with those in 1996–98.**



Data for Denmark, Germany and The Netherlands are from 1996. Data for the United Kingdom are from 1997. Data for Norway are from 1998.

Table 3.7 Waste (m^3) generated yearly in the North Sea region by different sectors, whereof a part may end up as litter. Source: OSPAR (1997b).

Sector	
Ferry traffic	290 000
Fishing vessels	100 000
Offshore installations †	90 000
Merchant shipping	60 000
Pleasure crafts	40 000
Recreation, tourism	20 000
TOTAL	600 000

† Waste collection, return to land and disposal onshore is strictly controlled in this sector. Consequently there is a low risk that waste from offshore installations contributes to marine litter.

Table 3.8 Gas and oil production by countries bordering the North Sea in 1996–8.

Country †	Number of platforms in production	Gas production (10^9 m^3/y)	Oil production (10^6 t/y)
Denmark (1996)	36	6	10
Germany (1996)	2	0.3	0.5
Netherlands (1996)	107	27.4	1.8
Norway (1998)	80	42	145
United Kingdom (1997)	250	92	128
TOTAL	475	167.7	285.3

† Belgium, France and Sweden do not have gas or oil production.

shallower southern regions in the United Kingdom, Dutch, and Danish sectors, as well as in Norwegian waters. There are several gas and oil production platforms in the Wadden Sea, with further exploration being subject to tight controls. Discharges are described in section 3.9.5.

The total length of pipelines has increased as, for example, pipelines connecting Norway and France (840 km) and Belgium to UK (240 km involving the dredging of 4 x 10^6 m^3 sand) were completed in 1997. In 1998, 9 670 km (estimated from 1998 sea charts) of rigid and flexible oil and gas pipelines formed a network of arteries between offshore petroleum production sites and terminals on land. These pipes represent approximately 1.7 and 2.2 x 10^6 t of steel and concrete, respectively. Furthermore, approximately 5 100 t of tar and 62 000 t of asphalt cover the pipe joints, and about 10 000 t of aluminium and 6 500 t of zinc anodes are fitted as electro-chemical protection against corrosion. The lifetime of individual pipelines is estimated to be from 20 to 50 years (Jacobsen *et al.* 1998).

3.11 Shipping

3.11.1 Traffic and cargo

The North Sea contains some of the busiest shipping routes in the world. In 1996 about 270 000 ships entered the main 50 ports in the North Sea and Channel area. Daily, more than 400 ships pass through and 600 ships cross (including 200 ferries) the Strait of Dover. In 1996 there were 37 055 shipping movements transporting 48 million tonnes of cargo between the North Sea and the Baltic via the Kiel Canal.

Most of Europe's largest ports are situated on North Sea coasts and rivers, namely Hamburg, Bremen, Amsterdam, Rotterdam, Antwerp, Le Havre, and London (*Figures 3.14* and *3.15*), with Rotterdam/Europoort being the most important. Container transfer in the main ports increased by 120% in the last ten years (*Table 3.9* and *Figure 3.16*). Approximately half the shipping activity in the Greater North Sea consists of ferries and roll-on/roll-off vessels on fixed routes.

Shipping can have a negative impact on the marine

Figure 3.13 **Oil and gas industry in the North Sea in 1996. Source: modified from Schöneich (1998).**

