9 OTHER HUMAN USES AND IMPACTS

Human uses are concentrated in the coastal waters of Regions II, III and IV and have increased in intensity since 2000. Some new uses, such as offshore wind farms, are part of efforts to mitigate climate change. The relative and cumulative environmental impact of these pressures is not fully understood. The needs of different users of the sea must be balanced to ensure environmental protection and sustainable use of marine resources.

OSPAR Contracting Parties should cooperate

- → to improve international coordination on integrated management of human activities, including marine spatial planning, building on existing experience in some OSPAR countries and in conjunction with the EU Marine Strategy Framework Directive;
- → to monitor the impacts from growing human uses of the sea and to agree on methods for cumulative impact assessment and socio-economic evaluation;
- → to promote international action on marine litter and underwater noise.

Key OSPAR assessments

- → Environmental impacts of human activities
- → Marine beach litter
- → Marine litter in the North-East Atlantic Region
- → Environmental impacts of underwater noise
- → Collective impact of human activities on the OSPAR maritime area

A range of other human uses of the sea provide goods and services for OSPAR countries. These include: shipping; tourism and recreational activities; wind farms; cables; land reclamation, coastal defence and other structures; artificial reefs; mineral extraction; and dredging and dumping (including dumped munitions). These activities exert physical, chemical and biological pressures on marine ecosystems which need to be carefully managed so as to avoid unwanted impacts. Some of these impacts have been covered in Chapters 4 and 5. Under the Biodiversity and Ecosystems Strategy OSPAR has been considering the impacts from these activities to determine whether any specific measures are needed to ensure the protection of ecosystems and biodiversity. Many of these activities are regulated through national procedures, including licensing and the application of environmental impact assessments (EIA). Shipping is regulated largely through the International Maritime Organization (IMO). OSPAR is developing tools to help with the socio-economic evaluation of these activities, as a basis for valuing ecosystem services. There are also specific impacts which result from more than one activity, such as marine litter, microbiological contamination, non-indigenous species and underwater noise. Integrated management based on an ecosystem approach to management is essential for balancing the demands of different uses of the sea and nature conservation interests → **BOX 9.1.**

OSPAR Strategy objective for biodiversity and ecosystems
To protect and conserve the ecosystems and the biological diversity of the maritime area which are, or could be, affected as a result of human activities, and to restore, where practicable, marine areas which have been adversely affected.

The Strategy includes the following actions:

- → Assessment of the impact of human activities on the marine environment.
- → Drawing up of programmes and measures for controlling human activities that have an adverse impact on species and habitats that need to be protected or conserved where this is necessary.
- → Drawing the attention of the IMO to questions concerning maritime transport on which OSPAR considers that action is desirable.

Ria de Vigo, Spain

BOX 9.1 Integrated management strategies and integrated tools

OSPAR is revising its structure and activities in line with recent legislative efforts to set in place instruments for the integrated management of the marine environment based on the ecosystem approach. In 2008, the EU adopted the Marine Strategy Framework Directive and Norway has agreed integrated management plans for several large marine areas. Overall integrated management strategies such as these should be developed in close coordination with a range of specific tools for the management of human activities: environmental impact assessment (EIA), marine spatial planning and integrated coastal zone management. Marine protected areas (MPAs) are a further tool for integrating the management of human uses with environmental protection. These are often complemented by sector-specific actions and measures.

Environmental impact assessment identifies the potential impacts of a project or activity on the environment and develops mitigation measures to reduce these to acceptable levels. The EU EIA Directive supports a common approach in applying EIA to major projects such as wind farm development, land reclamation, coastal defence works and the placement of structures. An EIA aims to identify a series of discrete, auditable measures to eliminate or reduce impacts, set out in an environmental management plan. The EU Strategic Environmental Assessment Directive aims to contribute to sustainable development by ensuring that environmental consequences of certain plans and programmes, including for fisheries, energy, industry, transport and tourism, are identified and assessed in consultation with the public during their preparation.

Marine spatial planning. In 2003, OSPAR agreed to pursue strategies that would promote cooperation in spatial planning and to develop spatial planning tools for the OSPAR area. Marine spatial planning is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process. While some of the objectives of spatial planning are to facilitate the orderly development of maritime activities, this tool can also be useful for ensuring that they are carried out within sustainable boundaries applying the ecosystem approach. Its development should therefore be closely coordinated with overall integrated management strategies designed to achieve good status of marine waters.

Integrated coastal zone management is a multi-disciplinary process designed to promote sustainable management of coastal zones. It seeks to balance environmental, economic, social, cultural and recreational objectives within the limits set by the environment. The complexity of the coastal zone means that marine, littoral and terrestrial issues are all involved.

Marine protected areas are areas for which protective, conservation, restorative or precautionary measures have been put in place to protect and conserve species, habitats, ecosystems or ecological processes of the marine environment on a temporary or permanent basis. MPA management plans set out how human activities within an MPA should be managed to meet conservation objectives. A joint network of MPAs is being developed through OSPAR and the Natura 2000 network under the EU Habitats Directive → CHAPTER 10.

SHIPPING

Several measures addressing impacts from shipping have been introduced recently and their effectiveness is not yet clear. Air emissions have increased with growing ship traffic. Illegal discharges of oil and wastes, including litter and sewage, continue.

OSPAR Contracting Parties should cooperate
- → to monitor and assess the development of shipping, the effectiveness of measures and the impacts on the OSPAR Regions;
- → within IMO on reducing air pollution from ships as a priority, and should ratify, implement and enforce existing instruments while applying the 'clean ship' approach;
- → with the IMO, the Bonn Agreement and regional organisations on the prevention of oil spills and on risk response, including for the Arctic.

Key OSPAR assessment → Environmental impact of shipping

The North-East Atlantic has some of the world's busiest shipping routes. The OSPAR area handles 90 % of EU external trade and around 35 % of trade between EU countries. There is also a huge amount of through-traffic. Ship traffic in Regions II and IV has been increasing over the past 20 years as trade has grown and alternatives to road transport have been promoted → FIGURE 9.1. This includes increases in the number of ships, the cargo carried and the size of ships. Transport by sea is considered more environmentally friendly than transport by air or road, but shipping has clear impacts on the marine environment.

What are the problems?

Shipping exerts a number of pressures

The main pressures associated with maritime shipping in the OSPAR area include the following:
- Pollution by oil and hazardous or toxic substances from incidental, operational and illegal discharges.
- Air pollution through emissions and particulate matter from engine exhaust gases and cargo tanks, which may be carried over long distances.
- Discharge and disposal of wastes from ships including sewage and litter.

- Release of toxic chemicals used in anti-fouling paints and anodes.
- Introduction of non-indigenous organisms through ships' ballast water and associated sediments, and fouling on ships' hulls.
- Pollution and physical impact through loss of ships and cargo.
- Physical and other impacts including noise and collision with marine mammals.

What has been done?

OSPAR cooperates with other international bodies

The IMO is the competent international body regulating international shipping to protect the marine environment. OSPAR can refer to the IMO any shipping-related concerns regarding environmental protection within the OSPAR area.

OSPAR is following up commitments made at the North Sea Conferences. The North Sea Ministerial Meeting on the Environmental Impact of Shipping and Fisheries in 2006, resulting in the 'Gothenburg Declaration', reinforced the commitment of North Sea states to the 'clean ship' approach. This is a concept whereby vessels are designed, constructed and operated in a way that aims to eliminate harmful discharges and emissions during their working life. The clean ship approach has been followed up by some OSPAR countries through 'green ship label' initiatives.

OSPAR also works closely with the Bonn Agreement. This is the mechanism by which the North Sea states and the EU work together to detect and combat pollution from maritime disasters and chronic pollution from ships and offshore installations.

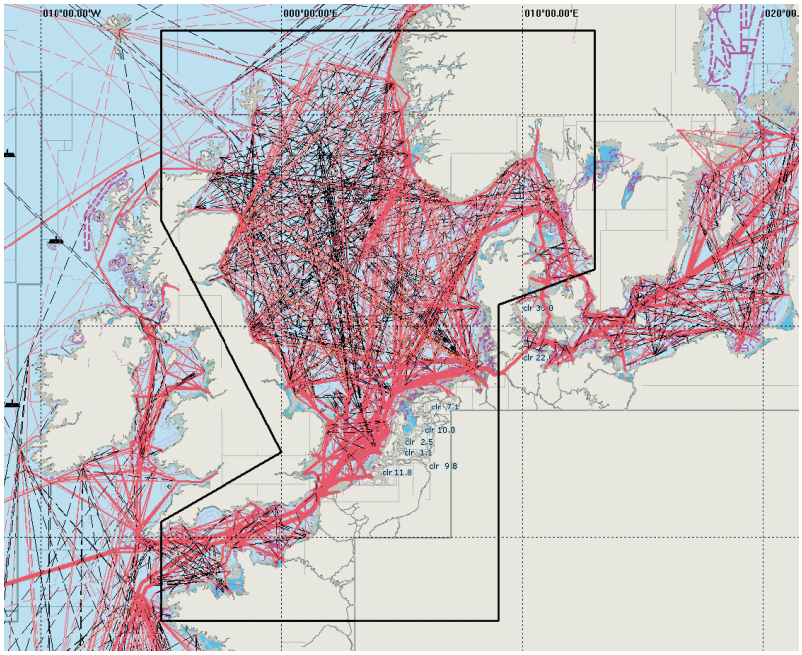


FIGURE 9.1 *Shipping traffic in Region II and connections with the Baltic Sea.*

Recent international measures target impacts from shipping

The main international convention covering the prevention of pollution from ships is the MARPOL Convention and its thematic annexes I to VI. Annex II on noxious liquid substances carried in bulk was revised with effect from January 2007 to reduce the impact of cargo tank cleaning. Annex VI, relating to the prevention of air pollution, was amended in October 2008 to further reduce harmful emissions from ships. The International Convention for the Safety of Life at Sea (SOLAS) sets technical minimum standards for vessels and so reduces the risk of shipping accidents and thus accidental pollution.

Several priorities identified in the QSR 2000 are now addressed through legislation developed at the international level by the IMO. This includes the Convention on the Control of Harmful Anti-fouling Systems on Ships (2001) and the Convention for the Control and Management of Ships' Ballast Water and Sediments (2004). OSPAR and the Helsinki Commission (HELCOM) have developed guidelines for managing ballast water, based on those of the IMO, which can be used on a voluntary basis, pending the ratification and entry into force of the IMO Ballast Water Convention.

In 2008, the IMO Marine Environmental Protection Committee developed a programme of work for minimising incidental noise from commercial shipping. It also began work on guidance for minimising the risk of ship strikes with marine mammals.