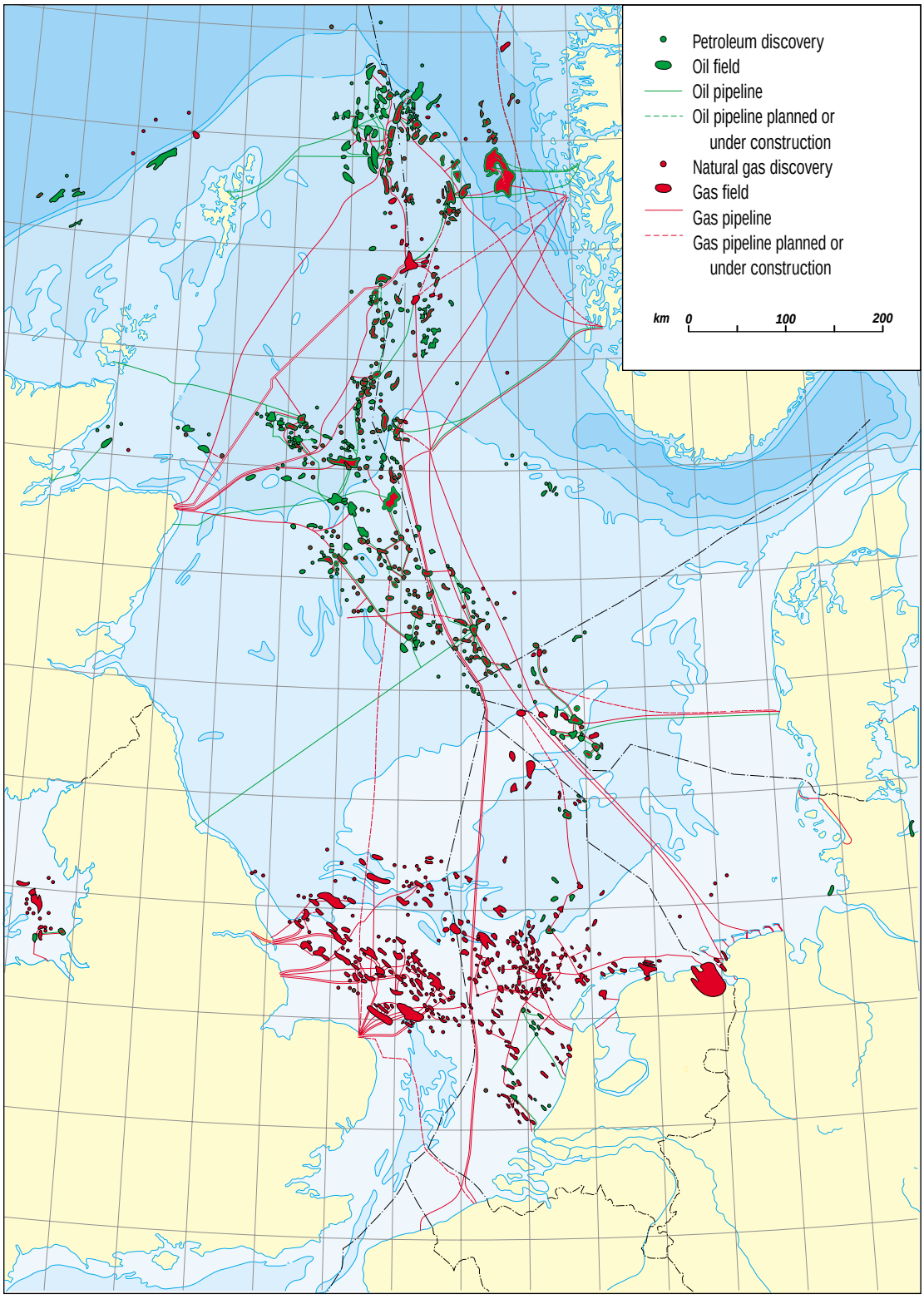


Figure 3.14 **Shipping in the Greater North Sea, showing total cargo shipments (10^6 t/yr) in the main ports in 1997 and international shipping traffic measures. Source of data: Port of Rotterdam (1999) and Department of the Environment, Transport and the Regions (UK) (1997).**

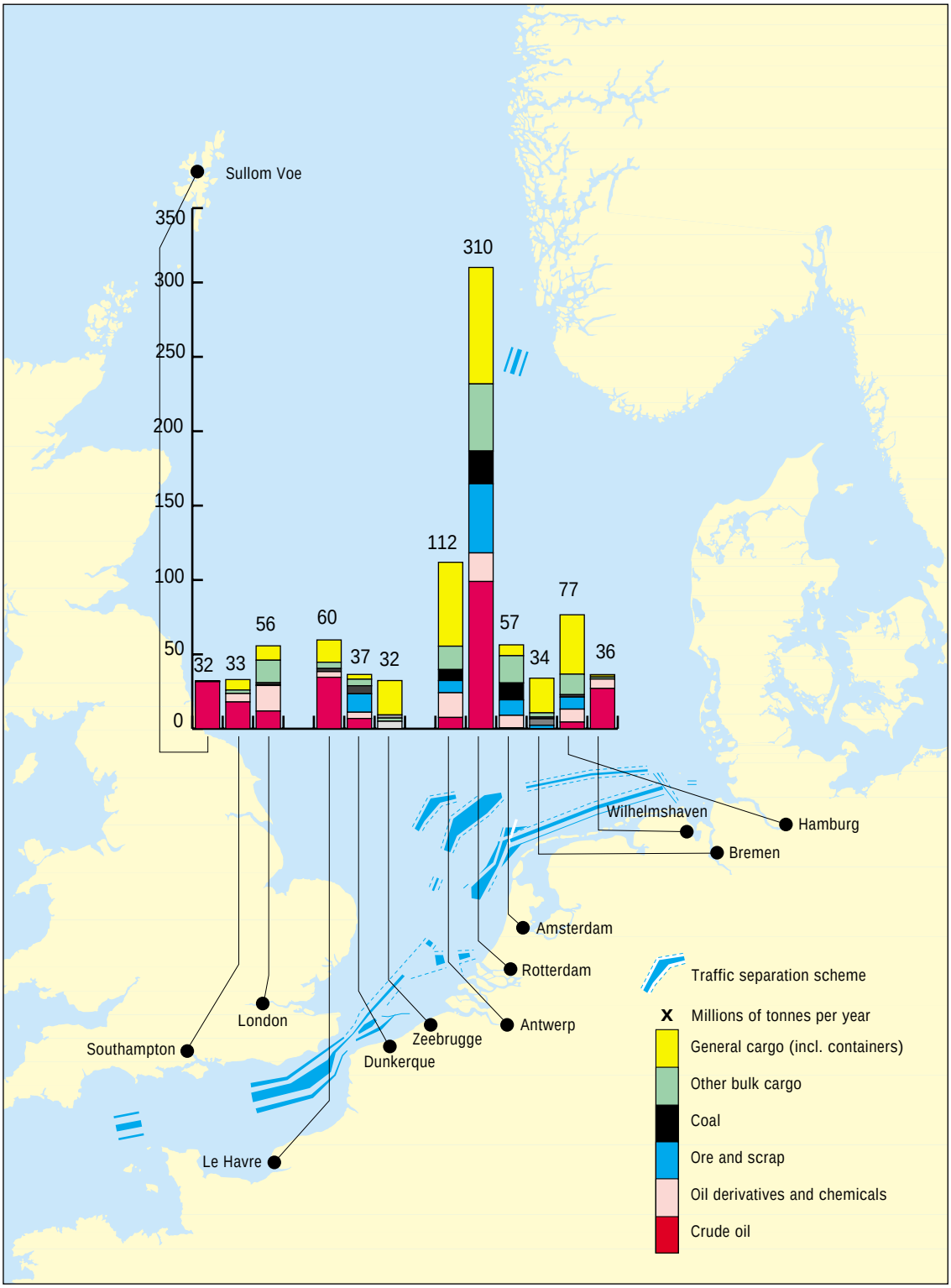
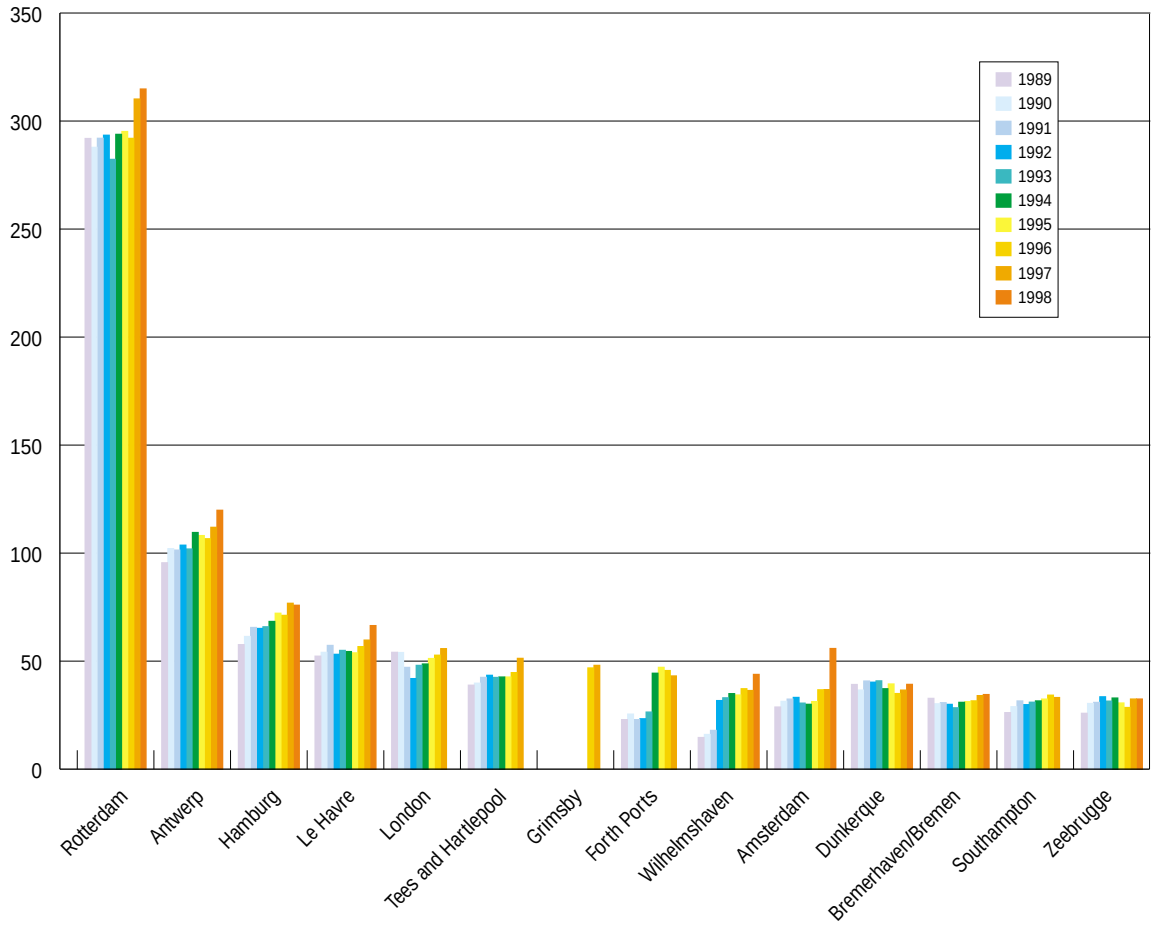