Following the loss of the *Erika* off the French coast in 1999, the EU adopted several Directives aimed at preventing accidents at sea and established the European Maritime Safety Agency (EMSA). The EU Blue Book on an Integrated Maritime Policy provides the framework for an integrated approach to managing marine activities, including shipping, and the environment.

Many of these measures have only been taken recently and it is too early to judge their effectiveness. In some cases, information is too limited to quantify the contribution of shipping to impacts such as oil spills or litter and to evaluate progress made since 1998. Improved monitoring of the development of impacts is therefore a priority.

Efficient surveillance, investigation and prosecutions are essential for the protection of the marine environment from pollution by shipping. The North Sea Network of Investigators and Prosecutors, a body associated with the OSPAR Commission and closely cooperating with the Bonn Agreement, was set up in 2002 to help enforce international pollution rules and standards in the North Sea. This is achieved through promoting effective use of evidence in the different national legal systems, comparable levels of penalties and exchange of information on convictions of offenders.

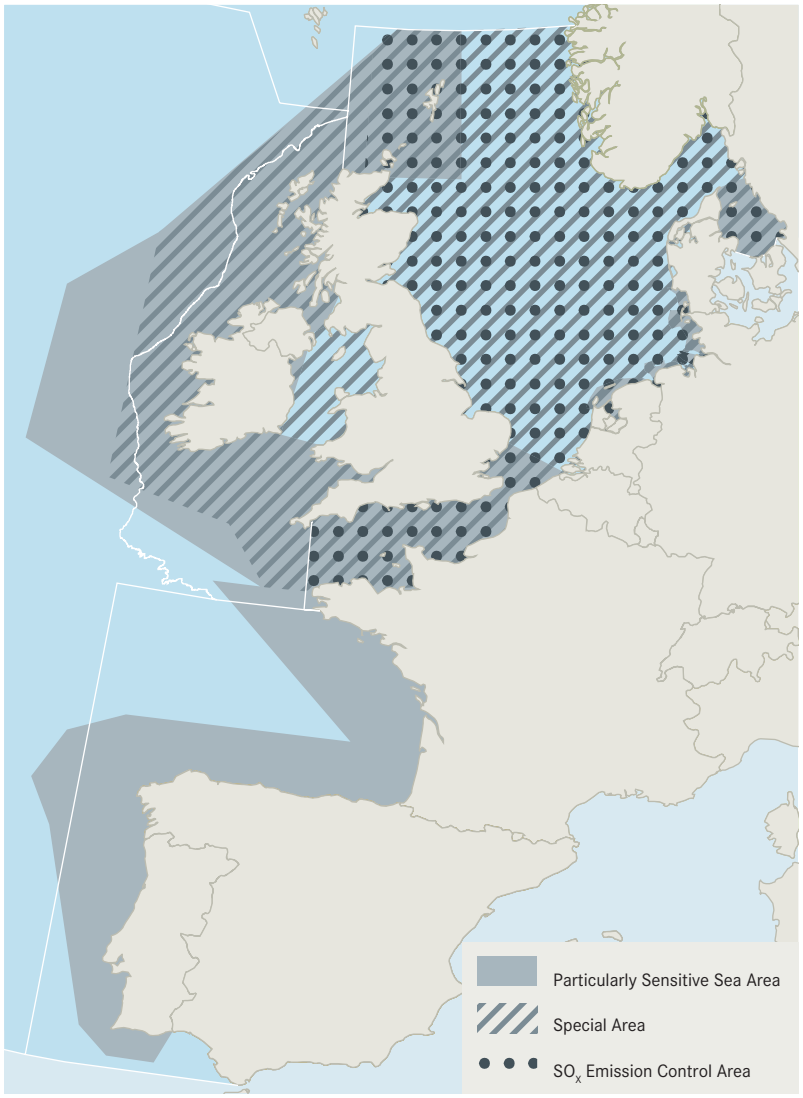


FIGURE 9.2 *Areas of the North-East Atlantic recognised as MARPOL Special Areas, MARPOL SO_x Emission Control Areas (SECA) or Particularly Sensitive Sea Areas (PSSAs). The Kattegat has been recognised under those regimes as part of the Baltic Sea.*

Special Areas and Particularly Sensitive Sea Areas

The IMO recognises that particular areas require a stricter regulatory regime for pollution from ships and management of shipping routes → **FIGURE 9.2**:

- The North Sea was designated a Special Area under MARPOL Annex V in 1991. More stringent restrictions for discharges of garbage apply in this area.
- The North West European Waters were designated a Special Area under MARPOL Annex I in 1999 leading to more stringent restrictions on the discharge of oil and oily waste in this area.
- The North Sea was designated a Sulphur Oxides (SO_x) Emission Control Area (SECA) under MARPOL Annex VI in 2007. Ships must comply with more stringent emission and fuel quality requirements if they want to pass through this area. Ships in the area are only permitted to burn low sulphur content fuel.
- The Wadden Sea and the Western European Waters were designated Particularly Sensitive Sea Areas (PSSAs) in 2002 and 2004, respectively, in recognition of their ecological, socio-economic or scientific importance.

Did it work? How does this affect the quality status?

Some signs of decreasing oil pollution in the North Sea

Because the North Sea has been designated a Special Area under MARPOL Annex I, the discharge of oil or oily waste is more stringently regulated. Nevertheless, aerial surveillance conducted under

the Bonn Agreement suggests that illegal discharges of oil or oily wastes are still occurring → **FIGURE 9.3.** Limited data are available to quantify how much oil has been spilt in the OSPAR area since 2000 as a result of incidental and illegal discharge. For around 80 % of slicks detected using aerial surveillance it is not possible to identify the polluter. This means it is not possible to quantify how many of the slicks are attributable to shipping. Monitoring for the North Sea Ecological Quality Objective (EcoQO) on oiled guillemots suggests that oil pollution at sea has been decreasing → **BOX 9.2.**

Incidental spills can cause severe damage

Incidents involving spills from ships carrying oil and other hazardous or toxic substances can have severe effects on the marine ecosystem. The effects may be short- or long-term depending on climatic and environmental conditions at the time of the spill and the sensitivity of the area. The *Prestige* oil spill demonstrates the importance of enforcement of IMO ship standards, appropriate risk response and management of shipping lanes in ecologically sensitive areas to reduce risks of incidents and impacts of oil spills → **BOX 9.3.** Since 1998, a number of incidents have occurred in the OSPAR area involving loss of cargo (e.g. chemicals, timber, containers) and of ships. In most cases, there is limited information to assess the environmental impact of these losses. Improved controls on the securing of cargoes could work to minimise cargo loss.

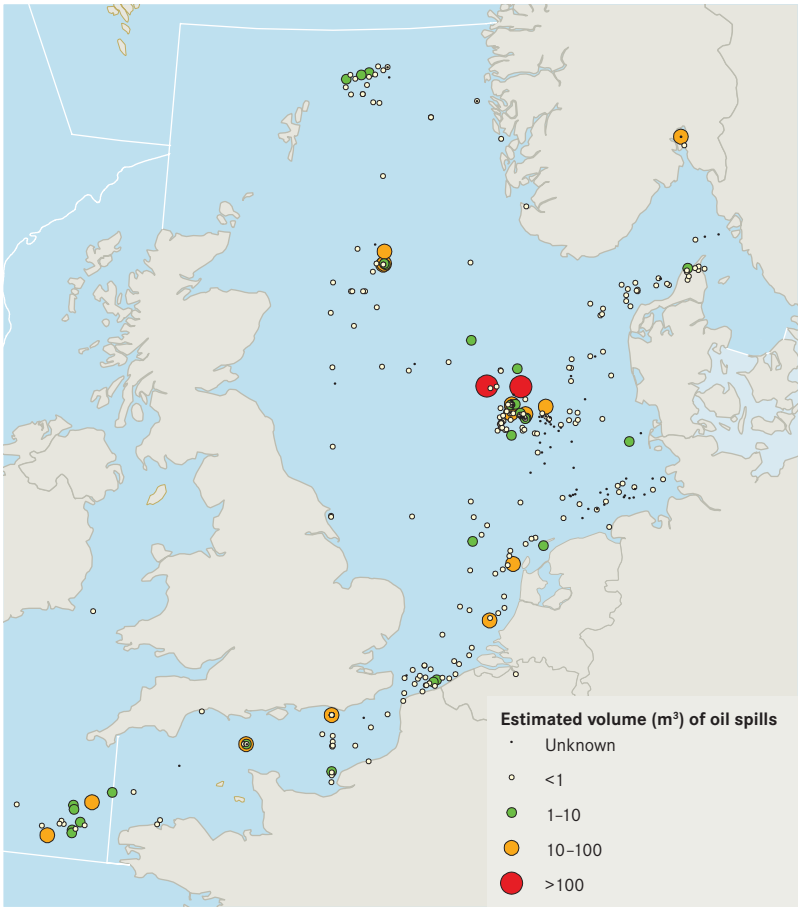


FIGURE 9.3 *Oil spills detected using aerial surveillance in the North Sea in 2008. Based on observations by Belgium, Denmark, France, Germany, Netherlands, Norway, Sweden and the UK. Data source: Bonn Agreement.*

BOX 9.2 Reduced rate of oiled guillemots indicates decreasing oil pollution in the North Sea

North Sea EcoQO: The average proportion of oiled common guillemots in all winter months (November to April) should be 10 % or less of the total found dead or dying in each of 15 areas of the North Sea over a period of at least 5 years.

Guillemots are deep-diving seabirds that are common and widespread throughout the OSPAR area. They are very sensitive to oil pollution. A guillemot will soon die once it is oiled, due to hypothermia and because it is unable to forage and feed. These dead birds wash ashore and the proportion of stranded guillemots that are oiled can be used as an indication of oil pollution in specific areas.

In some parts of the North Sea, over 90 % of all stranded common guillemots were oiled until only a few decades ago. Since then rates of oiled birds have declined substantially in most areas. This is thought to be the result of better enforcement of measures, improved awareness and the introduction of port reception facilities for waste oil. However, the EcoQO is achieved in very few parts of the North Sea. Current rates of oiled birds in the North Sea vary significantly from over 50 % in the southern North Sea (the Netherlands, Belgium and south-east England) to approximately 4 % in Orkney in the northern North Sea.

The main inputs of mineral oil originate from operational discharges from ships, land-based sources and, to a lesser extent, from the offshore oil industry. This partly explains why higher bird oiling rates are seen near busy shipping lanes (southern North Sea, Channel). Accidents at sea are a less frequent source.

Since the discharge of oil or oily mixtures that cause slicks is prohibited in the North Sea, management measures need to focus on the further enforcement of current regulations and raising awareness among operators of vessels to reduce illegal oily discharges.