Figure 3.15 **Development in shipments (10^6 t) in North Sea ports from 1984 to 1998.**



environment due to discharges of oil and wastes, cleaning and venting tanks, air pollution, loss of cargoes containing harmful substances (50% of goods carried at sea can be described as dangerous), discharges of ships' ballast water which may contain non-indigenous species, and the use of anti-fouling paints containing biocides.

As from 1 August 1999, the North Sea, the Seas around Ireland and their approaches have been established under the name North West European waters as a Special Area under MARPOL Annex I (oil). Within the IMO, a mechanism for a general ban on the use of organotin compounds in anti-fouling paints has been agreed. The target is to prohibit their application from 2003 and to require the removal of TBT from ships' hulls by the year 2008. Given the serious effects of TBT on snail and bivalve populations, effective implementation of this measure is required. Within the EC, controls on other TBT applications have been increased with the revision of Directive 76/769/EEC. The Marine Environmental Protection Committee (MEPC) plans to develop a global legally-binding instrument to address the harmful effects of anti-fouling systems used on ships. Within the IMO framework, activities are also ongoing to reduce air pollution by emissions.

3.11.2 Accidents

In the North Sea in 1993 a serious pollution incident occurred when the 'Braer' ran aground in Shetland releasing 84 700 t of crude oil and 1 600 t of bunker-C oil. In the Greater North Sea, eleven accidents occurred in 1994 and six accidents occurred in 1995 where pollution of the seawater was recorded (world wide 101 in 1994 and 86 in 1995) (Quell and Klimsa, 1997). In 1996, two major cases of fire and one of grounding were reported in the North Sea or adjacent waters (Hooke, 1997).

In 1998, the ship 'Pallas', under a Bahamas flag and carrying a shipment of timber, caught fire off the coast of Jutland and finally ran aground near the German island of Amrum, spilling an estimated 244 m^3 of heavy fuel oil causing the death of about 16 000 overwintering birds.

Lost cargo can cause harm to the environment. In 1994, The Netherlands registered lost containers with various types of cargo on five occasions. In one case the 'Sherbro' lost

Table 3.9 Development of market shares in container t ransfer. Source of data: Wirtschaftsbehörde Hamburg (1998).

	1985		1990		1997		
	Quantity (1000 TEU)	Market share (%)	Quantity (1000 TEU)	Market share (%)	Quantity (1000 TEU)	Market share (%)	Increase in quantity 1985-97 (%)
Rotterdam	2 655	43.9	3 666	43.7	5 340	40	+101
Hamburg	1 159	19.1	1 969	23.5	3 337	25	+188
Antwerp	1 243	20.5	1 549	18.5	2 969	22.2	+139
Bremen ports	998	16.5	1 198	14.3	1 705	12.8	+71
TOTAL	6 055		8 382		13 351		+120

TEU = 20 ft container equivalent unit

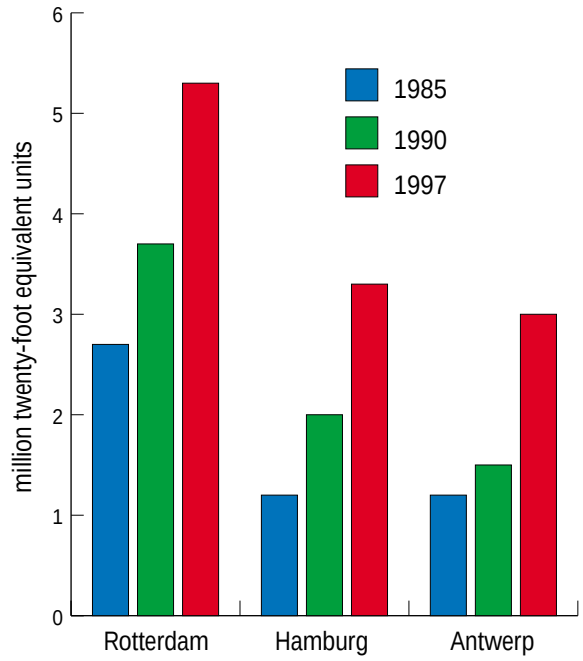
88 containers, 5 of which contained the pesticides 'Apron Plus' and 'Ridomil Plus', and 'Apron Plus' packages from this accident washed up on the Dutch and German coasts. In another case the coast of a Dutch Wadden Sea island was polluted by lumps of elemental phosphorus.