BOX 9.3 The long-term effects of the *Prestige* oil spill are not yet known

In 2002, the 26-year old, single-hull tanker *Prestige* started leaking heavy fuel oil from its 77 000 tonne cargo following an incident 50 km off the Galician coast of northern Spain. The *Prestige* was towed out to sea. During this operation it broke in two in a storm and sank some 200 km off the coast coming to rest at 3600 m depth on the slopes of the Galicia bank seamount where the wreck continued leaking oil.

An estimated 64 000 tonnes of oil were spilled and polluted the seabed and more than 1000 km of coastline in Spain and France. The immediate area affected off Galicia is an area of ecological importance supporting cold-water coral reefs and deep-sea sponges. The area is also important for the fisheries on which 60 % of the Galician population depends.

Initial effects on seabirds were profound. Of the 20 000 oiled birds collected, 75 % were dead and few of those collected alive were able to recover. The last remaining Iberian populations of the guillemot were among the worst affected. Given the widespread and long-term impact of the oil spill on the Atlantic coast, estimates suggest that the total number of birds affected was much higher, up to some hundred thousand.

Biomarker measurements in fish showed that large areas of the northern Iberian shelf were affected by oil from the *Prestige* and that measurable effects decreased over the period 2002 to 2005 indicating a recovery of the water quality. Little is known about the effects of the oil pollution on the deep seabed and its biological communities and the rate of recovery.

Air pollution from ships is increasing

Emissions of nitrogen oxides (NO_X), SO_X and particulate matter from engine exhaust gases and cargo tanks may be carried long distances. Most emissions in EU sea areas are from cargo ships over 500 gross register tonnage. Around 45 % of all emissions are from EU-flagged ships and around 20 % of emissions are emitted within 12 miles of the coast. The total contribution of NO_X from international ship traffic in the North Sea and the Atlantic was 1850 kt in 2007. This is an increase of more than 20 % since 1998. Without the strict standards of the revised MARPOL Annex VI adopted in 2008, emissions from international shipping would have been expected to increase substantially. Models predict that by 2020 emissions of sulphur dioxide, NO_X and particulate matter from international shipping in all EU seas would have increased from their 2000 levels by 40 % (3200 kt), 45 % (4800 kt) and 55 % (400 kt) per year, respectively → **FIGURE 9.4**. Implementing the more stringent emissions standards in the amended MARPOL Annex VI will help target air pollution and should be given high priority, particularly in light of the expected increase in ship traffic. Even stricter standards apply in designated NO_X and SO_X Emission Control Areas. As a SECA, the North Sea currently profits from the more stringent ship fuel regulation for SO_X, but this still allows sulphur contents in fuels 15 000 times that

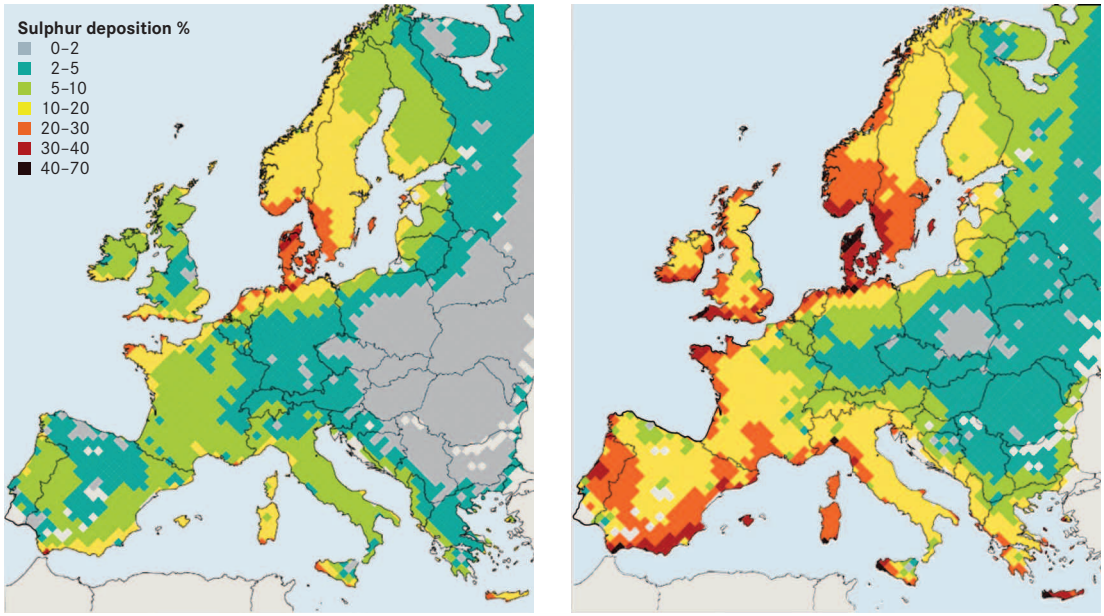


FIGURE 9.4 *Percentage of atmospheric deposition of sulphur originating from international shipping in 2000 (left) and projected for 2020 if no action is taken (right). Emission controls as a result of revisions to MARPOL Annex VI adopted in 2008 are expected to progressively reduce deposition. Source: IIASA, 2007.*

of fuel for road vehicles. Moreover, fuel regulations under MARPOL Annex VI address only sulphur and not other polluting substances. This is a gap that needs to be closed. Despite a large amount of information on inputs via the atmosphere, there is limited understanding of the contribution of shipping to environmental impacts.

Ships also emit ozone-depleting gases (e.g. from incinerators and cooling installations) and greenhouse gases from engine exhausts and so contribute to global emissions. A recent IMO study estimates that shipping emitted 1046 million tonnes of carbon dioxide (CO_2) globally in 2007, which is 3.3% of total world-wide CO_2 emissions in 2007. Most of these emissions (870 million tonnes or 2.7% of global CO_2 emissions) have been attributed to international shipping.

The IMO is currently working towards measures to reduce greenhouse gas emissions from shipping. The EU also targets air emissions from shipping through its 2005 Thematic Air Strategy. OSPAR countries support these initiatives.

Illegal discharges and disposal of waste are still occurring

Illegal disposal of waste (litter) from ships can be as detrimental to marine life as oil or chemicals. The greatest danger comes from plastics. Discharge of garbage is regulated through MARPOL Annex V. This prohibits the disposal of plastics anywhere into the sea, and severely restricts discharges of other types of garbage from ships to coastal waters and Special Areas. While shipping is acknowledged as a major source of marine litter it is difficult to quantify the exact amount as many litter items can be attributed to more than one source.

The effects of sewage discharges on water quality and in relation to eutrophication are thought to be minimal provided they comply with MARPOL Annex IV. In the open sea, raw sewage is assimilated through natural bacterial action, but illegal sewage discharges near the coast may be a problem locally.

Lack of data prevents assessment of port waste reception facilities

According to MARPOL, oily ballast and tank washing water, oily bilge water and wastes should be retained on board until they can be delivered to port waste reception facilities. It is difficult to identify improvements brought about by the introduction of port waste reception facilities because there are few data on the amounts and types of wastes handled. Prior to the implementation date of measures there was no reporting system in place and most waste operations in ports are contracted out to private operators which rarely report to port authorities.

TBT losses are expected to cease

There has been much progress towards the phasing out of tributyltin (TBT) → CHAPTER 5. Following the global ban on TBT in anti-fouling systems through the IMO, the release of TBT from ships' hulls is expected to cease with an associated decline in effects on marine species from TBT. However, losses of TBT substitutes (such as copper and Irgarol) are expected to increase. It has been estimated that ships in the Netherlands' Exclusive Economic Zone (EEZ) collectively release up to 30 tonnes of copper into the North Sea each year, both in transit and at anchor → FIGURE 9.5. There has been some progress in the development of non-biocidal

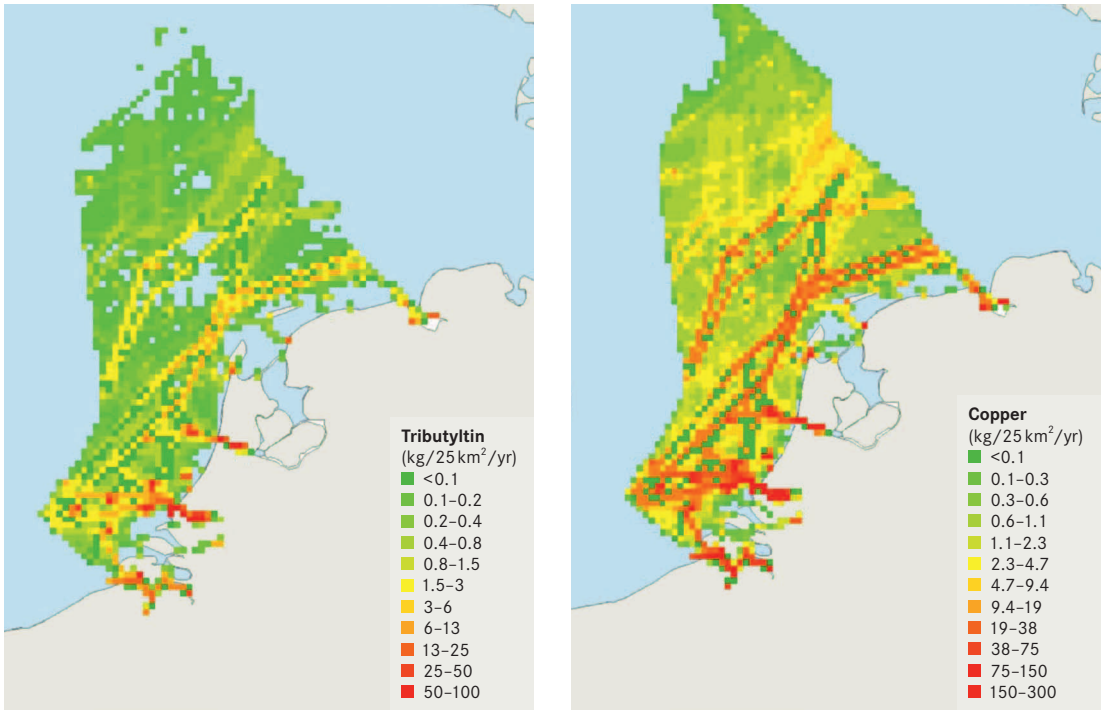


FIGURE 9.5 *Estimated losses of TBT and copper from ship coatings at sea (excluding fishing vessels) in the EEZ of the Netherlands in 2007.*

alternatives to TBT and copper such as self-polishing surfaces and non-sticky paints.