To reduce the risk of accidents, the IMO has introduced shipping corridors in several regions of the North Sea *(Figure 3.14)*.

3.12 Coastal industries

Industries of various types (e.g. metal and metal-processing industry, chemicals industry, shipbuilding) are located along the coasts of the North Sea.

Figure 3.16 **Development in container transfer in Rotterdam, Hamburg and Antwerp 1985–97. Source: Wirtschaftsbehörde Hamburg (1998).**



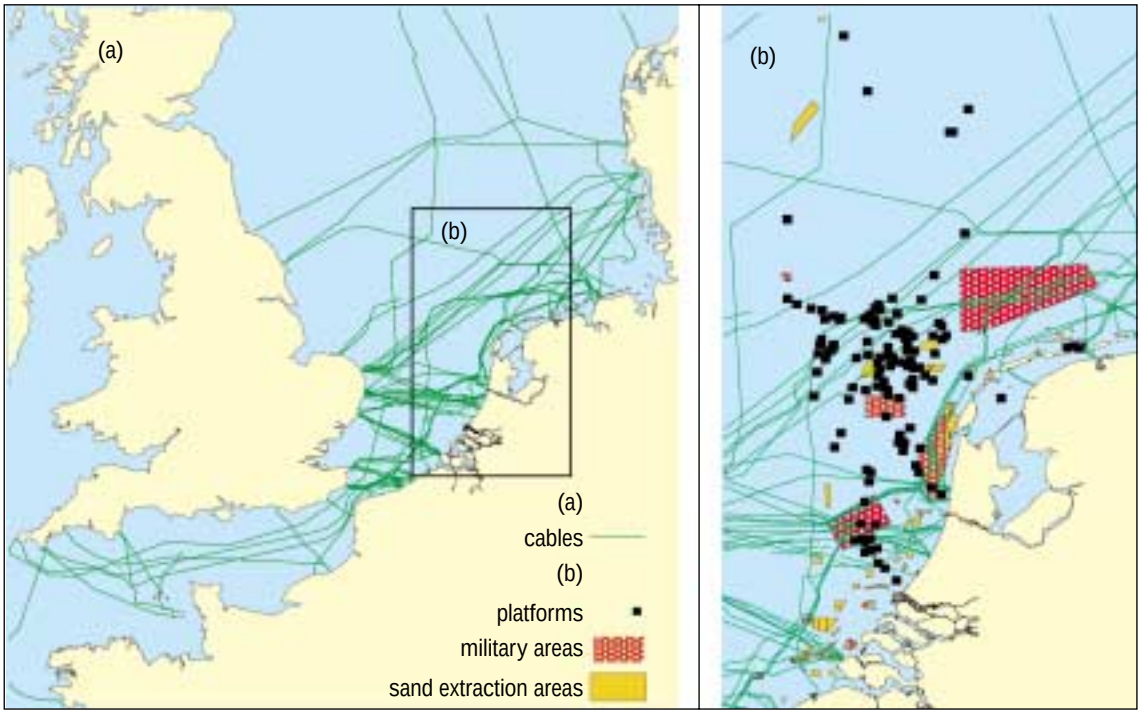
The most industrialised coastal area in Norway is the Frierfjord area. Along the south and west coast most industries are situated in the innermost part of the fjords, often in connection with larger cities (Oslo, Bergen), or at locations where hydroelectric power is generated (smelting plants). Some oil refineries are located in the coastal zones. In Denmark, industrial production is on the east coast of Jutland, and near Esbjerg. German coastal industries are concentrated near the banks of the rivers Elbe, Weser, Ems and Jade. In The Netherlands, industries are situated in the Scheldt estuary, in the estuary of the Rhine/Meuse (Rotterdam area), and near Amsterdam and Ijmuiden. The Belgian coastal industry is mainly situated in the Antwerp area, close to the Scheldt estuary. On the French coast, various industrial developments are focused on the Calais-Dunkerque coast and the Seine estuary. The main UK industries on the coasts of Region II are found in the estuaries of the rivers Thames, Tyne and Tees, near Southampton and in the Firth of Forth.

missions to air or discharges to water or indirectly by effects on land or soil. Industry uses water in large quantities for cooling, rinsing and cleaning.

Some nuclear power plants and the French reprocessing plant can be considered as coastal industries discharging heat and radioactive substances into the marine environment. OSPAR reports show that the discharges from most facilities are much lower than those permitted. In their Statement at the Ministerial Meeting in 1998 (Sintra, Portugal), OSPAR Ministers agreed to ensure that discharges, emissions and losses of radioactive substances were reduced by the year 2020 to levels where the additional concentrations in the marine environment above historic levels, resulting from such discharges, emissions and losses, were close to zero.

Many data and energy cables and pipelines are submerged in the North Sea sediment (*Figures 3.13* and *3.17*). Over 5 000 km have been dredged for this purpose. This may become a problem for some user functions and groups, such as beam trawl-fisheries and sand, gravel and shell extraction. Within their territorial waters countries can demand that cables and pipelines are removed when no longer in use.

Figure 3.17 **Cables, military training areas and sand extraction areas in the North Sea. Source of data: Rijkswaterstaat North Sea Directorate (Netherlands).**



3.13 Military activities

Military uses of the sea in peacetime constitute a small part of the sea-borne and coastal activities around the Greater North Sea. Activities include fishery protection patrols by the respective navies, and NATO exercises.

There are extensive British Royal Navy exercise areas in the Greater North Sea, mainly concentrated off the south coast of the UK. There are also exercise areas off the eastern coast of England and around the Firth of Forth.

Dumping of munitions at sea, including chemical weapons, took place after World War I, e.g. at the location 'Paardenmarkt' off the Belgian coast, and after World War II. Before 1947, the Allies sunk 34 ships in the Skagerrak containing roughly 150 000 t of chemical weapons (Duursma, 1999). The chemicals involved included mustard gas, tabun, chloroacetophenone and different arsenic containing compounds. Other ammunition dumpsites are also located in the Channel and off the southeast coast of the UK.

3.14 Land based activities

3.14.1 Non-direct discharges

Land-based activities such as industry, households, traffic and agriculture may have an impact on the ecosystem of the Greater North Sea via riverine or atmospheric inputs of contaminants. Quantification has focused on the overall input of substances to the marine environment, and for substances other than nutrients only limited attention has been given to the contributions from different sources (see also Chapter 4). Substances of concern are nutrients, which may lead to eutrophication, and hazardous substances which could pose a risk to marine organisms and, via food from the sea, to human health.

At the International Conferences on the Protection of the North Sea, commitments were made to reduce inputs of hazardous substances and nutrients into the North Sea by 50% between 1985 and 1995 and also to reduce by 70% inputs of dioxins, mercury, cadmium and lead.

Reductions in mercury discharges have been achieved by measures taken in the chlor-alkali industry, by mercury replacement in certain products and by reducing discharges from dentistry. For cadmium reductions have been achieved by minimising discharges from the (non)-ferrous metals and fertiliser industries, and through the substitution of cadmium by less harmful elements. Efficient flue gas treatment has reduced atmospheric emissions of cadmium, mercury and dioxins. Lead emissions from petrol have declined markedly.

Reduction in the inputs of phosphorus and limited reductions in the inputs of nitrogen were achieved through improvements in sewage treatment (see below); and by

reductions in ammonia volatilisation, in leaching of nitrate, in losses of phosphorus, and in farm waste discharges.

Little success has been reported in reducing inputs from diffuse sources, i.e. erosion and leaching of arable land (fertilisers), atmospheric deposition (nitrogen), run-off from roads (e.g. wear of tyres) and building materials.

Consequently, the North Sea States considered further action to achieve the reduction targets by, for example, enhanced substitution of hazardous metals in various applications, replacement of products and by more stringent controls of industries discharging wastes.

To achieve a decline in atmospheric emissions, measures such as improvements in flue-gas cleaning at waste incinerators and coal-fired power stations and the introduction of best available technology for the metallurgical industry were adopted.