Introductions of non-indigenous species through ballast water continue

Over 160 non-indigenous species have been identified in the OSPAR area, as reported later in this chapter. Some of the main routes for these unintended introductions are through the discharge of ballast water (and the sediments that it carries) and fouling on ships' hulls. The risk of new species introductions is related to the amount of ballast water discharged, the frequency of ship visits and the match between environmental conditions where ballast water originated and where it is discharged. With increasing ship traffic there is a higher risk that new species will be introduced. Faster ships and shorter journey times mean that organisms have a greater chance of surviving the voyage.

Non-indigenous species can severely affect the structure of ecosystems. For example, the comb jelly (*Mnemiopsis leidyi*) which feeds on zooplankton and fish eggs was introduced to the Black Sea through ballast water in the 1980s and has been associated with dramatic changes in the pelagic food web and the collapse of commercial anchovy fisheries. The species was first recorded in the Netherlands, Norway and Sweden in 2006. So far, effects on the North Sea trophic structure and on fish stocks are unknown. Milder winters due to climate change are expected to favour its expansion. There is a need for OSPAR countries to ratify and implement the IMO Ballast Water Convention and to assess the risk of new species introductions.

Comb jelly

Increasing concern over noise and ship strikes

There are growing concerns over pressure on marine mammal populations due to noise from shipping and the risk of ship strikes, especially along migration routes in Regions I, IV and V. Ship traffic has been shown to be a dominant source of low frequency noise in many, if not most, coastal zones with high ship traffic. It is estimated that there has been an approximate doubling (3 dB increase) of background noise per decade since the 1950s in some sea areas. Commercial shipping is the most probable source of this increase. The development of faster and larger ships, and growth of ship traffic have increased concern about the risks associated with ship strikes. Collisions with ships are known to be fatal for whales, especially larger species, and may be a threat to vulnerable populations in waters with high levels of shipping.

Pressures on the environment are expected to increase

Predictions for shipping for the period to 2020 are difficult, due to confounding economic factors such as oil price and geopolitical issues. However, through-traffic of oil tankers is predicted to increase with higher environmental risks in the busier shipping lanes especially in Region II. Shipping is expected to increase in Region I, where sea-ice retreat and new technology are expected to afford new opportunities for exploiting Arctic resources (hydrocarbons, minerals, fisheries). The most significant threats from Arctic shipping are oil discharges.

With growing ship traffic and vessel size, increasing pressure can be expected from dredging and dumping of sediments from shipping channels, land reclamation and the construction of port facilities. These pressures are mainly concentrated on coastal areas where increasing pressures may conflict with nature conservation objectives for areas of particular ecological value.

Fin whale showing marks of ship strike in the Mediterranean Sea

What happens next?

Implementing and enforcing existing measures are the priorities

There has been significant progress in the development of measures to address pressures from shipping on the marine environment. The implementation of these measures, especially MARPOL Annexes I to VI, and their enforcement is essential to reducing pollution from ships.

OSPAR should promote the strict implementation of existing measures and, where appropriate, should seek to influence those international organisations with the competence to improve enforcement of shipping regulations at sea. OSPAR should assess the effectiveness of these measures through improved data collection on, and continued monitoring of, key pressures and impacts of shipping on the marine environment.

OSPAR should promote action by OSPAR countries within the framework of the International Maritime Organization (IMO):

- To implement the 'clean ship' approach agreed under the Gothenburg Declaration in maritime and environmental policies.
- To develop improved practices and innovative technologies for ships in port and at sea to help reduce current and future emissions of greenhouse gases, NO_X, SO_X and particulate matter, taking into account the relevant IMO regulations.
- To provide effective port reception facilities for litter and oily waste and apply best practice as recommended by the IMO.
- To implement the global ban on the use of organotin compounds in anti-fouling systems in ships.

OSPAR should further assess effects of ship noise and ship strikes on marine mammals in cooperation with the relevant international organisations, and work with the IMO in developing and implementing mitigation strategies.

A range of initiatives is needed to mitigate effects

OSPAR countries should undertake the following range of initiatives to mitigate the effects of shipping in the North-East Atlantic:

- Cooperate in the field of oil spill prevention and implement, as soon as possible, the IMO regulations aiming at reducing the risk of collisions and grounding, and the associated impacts from accidental spills and losses of cargo.
- Cooperate in contingency planning and counter-pollution responses. This should be done through the Bonn Agreement in Region II; through the development of response capacities and international cooperation agreement(s) in the Arctic; and, once entered into force, through the Lisbon Agreement (Cooperation Agreement for the Protection of the Coasts and Waters of the North-East Atlantic against Pollution) in Region IV and some adjacent areas of Region V.
- Apply the global and regional measures for preventing the spread of non-indigenous species via ballast water. The D1 Ballast Water Exchange Standard should be applied in the North-East Atlantic in the interim period before the more stringent D2 Standard comes into force.
- Ratify the IMO Ballast Water Convention and work to promote its entry into force. OSPAR countries should also assess the risk of introducing non-indigenous species so that appropriate regional and national preventive measures can be implemented.
- Consider the development of systems to collect and store accurate and comparable data that can be used to assess the impact of shipping on the marine environment.
- Cooperate closely with respect to shipping in the Arctic and promote related work by other international forums, particularly the IMO and the Arctic Council. Priority issues include the update and mandatory application of the IMO Guidelines for ships operating in Arctic ice-covered waters (the 'Arctic Guidelines') and, where necessary, the designation of 'Special Areas' or 'Particularly Sensitive Sea Areas', and better passenger ship safety.

TOURISM AND RECREATIONAL ACTIVITIES

Tourism is leading to increasing demand for space and increasing pressures on species and habitats. Special attention should be given to growing pressure from tourism in remote areas.

Key OSPAR assessment → Environmental impact of tourism and recreational activities

Many coastal areas in the North-East Atlantic are popular holiday destinations. Since the 1990s, the total number of tourists visiting the OSPAR Regions has increased steadily, growing from around 100 million in 1998 to around 146 million in 2007 → **FIGURE 9.6.** There are continued increases in coastal infrastructure, including for accommodation and service, and an increasing demand for resources, especially in Region IV, the southern part of Region II and parts of Region III.

The growth of tourism has increased pressure on natural areas and fragile ecosystems, such as dunes, cliffs and wetlands. Tourism also contributes to pollution, marine litter and coastal erosion. Beach tourism and recreational boating are widespread forms of coastal or sea-based tourism and have direct effects on marine species and habitats. Cruise tourism has steadily increased and is expected to continue growing. Other recreational activities that can put pressure on the marine environment include scuba-diving, angling and whale-watching.

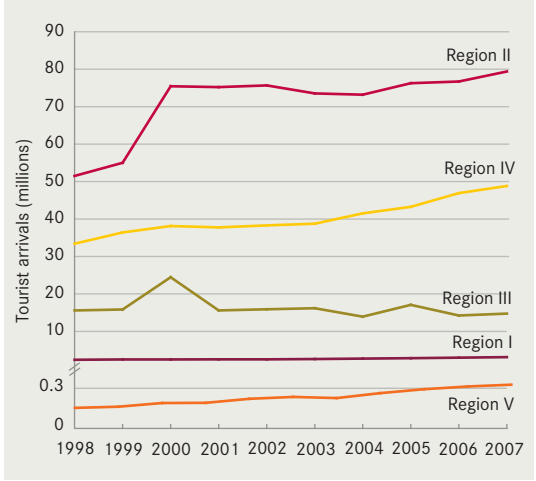


FIGURE 9.6 *Tourist arrivals to coastal areas in the OSPAR Regions (1998–2007). Data source: Eurostat.*

A particular concern is habitat fragmentation caused by tourism-related development, especially along the coasts of Regions II and IV. Another concern is the disturbance of beach-dwelling species by tourists during the breeding season. For example, the little tern has suffered reduced breeding success in the southern North Sea. Seagrass meadows (*Zostera* sp.), which OSPAR has identified as a habitat in need of protection, are impacted by recreational boating, both from frequent anchoring and from dredging to increase water depth. The growing attraction of remote areas as tourist destinations, including in the Arctic → **BOX 9.4**, puts these relatively pristine areas under pressure.

OSPAR is working to address some of the main impacts from activities associated with tourism, such as nutrient inputs from sewage → **CHAPTER 4**, effects of dredging and marine litter. Efforts to comply with the EU Bathing Water Directive provide a focus for water quality in coastal areas. OSPAR countries have also undertaken various actions to preserve their coasts from excessive development. These have been supported by the designation of Natura 2000 sites, OSPAR marine protected areas (MPAs)

BOX 9.4 Cruise tourism in the Arctic

Arctic cruising has seen significant growth in recent years. The Svalbard archipelago (Norway), often referred to as Spitsbergen, is one of the most popular destinations in the Arctic. The number of sites visited has increased from 64 in 1996 to 160 in 2008. In 2008, 97 704 tourists visited Svalbard. All recreational ships coming to Svalbard are required to notify the Governor of Svalbard and obtain approval for their travel plans in advance of their trip.

Cruise ships represent a source of disturbance and pollution in areas that are not otherwise affected. The biggest single threat posed by ship-based activities on Svalbard is from a major oil spill. Other environmental threats include degradation of regularly-visited sites, air pollution, discharges of sewage and waste water and introduction of non-indigenous species.

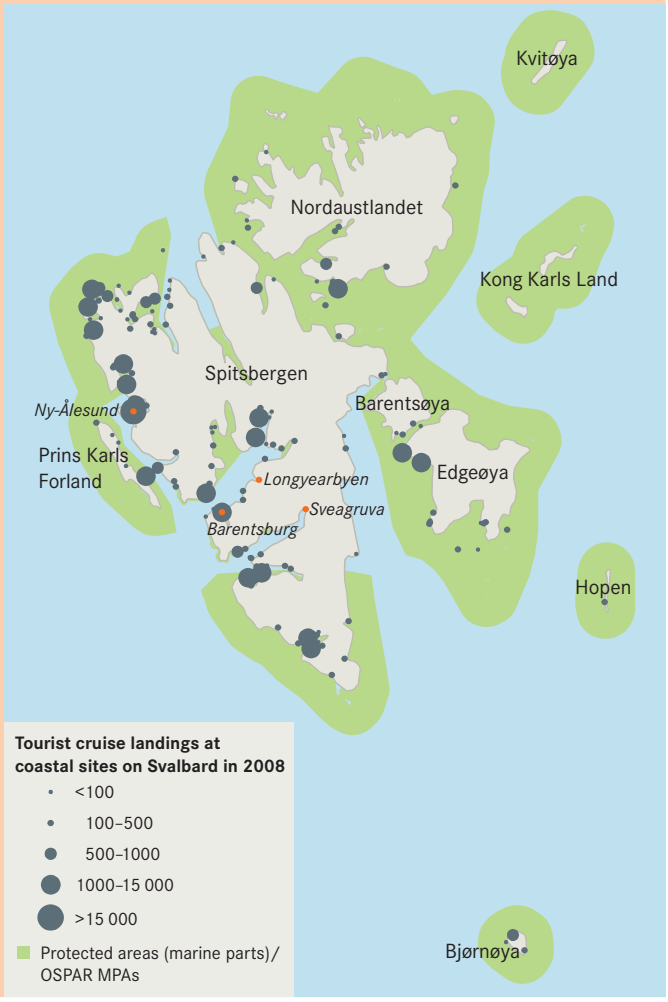
Norway has established a number of protected areas to conserve the archipelago's natural and cultural values. Where national parks and nature reserves border the sea, their boundaries extend 12 nautical miles out from shore. These marine areas have been included in the OSPAR network of MPAs. Voluntary guidelines, such as the 'Ten Principles' for Arctic Tourism developed by WWF International together with local communities, tour operators and other stakeholders, help to reduce negative impacts.

Ny-Ålesund, a scientific community on the west coast, is the world's most northerly permanent settlement and is popular with cruise ships. The annual influx of 15 000 to 20 000 tourists has forced the development of a code of conduct for tourists to reduce their impact on the local environment and research programmes.

Tourist pressure is also managed by restricting access to land areas. In addition, there are time limits imposed on anchoring by ships at Ny-Ålesund.

It is likely that Svalbard will continue to be a popular cruise destination. There is also a possibility that more remote areas of the archipelago will be impacted as larger ice-class vessels are commissioned and the extent of summer sea ice is reduced due to climate change.

Text based on WWF (2004); map based on data from the Governor of Svalbard.



and national marine parks → CHAPTER 10. The European Commission's proposed strategy on Integrated Coastal Zone Management (ICZM) and the recommendation of the European Parliament and the Council concerning the implementation of ICZM could contribute to minimising impacts on the marine environment while supporting sustainable tourism, if effectively implemented. In this context, implementing marine and coastal spatial planning policies, the use of guidelines and principles for sustainable tourism, and the designation and management of protected areas should be encouraged. OSPAR should keep under review the extent of impacts from tourism-related pressures as the industry develops further.

WIND FARMS

Offshore wind energy production is projected to increase rapidly. Careful planning and site selection is needed. Operators should follow OSPAR guidance to minimise environmental impacts. OSPAR Contracting Parties should cooperate to monitor these impacts and address gaps in knowledge.

Key OSPAR assessment → Environmental impact of offshore wind farms

Over the past ten years, energy production by offshore wind farms has emerged as a new use of coastal and shallower offshore waters → **FIGURE 9.7**. Operation and proposed development of offshore wind farms is currently limited to Regions II and III. In 2009, 17 wind farms with a total of 713 turbines were either operational or under construction covering an area of over 500 km^2. These will have a combined capacity of almost 1900 MW. Around 800 turbines are expected to be operational by 2010. The development of large-scale offshore wind farms is being driven by demands for increased renewable energy production as a result of policies to reduce reliance on fossil fuels and to mitigate the effects of climate change. The EU is committed to having 20% of its energy production from renewable sources by 2020. By the end of 2009 a further 50 wind farms (2490 turbines) had been authorised, but construction work for most was still to start. Applications had been submitted for another 74 (2463 turbines).

Impacts arise throughout the life cycle of wind farms, including: site selection, construction, operation, decommissioning and removal. Impacts include the effects of noise on marine mammals and fish, disturbance and loss of habitats, bird collisions and visual intrusion. Wind farms can also interfere with other uses of the sea – causing hazards to shipping and the servicing of the offshore industry, and displacing fishing activities and recreational boating. There may also be conflict with marine conservation objectives.

Knowledge of the wider effects of offshore wind farms on environmental quality is limited and mainly based on data from monitoring at specific sites, similar activities, government sponsored research and development, and predictions from EIAs. Monitoring of bird abundance in the vicinity of the *Horns Rev* and *Nysted* offshore wind farms off Denmark shows a statistically significant decrease in numbers of some seabird species up to 2 km from the wind farms. Such displacement could potentially give rise to a loss of feeding grounds. Marine mammals have been disturbed by noise from pile driving up to 20 km from the *Horns Rev* wind farm. As with other construction on the seabed, wind farms may also have positive impacts, for example,

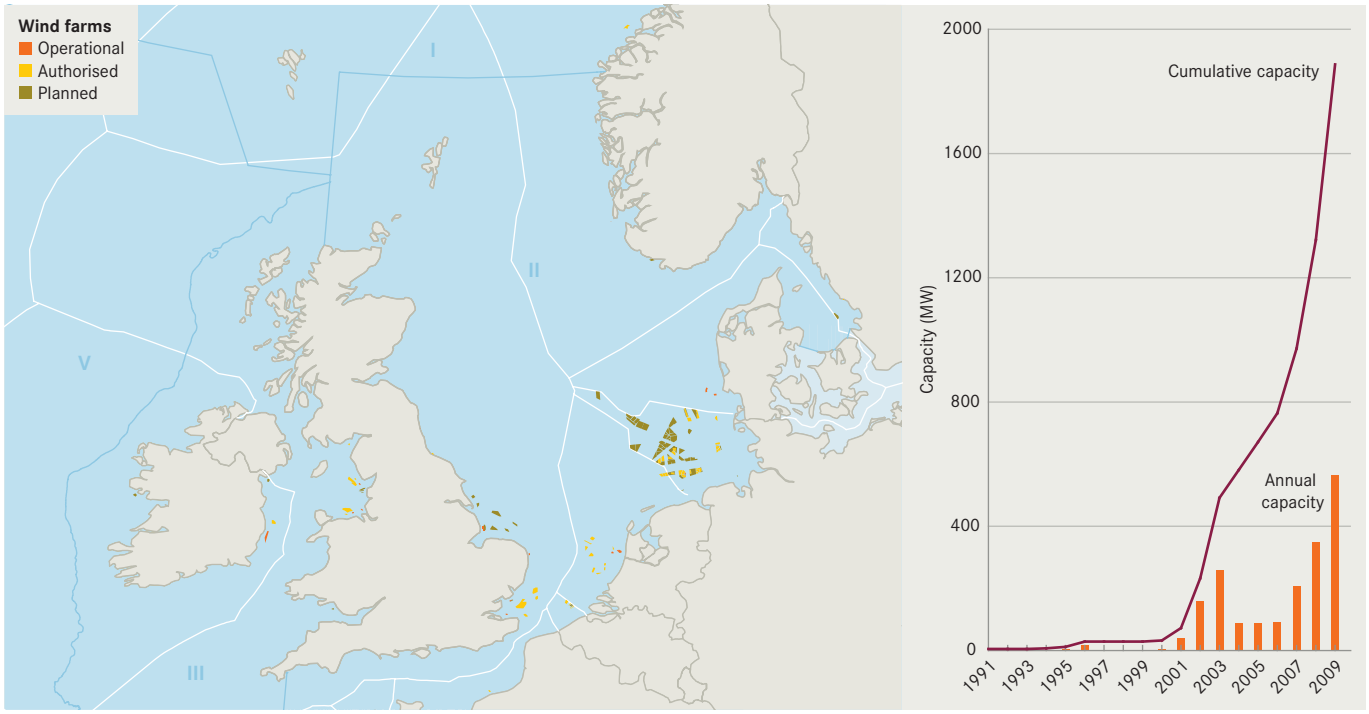


FIGURE 9.7 *Location of operational, authorised and planned wind farms in the OSPAR area in 2009. The graph shows trends in the development of wind power since the 1990s. Data source: OSPAR database on offshore windfarms and development of offshore wind power in the OSPAR maritime area (1998–2009). Source: European Wind Energy Association, offshore statistics 2009.*

Horns Rev offshore wind farm, Denmark

by restricting other human activities, such as fishing. The degree and extent of these benefits is still being established.

Currently, the location, size and separation of the relatively few operational offshore wind farms in the OSPAR area are such that population-scale impacts on marine organisms have not been found. However, many proposed wind farms are more extensive than those in operation and in some cases several hundred turbines are planned per farm. The potential for cumulative and transboundary effects (particularly on migratory species) will increase as more wind farms are developed.

OSPAR has developed guidance on environmental considerations for the development of offshore wind farms. This recommends best practices to assess, minimise and manage the potential impacts of wind farms. All OSPAR countries have national approval procedures for marine developments; Germany, the Netherlands and the UK have specific guidance for offshore wind farms. OSPAR has a database on operational and proposed sites and promotes the exchange of information through its website.

Many of the environmental impacts associated with offshore wind farms can be mitigated through national licensing procedures. These should ensure that the OSPAR guidance is followed, in particular, that sites are selected to avoid important seabird feeding areas, construction is timed to minimise effects on spawning fish, and routes taken by construction vessels are positioned to minimise disturbance to seabirds. Monitoring at operational wind farms will provide the basis for better management at future wind farms.

With the expected increase in the number and scale of offshore wind farms beyond 2010, OSPAR will need to address the gaps in knowledge about the effects of wind farms on the marine ecosystem. Information from monitoring of operational wind farms should be exchanged and assessed. Impacts from wind farms need to be kept at acceptable levels in relation to reference populations of species that are affected. These could be populations that are functionally or regionally significant or populations within biogeographic regions or flyways. Where appropriate, consideration of cumulative and transboundary effects should become a more critical part of the national assessment and consenting process. OSPAR will need to keep under review the need for measures or guidance to address these aspects. In the interim, existing approaches to wind farm management should be followed to ensure that impacts are minimised. These approaches should be supported by measures to mitigate effects such as underwater noise (e.g. from pile driving during construction), electromagnetic fields, bird displacement and physical changes to the seabed.

CABLES

Power cables are regarded as having localised impacts, but there is limited knowledge on their effects on marine organisms, particularly from heat emission and electromagnetic fields.

Key OSPAR assessment → Environmental impact of cables

Submarine cables have a long history in telecommunication services and are increasingly important for transmission of electric power. Most telecommunication cables are located in the southern parts of Region II, Region III and in a transatlantic corridor in Region V → **FIGURE 9.8**. Almost all power cables are located in Regions II and III. Submarine cables are usually buried, but in areas of exposed bedrock they are laid directly on the seabed and may be covered by a protective structure. The development of offshore power generation and transnational energy networks will require new power cables and the need for new communication links is likely to remain high in some areas.