3.14.2 Domestic sewage

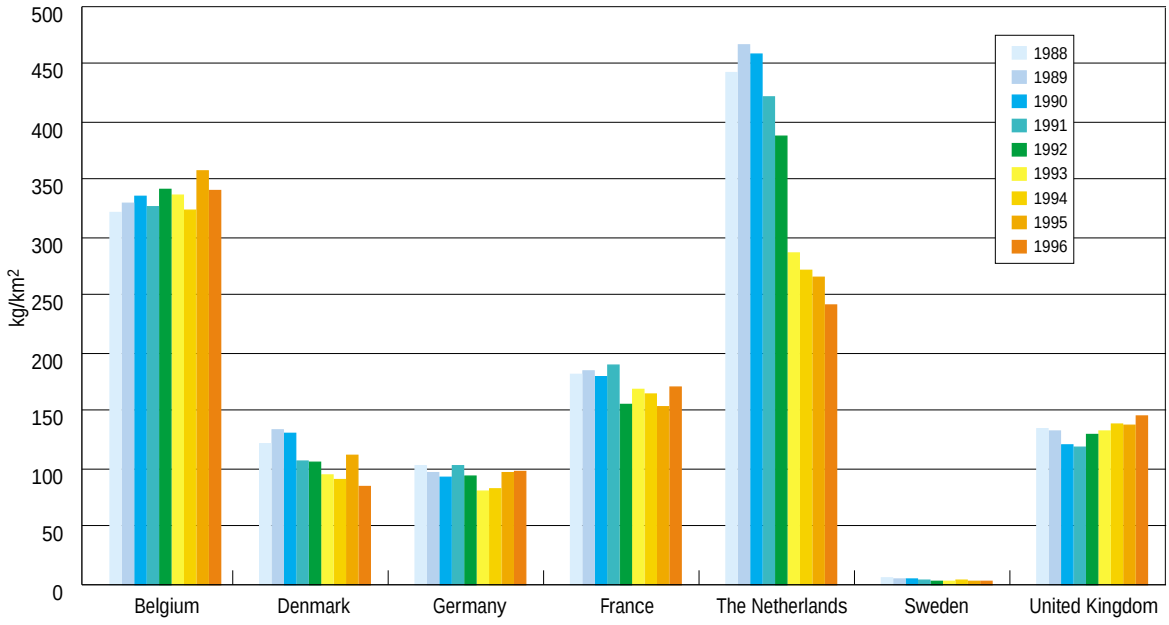
Considerable effort has been made to collect urban and industrial waste waters and apply appropriate levels of treatment. Nevertheless, even where households and industries are served by tertiary treatment systems, exceptional rainfall or tourism during the summer can reduce the efficiency of these systems. Measures relating to the reduction of nutrient inputs were adopted by the Paris Commission in 1998 and 1999 (PARCOM Recommendations 88/2 and 89/4). The EC Urban Waste Water Treatment Directive (EC, 1991) regulates the required level of treatment of waste water (i.e. in general biological treatment). The deadline for implementing this Directive is 31 December 1998 to 31 December 2005, depending on the size of the population. In 1995 the portion of the population connected to sewerage treatment in different countries ranged from 80 – 98% (OSPAR, 1995).

3.15 Agriculture

Highly productive agricultural systems in Western Europe fall into two broad categories. Firstly, there are areas of intensive field-crop farming, dominated by large holdings concentrated in eastern England, northern Germany and much of The Netherlands. Secondly, there are areas of very intensive agriculture specialising in animal production and/or fruit and vegetable farming found in the coastal and southern areas of western Denmark, parts of Germany, The Netherlands, northern Belgium, and northern Brittany. Agricultural land accounts for more than 42% of the total land area in Europe, although the proportion varies between less than 10% and more than 70%.

There are considerable environmental impacts associated with agricultural activities and the main types of pollution are from nitrates, ammonia, methane, pesticides and run-off of silage and slurry. Trends in the use of pesticides in countries bordering the North Sea are shown in *Figure 3.18*. Emission of nitrates and phosphates can lead to eutrophication of coastal waters.

Figure 3.18 **Trends in the use of pesticides in agriculture from North Sea countries from 1988 to 1996 related to the total surface of the country. Source of data: Eurostat (1998).**



Reduction of nutrient inputs from agriculture was addressed by PARCOM Recommendation 92/7. Agriculture also contributes emissions to the atmosphere (including, in particular, ammonia and methane) (European Environment Agency, 1995).

3.16 Regulatory measures and future developments

The environmental policy framework for the North Sea is developed through the International Conferences on the Protection of the North Sea, under the OSPAR Convention, in the framework of the European Union, by the Trilateral Governmental Wadden Sea Conferences, under the Bonn Agreement and, indirectly, under the London Convention and in the framework of the IMO. It takes into account the Rio Declaration and policies developed under the Convention on the Protection of the Marine Environment of the Baltic Sea (Helsinki Convention 1997/1992). Additionally there is co-operation in the framework of international river conventions, such as for the Elbe, Rhine, Scheldt and Meuse.

The four ministerial NSCs held since 1984 have resulted in political commitments to implement certain measures at a national or OSPAR level, or within the EU. Important agreements were to adopt the precautionary principle and to reduce inputs of hazardous substances and nutrients.

The OSPAR Convention, which was opened for signature in 1992 and came into force in March 1998, served to merge and modernise its predecessors the Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, and the Paris Convention for the Prevention of Marine Pollution from Land-Based Sources. It has the general objective of preventing and eliminating pollution of the Maritime Area of the Convention, to ensure that the ecosystems are in a sound and healthy condition, used in a sustainable way, and that human health is protected. The 'Ministerial Meeting of the OSPAR Commission' (1998) expanded the Convention itself by a further Annex which allows for the protection and conservation of the ecosystems and biological diversity of the Maritime Area. In 1998/1999, the OSPAR Commission adopted five strategies that established objectives and requirements for action relating to hazardous substances, radioactive substances, combating eutrophication, the protection of ecosystems and biological diversity, and environmental goals with regard to offshore activities. Amongst other measures, the OSPAR Convention provides for the adoption of legally binding 'Decisions', the first five of which were adopted in 1998.