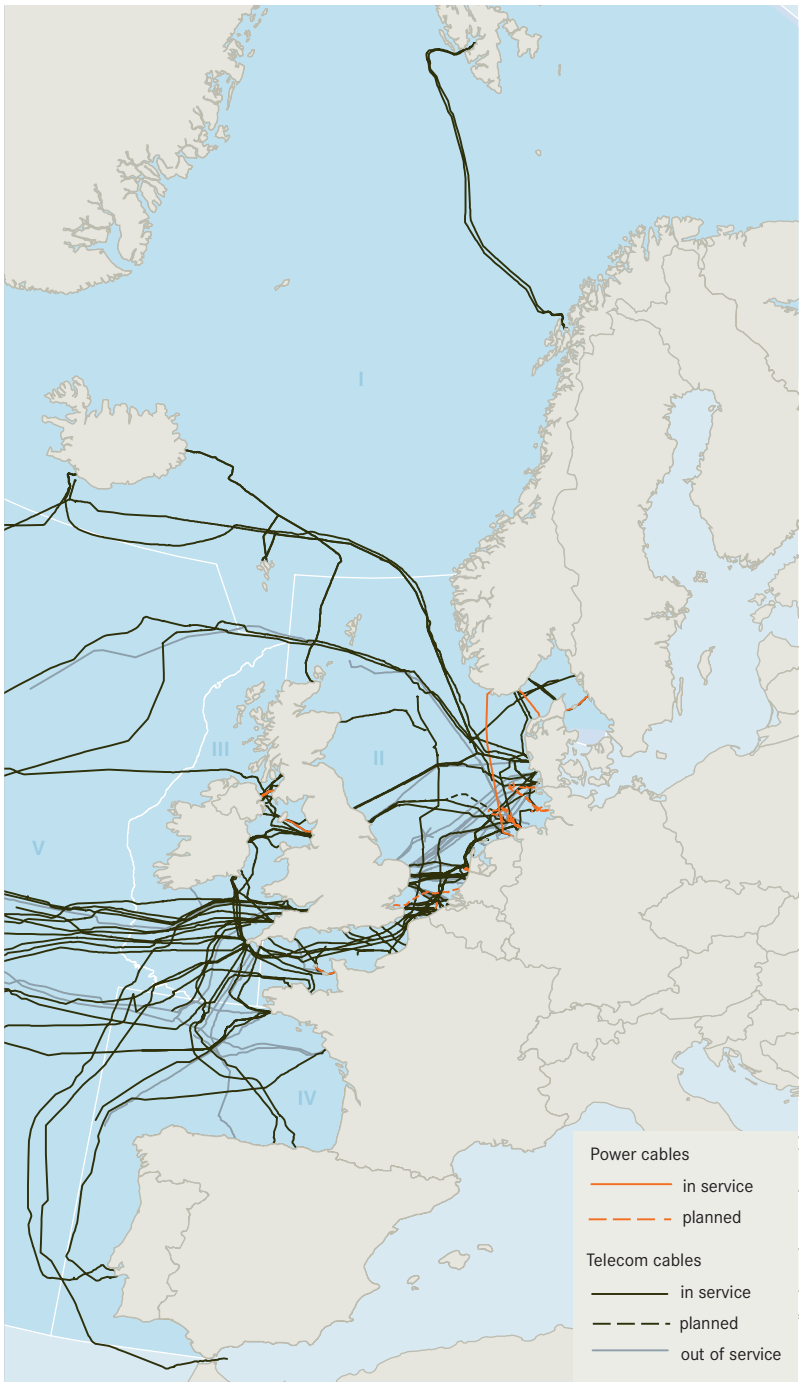


FIGURE 9.8 *Subsea cables in the OSPAR area (data incomplete). Composed from different sources by the German Federal Agency for Nature Conservation.*

Placement and removal of power cables causes temporary local disturbance of the seabed. There are also a range of permanent environmental effects. These include the settling of non-indigenous hard-substrate species on unburied cables or protective structures. During operation, electromagnetic fields from power cables may affect the behaviour and migration of fish and marine mammals that use electric fields or the Earth's magnetic field for orientation. Heat from power cables may affect bottom-dwelling species and biogeochemical processes. These effects need further study.

So far, no common programmes or measures for the placement of subsea cables have been developed either by OSPAR or by other organisations, but some OSPAR countries subject the placement and operation of cables to licensing procedures.

Mitigation measures should be used, such as the choice of cable type, appropriate selection of burial or surface laying and scheduling placement according to the sensitivity of local habitats. OSPAR should develop guidelines to help OSPAR countries assess the environmental effects of cables. Research is needed on the effects of heat emission and electromagnetic fields and the impact of burial and removal operations on marine organisms.

LAND RECLAMATION, COASTAL DEFENCE AND OTHER STRUCTURES

There are increasing demands for coastal defence in Regions II and III. Local management needs to take into account regional-scale effects, such as sediment balance.

Key OSPAR assessments

- → Environmental impact of land reclamation
- → Environmental impact of coastal defence structures
- → Environmental impact of construction or placement of structures

Various artificial structures have been constructed within the OSPAR area. Land has been reclaimed to extend ports and provide associated industrial zones and various sites have been proposed for future land reclamation projects. Coastal defence structures have been installed to prevent erosion and protect against flooding at vulnerable sites. Many ports, marinas, piers and other infrastructure have been created. It is estimated that over 13 000 individual structures have been placed in the OSPAR area → **FIGURE 9.9**.

Construction activities can have a range of impacts on the marine environment. They may cause loss or damage of coastal habitats and changes to the physical nature of the seabed, which in turn cause erosion, sedimentation and physical and chemical disturbance of ecosystems. While the structures are under development there may be more underwater noise, water pollution (e.g. higher turbidity), and air pollution. Foraging or breeding seabirds and marine mammals are affected by visual or noise disturbance. There may be a loss of space for human activities, such as coastal fishing.

Since 1998, OSPAR countries have reported on the reclamation of around 145 hectares from the sea and coastal wetlands, mainly in the form of small-scale developments. Most sites, including the largest, are located in Region II. Typical habitats affected by land reclamation and the construction of other structures include sandbanks, estuaries, mudflats and salt marshes. Long-term growth in world trade is likely to lead to more development of shipping-related infrastructure.

Extensive lengths of coastline in the OSPAR area are protected against erosion by coastal defence structures. Techniques employed include dykes, groyne fields, seawalls, and beach nourishment schemes to replace sand lost from beaches. The almost unbroken line of coastal defence schemes protecting the southern coast of the North Sea and parts of its west coast has caused extensive fragmentation of habitats. Hard-engineered coastal defence structures, such as seawalls and dykes, change ecosystems and create new hard-bottom habitats. Soft-engineering coastal structures, such as dunes and salt marshes, are increasingly being

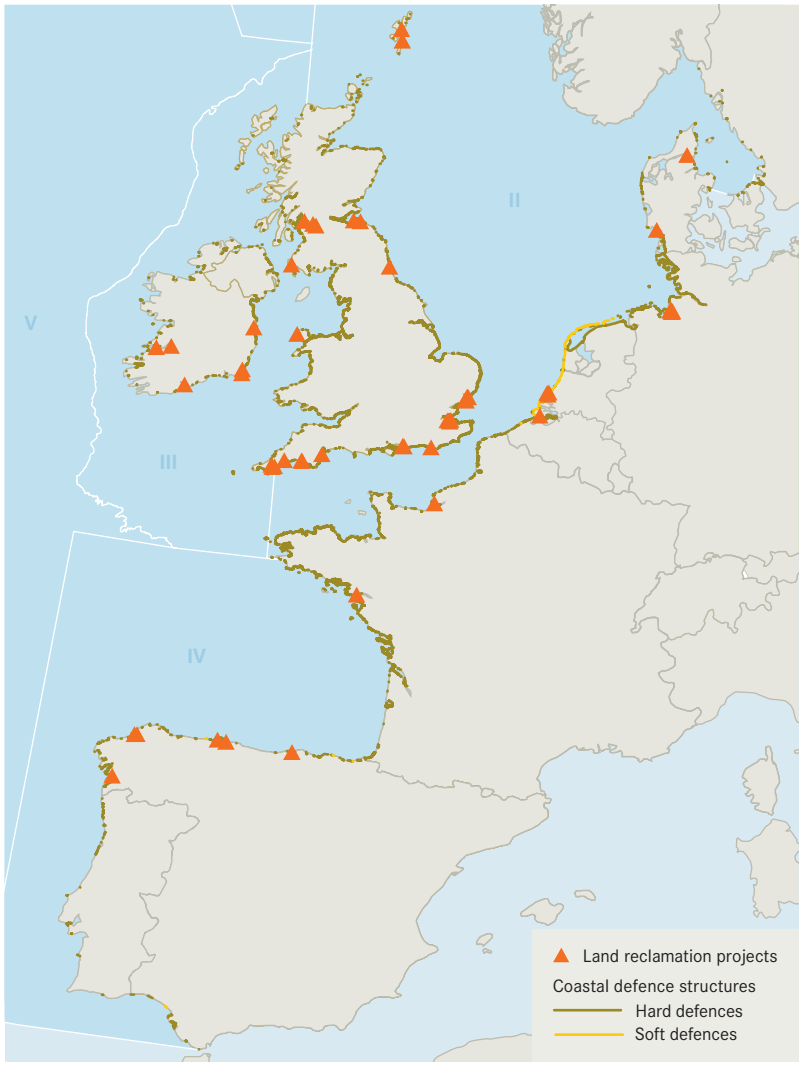


FIGURE 9.9 *Location of land reclamation and coastal defence structures.*

BOX 9.5 Extension of Rotterdam harbour

Artist's impression of the Maasvlakte extension to the harbour of Rotterdam (Source: Port of Rotterdam Authority)

The Maasvlakte extension to the harbour of Rotterdam built in 1970 is one of the largest land reclamation projects in the OSPAR area to date, covering 2000 hectares. An extension to this site, *Maasvlakte 2*, was proposed in 1997 comprising a further 2000 hectares to provide port facilities and deep water wharfs for container ships, chemical carriers and other large vessels. Reclamation began in September 2008 with the aim that the new facility would be operational from 2013 onward and completed in 2033.

A series of environmental assessments were published in 2007 to comply with national and EU regulations. The studies concluded that, although the project design minimises environmental impact as far as possible, there were unavoidable environmental impacts on water quality from the increased levels of shipping.

This is mostly due to the use of organotin compounds in anti-foulants on vessels from outside the EU. *Maasvlakte 2* is sited in and near an EU Natura 2000 area (Voordelta), which is also an OSPAR MPA, and will result in important ecological values and habitats being lost. There will be a loss of 2.8 % (2455 ha) of shallow sandbanks (a habitat of community interest under the EU Habitats Directive). This will be compensated by improving shallow sandbank habitat quality in the Voordelta in an area ten times larger than the affected area (24 550 ha). The significant loss of feeding and/or living area for the sandwich tern (1.7 %), common tern (5.9 %) and common scoter (3.1 %) will be compensated by measures that guarantee extra quiet areas for birds. Permits requiring the compensation scheme are based upon worst-case scenarios, but acknowledge uncertainties in the prediction of longer-term impacts. An extensive monitoring programme is required to identify additional compensation measures that may be necessary.

employed to act as natural buffers against rising tides. These work with the coastal sediment balance to ensure coastal stability. Beach nourishment means more marine sand and gravel extraction. The projected rise in sea levels, storm frequencies and wave loads is likely to increase the need for coastal protection measures, especially in the southern North Sea.

OSPAR countries regulate land reclamation, coastal defence works and the construction of other structures through national legislation. The aim is to minimise and put right any adverse environmental effects. National regulations for coastal defence often prioritise natural and soft techniques. This is supported by EU legislation, such as the Environmental Impact Assessment Directive, the Habitats Directive, the Birds Directive and the Recommendation on Integrated Coastal Zone Management.

EIAs for land reclamation, coastal defence works and other structures have identified various effects on marine ecosystems. Although the regulatory system appears adequate for controlling impacts on a site by site basis, in most cases monitoring data are not available to evaluate the actual changes in environmental quality. For the recently started expansion of the port of Rotterdam in the Netherlands (*Maasvlakte 2* project → **BOX 9.5**) an extensive monitoring programme will be carried out to investigate the recovery of benthic fauna, concentrations and spread of suspended matter, physical effects and underwater noise. In developments where negative effects are expected or observed, compensation is often more feasible than remediation.

To help address gaps in knowledge of cumulative and wide-scale effects, a coordinated system is required for collecting and reporting information on land reclamation, coastal defence structures and other artificial structures. This will help improve the effectiveness of regulations and other measures for managing impacts.

OSPAR countries should promote a shift to a sediment management approach and modern methods of soft coastal engineering, which reinforce natural coastal defences (such as salt marshes and dunes) and protect key sources of sediment. OSPAR guidelines should be updated to include best options and practices for use of marine sand and gravel for coastal defence. The updates should reflect the experience of OSPAR countries, strategies under the EU Water Framework Directive and the need to adapt to rising sea levels and increased flood risk.

ARTIFICIAL REEFS

Environmental impacts from artificial reefs should remain localised provided the relevant OSPAR guidelines are followed.

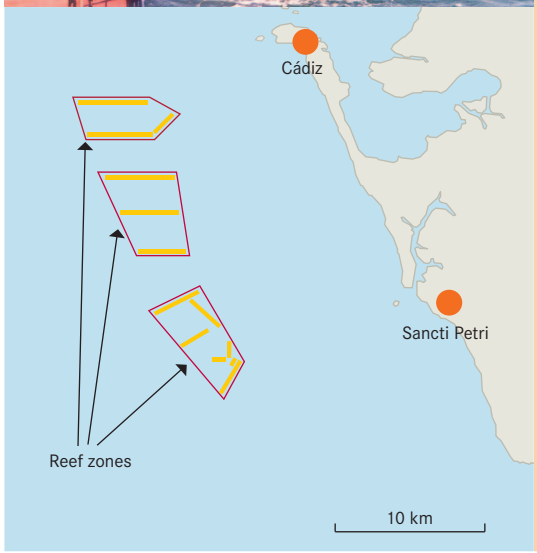
Key OSPAR assessment → Environmental impact of artificial reefs

There are around 50 artificial reefs in the OSPAR area. These are located at various sites within Regions I to IV. There are no artificial reefs in Region V. Most have been created in the past two decades and are purpose-built and made of concrete → **BOX 9.6**. Their purpose ranges from improving marine resources, compensating for, and protecting against, habitat loss, to providing recreational dive sites. Effects on the general biodiversity are unclear and opinions differ as to whether artificial reefs increase the productivity of fish species or whether they serve to concentrate them. Localised impacts on the marine environment are possible, for example, changes to waves and currents and displacement and changes to biological communities. Monitoring confirms that environmental impacts around artificial reefs are local and of limited intensity.

The design, choice of material and placement of artificial reefs in the OSPAR area are mostly subject to national authorisation, supported by EIAs. OSPAR has developed guidelines for artificial reefs that are specifically built for protecting, regenerating, concentrating and/or increasing the production of living marine resources. These recognise that negative impacts are possible at the local scale. The United Nations Environment Programme (UNEP) and the London Convention have prepared guidelines covering artificial reefs built for a wider range of purposes.

Because most of the impacts from artificial reefs are relatively local, as long as there is not a massive increase in the number of reefs and the OSPAR, UNEP and London Convention guidelines are followed, the development of artificial reefs is not expected to have major negative effects in the OSPAR area. However, monitoring the extent of this activity will assist further consideration of its impacts. To facilitate this, OSPAR should establish an inventory of artificial reefs.

BOX 9.6 Sancti Petri artificial reef in the Gulf of Cadiz (Spain)



The Sancti Petri artificial reef is situated off the coast of Cadiz at a depth of between 15 and 40 m (see map). The area attracts a high level of artisanal fishing activity. In 2000, the Spanish Ministry of Agriculture, Fisheries and Food started to develop a reef to protect fish populations from the action of illegal bottom trawlers, thereby reducing catch pressure, avoiding damage to artisanal fishing gear and reducing social conflicts. The reef was completed in 2005.

The reef complex comprises three reef zones, each with three barrier structures placed perpendicular to the favoured trawling routes. The barriers are separated by one nautical mile of free area. The barriers are rectangular structures between 2 and 4 km long and 200 m wide, comprising modular units (see photo).

Each artificial reef unit is a 5.5 tonne reinforced concrete cylinder with a 3 m foot to prevent it from sinking into the seabed. Units are typically placed 75 to 200 m apart to form the barriers. A total of 569 units have been placed creating 2845 m^2 of reef within an overall protected area of 4818 ha.

The performance of the reef is monitored in several ways. Every two years, a structural and functional survey is carried out using side scan sonar. In addition, the artisanal fishing catches are regulated and the fishermen are consulted using opinion polls. The results show a dramatic decrease in illegal trawling activity in the area and an increase in artisanal catch.

The limited spatial extent and inherent physical and chemical stability of the reef mean that no significant impacts have been detected. Entanglement of trammel nets occurs occasionally, but does not appear to result in 'ghost fishing'.

MINERAL EXTRACTION

Sand and gravel extraction can have a range of impacts, such as habitat damage and noise. Existing regulations and guidelines provide a framework for management of impacts. OSPAR Contracting Parties should cooperate to keep under review the impacts from any increases in mineral extraction and give special attention to avoiding damage to OSPAR priority habitats.

Key OSPAR assessment → Environmental impact of sand and gravel extraction

Around 50 to 60 million m^3 of marine mineral deposits are extracted each year, mainly for the construction industry, for use as fill sand on land, or for beach nourishment. Sand and gravel are the main materials extracted, but maerl (calcareous seaweed) is also extracted in France and to a lesser extent in Ireland to improve agricultural soils and as a filtering material in water treatment. Small amounts of shell are extracted in the Netherlands, for example, for paving hiking trails. The greatest amounts of sand and gravel are extracted in Regions II and III, with smaller amounts extracted in Regions I and IV → **FIGURE 9.10**. About 80 % of the total volume extracted in the OSPAR area is

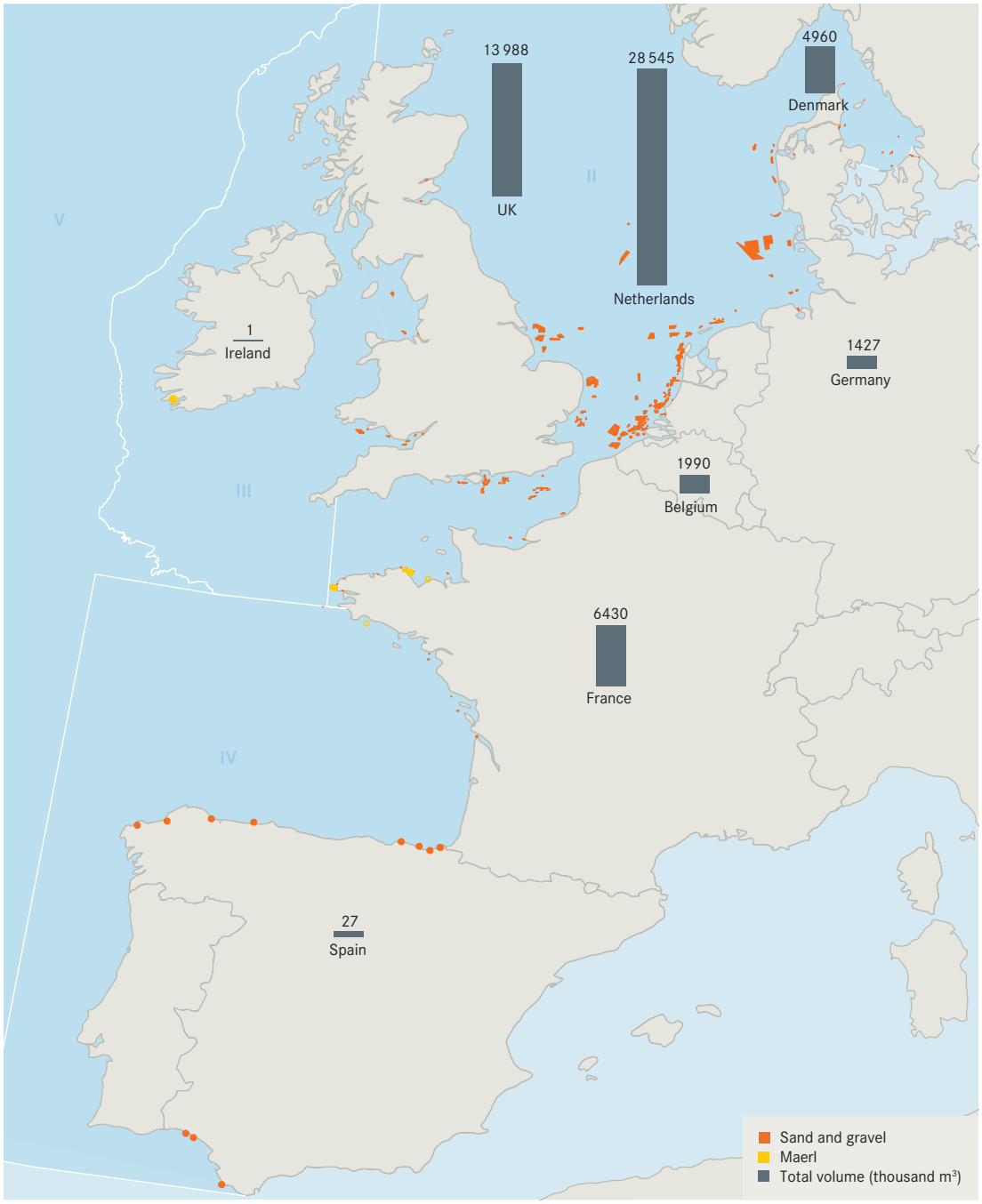
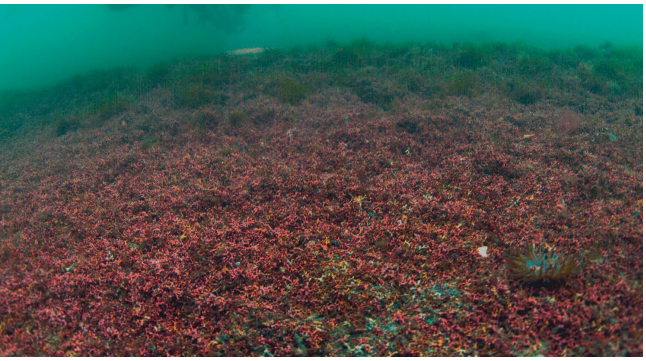


FIGURE 9.10 *Extraction sites for sand, gravel and maerl in the OSPAR area and volumes extracted in 2007.*

extracted in Region II. The biggest extractors are the Netherlands, the UK, France and Denmark. There is no mineral extraction currently in Region V, but the deep seabed is being explored for possible mineral resources, which may be extracted by new technology. Regulation of mineral extraction in the area beyond national jurisdiction is in the exclusive competence of the International Seabed Authority.