The OSPAR Strategy to Combat Eutrophication takes up agreements made within the NSC framework, followed through by the Oslo and Paris Commissions and which have been partly fulfilled to date, regarding the reduction of nutrient inputs by about 50%. An important element of the OSPAR strategy is a Common Procedure for the Identification of the Eutrophication Status of the Maritime Area.

OSPAR has agreed on measures for a number of substances (e.g. mercury, hexachloroethane, short chained chlorinated paraffins, PAHs and PCBs) and industrial sectors (e.g. iron and steel, aluminium, PVC , pulp and paper), and has defined BAT or BEP for a number of industrial sectors (e.g. the pulp and paper industry, the aluminium and the non-ferrous metal industry, combustion plants, use of toxic chemicals and pesticides in agriculture and aquaculture).

The OSPAR Strategy with regard to Hazardous Substances takes up agreements made within the NSC framework. This strategy contains provisions for the development of a dynamic selection and prioritisation mechanism to define those hazardous substances where priority action will be taken to continuously reduce discharges, emissions and losses with the ultimate aim of achieving concentrations in the environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. Every endeavour will be made to move towards the target of cessation of discharges, emissions and losses of hazardous substances by the year 2020. OSPAR 1998 also adopted Decisions relating to the disposal of disused offshore installations (see section 3.9) and radioactive discharges (see section 4.8).

Specific OSPAR guidelines for the identification, selection and implementation of measures for Marine Protected Areas (MPAs) are under consideration. However, several other national and international initiatives have led to the establishment of a number of MPAs within the OSPAR maritime area.

The OSPAR Convention prohibits incineration at sea. It also prohibits the dumping of all wastes or other matter except for dredged material, inert materials of natural origin, fish waste and, until the end of 2004, of vessels and aircraft.

The UN Conference on Environment and Development (UNCED 1992, Rio de Janeiro) has made 'sustainable development' an underlying principle in the development of environmental policy. The 'precautionary principle', and the 'polluter pays' principle were introduced on a global level. Agenda 21 was agreed to implement this key idea and to express general policy direction for the 21st century. The 'Rio Declaration' emphasised that States have the sovereign right to exploit their own resources pursuant to their own policies, but also the responsibility of ensuring that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Environmental policy objectives contained in the

'Amsterdam Treaty' of the EC (1997) are based on the same principles as in the Rio Declaration and articulated in action programmes towards sustainability. While EU environmental policy does not generally address the marine environment per se, many elements of EC environmental legislation have a direct or indirect role in improving the quality of the marine environment as they address the various land-based activities which impact on the marine environment. Successful implementation of the directives on nitrates and urban wastewater would substantively address eutrophication in the marine environment. The various directives on assessment of substances integrated pollution prevention and control and on marketing and use limitations and accident hazards should make a substantial contribution to the realisation of the objective of the OSPAR strategy with regard to hazardous substances. The EU biodiversity strategy, and the birds and habitats directives in principle cover marine species even if so far these have not yet been emphasised. Agreements on total allowable catches (TACs) in the context of the common fisheries policy are the key instrument to ensure maintenance of stocks of target species. Impacts on populations of non-target species and on ecosystems can be addressed by technical measures. OSPAR and the EU are moving towards closer co-operation, *inter alia* in the context of the Water Framework Directive which is currently under preparation.

Eight governmental conferences on the protection of the Wadden Sea have been held since 1978 and have resulted, *inter alia*, in the agreement of a trilateral monitoring and assessment programme, common targets for nature conservation, and cultural and landscape values for this area. Conservation is dealt with in the Trilateral Wadden Sea Cooperation and under EU directives on the conservation on wild birds and on habitat, fauna and flora, by the Ramsar Convention and agreements under the Bonn Convention. National regulation is important on archaeological conservation.

The IMO deals with the safety of shipping and the protection of the marine environment against risks related to shipping. The MEPC deals with issues relating to the prevention and control of pollution from ships. As well as conventions relating to ship safety, IMO has agreed on the 'International Convention for the Prevention of Pollution from Ships' (MARPOL 73/78) which relates to operational discharges from ships.

The 'Bonn Agreement', which first came into force in 1969, was a reaction to major oil spills and aimed to encourage North Sea states to jointly improve their capacity for combating oil pollution. The current Bonn Agreement (1983) is a commitment by North Sea states and the EU to offer mutual assistance and co-operation in combating pollution, and to execute surveillance as an aid to detecting and combating pollution and preventing violations of anti-pollution regulations. In recent years the emphasis has been on the co-ordination of surveillance activities *(see Figure 4.16)*.

The framework for fisheries management within the North Sea is the Common Fisheries Policy (CFP); it will be renegotiated in 2000. In addition, stocks shared between Norway and the EU are managed by separate agreements. Although the 'Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues' 1997 (IMM) has agreed on important guiding principles and strategies to ensure sustainable use of marine living resources, concrete measures to implement them remain to be taken.