Maerl bed

The total quantity of marine sand and gravel extracted has increased by around 30 % over the past decade. However, the total geographical extent of extraction areas has been relatively stable as new concessions have been offset by extraction activity ceasing in some areas.

The main impacts from the extraction of mineral deposits are the removal of substrate and associated organisms, which can affect the stability of the seabed and lead to changes in food webs. Areas from which sand and gravel have been extracted may start to re-colonise quite quickly. Biomass is restored two to four years after short-term extraction activities. Recovery after intensive or protracted periods of extraction takes longer or may not occur at all depending on local conditions. There are also transitory plumes of suspended material, but the impacts, including lowered dissolved oxygen and interference with foraging fish and seabirds, are considered negligible. Extraction also causes underwater noise.

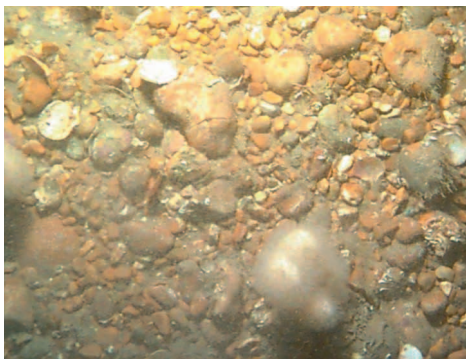
EIAs should ensure that damage or loss of habitats that OSPAR has identified as threatened or in decline, for example, maerl beds or *Sabellaria spinulosa* reefs, is minimised or avoided. Because it forms very slowly, maerl is considered a non-renewable resource and even extracting dead material can have major ecological effects. Sand and gravel extraction often takes place in areas of mixed sediment where *Sabellaria spinulosa* reefs occur and so there is a risk of damage to reefs, although they are known to exist close to extraction sites without any harm. The EU Habitats Directive requires Member States to take appropriate management measures to ensure that any exploitation of maerl is compatible with maintaining the habitat at a favourable conservation status. Maerl beds are included in several protected areas in Region III.

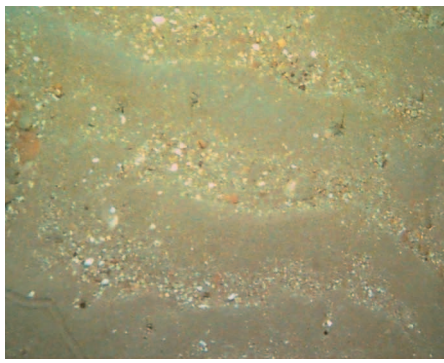
All OSPAR countries undertaking large amounts of sand and gravel extraction have legislation in line with the EU EIA and Habitats Directives. OSPAR countries have agreed to apply guidelines developed by the International Council for the Exploration of the Sea (ICES) for managing the extraction of marine sediments. These also address nature conservation and conflicts over space between different users. Belgium, Denmark, Germany, the Netherlands and the UK have required sand and gravel extractors to use black-box recorders to monitor changes in the geographical extent of extraction activities in real time.

The use of ICES guidelines and EIAs has proved successful for managing extraction of sand and gravel in some areas, for example the Channel (UK). The stable, or in some areas decreasing, geographical extent of extraction has reduced conflict between different coastal users, but this has been offset by an increase in the intensity of extraction, potentially slowing the recovery of affected areas. Comprehensive extraction data are not reported by all OSPAR countries. Also, the threshold at which countries require EIAs and the quality of the assessments themselves are very variable. Without accurate data, it is difficult to assess whether regulation has improved the protection of benthic ecosystems.

Demand for marine sand and gravel in coastal protection schemes is likely to increase as sea level rise and the growth in infrastructure projects drive requirements for marine sand and gravel for construction purposes. Efforts to reduce the negative impacts from sand and gravel extraction will therefore be required. These should include stringent implementation of the ICES guidelines, harmonised and accurate reporting on the extent and impact of extraction, and follow-up activities to EIAs. OSPAR should promote research to address gaps in knowledge on the impacts of sand and gravel extraction on fish and small benthic fauna, on long-term recovery of the seabed and on the feasibility of restoring the seabed, taking into account other activities that may impact the seabed. Regional approaches for managing sand and gravel extraction should be considered. These may require cooperation between different countries if a resource is on or near a national boundary.

Gravel seabed before dredging (left) and after extraction of gravel (right)





DREDGING AND DUMPING

Dredging and dumping of wastes or other matter at sea is a well-regulated localised activity. OSPAR Contracting Parties should cooperate to promote the development of regional sediment management plans and encourage research into the effects on the wider ecosystem.

Key OSPAR assessments

- → Environmental impact of dredging for navigational purposes
- → Environmental impact of dumping of wastes at sea

Sediment is an essential, integral and dynamic part of the ecosystem. Over 99 % of sediment dumped at sea is locally-generated and results from dredging of harbours and their approaches to ensure they are navigable. Most dredged material is dumped at established sites → FIGURE 9.11. It is also used for purposes such as beach nourishment or land reclamation. Fish wastes and inert material of natural origin, for example rock and mining wastes, may also be dumped at sea. Fish waste is only dumped in small amounts and at a few sites (fewer than 1000 tonnes per year). The phasing out of several types of waste disposal has reduced pressure on the marine environment. Dumping of sewage sludge and of vessels or aircraft has been banned by OSPAR since 1998 and 2004, respectively. Dumping of radioactive wastes has been prohibited since 1999.

Dredging and dumping operations and techniques have changed little over the past ten years. About 90 % of all sediments dumped each year are dredged and dumped in the southern North Sea. This is largely from maintaining navigation channels to major seaports such as Hull, Antwerp, Rotterdam, Hamburg and Esbjerg. In 2005, there were around 350 dumpsites in the OSPAR area → FIGURE 9.11. Between 1990 and 2007 the total annual amounts dumped at sea varied from 80 to 130 million tonnes (dry weight) with much of the variation due to capital dredging associated with port expansion and deepening of navigation channels. The level of dumping and dredging activities has been relatively stable over the past decade and is unlikely to fall. The need for dredging may be increased in coming years by a growth in ship size, requiring deeper and wider navigation channels, or a greater frequency and intensity of storm events, and thus sediment movement by waves and currents.

One of the main concerns over dumping and dredging is the release of contaminants to the water column (such as heavy metals and TBT), which is associated with temporary increases in turbidity. This can lead to increased availability of contaminants to the food chain. Contaminants in dredged material are monitored and assessed against action levels to help reduce pollution at dumpsites. There was a clear fall in contaminant concentrations in dredged material from the southern North Sea throughout the 1990s. This trend has since stabilised. In the Netherlands, TBT concentrations in dredged material have fallen since monitoring began in 1998. A further decrease in TBT concentrations is likely following the global ban on TBT-based anti-foulants. Nutrients released from dumped dredge spoil may contribute to eutrophication, but this will generally be of minor significance.

Knowledge about the effects of dredged material disposal on the wider environment is mainly from studies at individual dumpsites and from EIAs. Sediments are part of the marine environment and relocation of non-contaminated sediments to the sea supports the natural processes of the sediment balance. Increased turbidity may also lead to short-lived effects on organisms that are light-dependent, but these are generally considered to be negligible. Dumping sediments on the seabed may smother and crush organisms living on the seafloor and may cause changes in benthic habitats and biological communities. Changes in community structure are restricted to within 5 km of the dumpsite. Continuous maintenance dredging often takes place where navigation channels to ports have high sedimentation rates, such as in estuaries. Areas that are frequently dredged have a permanently changing benthic environment. Dredging in estuaries to create a new harbour, berth or waterway, or to deepen existing facilities, can affect tidal characteristics which may affect sensitive habitats. Dredging and dumping activities also contribute to underwater noise.

Dredging and the dumping of waste and other matter have been well-regulated since the Oslo Convention came into force in 1974. OSPAR guidelines specify best environmental practice (BEP) for managing dredged material. National authorities use these guidelines to manage dredging and dumping and to minimise effects on the marine environment. The main management tools are licence and control systems. These require assessments of the environmental impact of planned disposal activities in relation to a specific dumpsite, sediment characteristics and contamination load. Since the QSR 2000, assessment and licensing procedures for dredged materials in most OSPAR countries have included action levels for contaminant loads based on the OSPAR guidelines. Since 1998, OSPAR has also had guidelines for the dumping of fish wastes.

Management of dredged material should respect the natural processes of the sediment balance. Selecting the appropriate location for a dumpsite is essential to minimise environmental impact. Several dumpsites have been relocated by applying the OSPAR guidelines. A planned site in the Weser estuary was relocated after a site survey detected a mussel bank. Dumpsites have also been relocated or closed to avoid impacts on MPAs, fisheries and shipping. The ban on dumping vessels or aircraft has been implemented successfully.

Existing regulations, including EU legislation, need to be fully implemented and their effectiveness evaluated before additional OSPAR measures are developed. Improved understanding of the effects of dredging and dumping activities on marine ecosystems, including in combination with other pressures, is needed. OSPAR should promote the development of local or regional sediment management plans focusing on maintaining sediment balance, particularly in relation to sensitive marine areas such as OSPAR MPAs and Natura 2000 sites. Greater use should be made of dredged material for beneficial purposes, such as for protecting the stability of coastal and shelf systems.

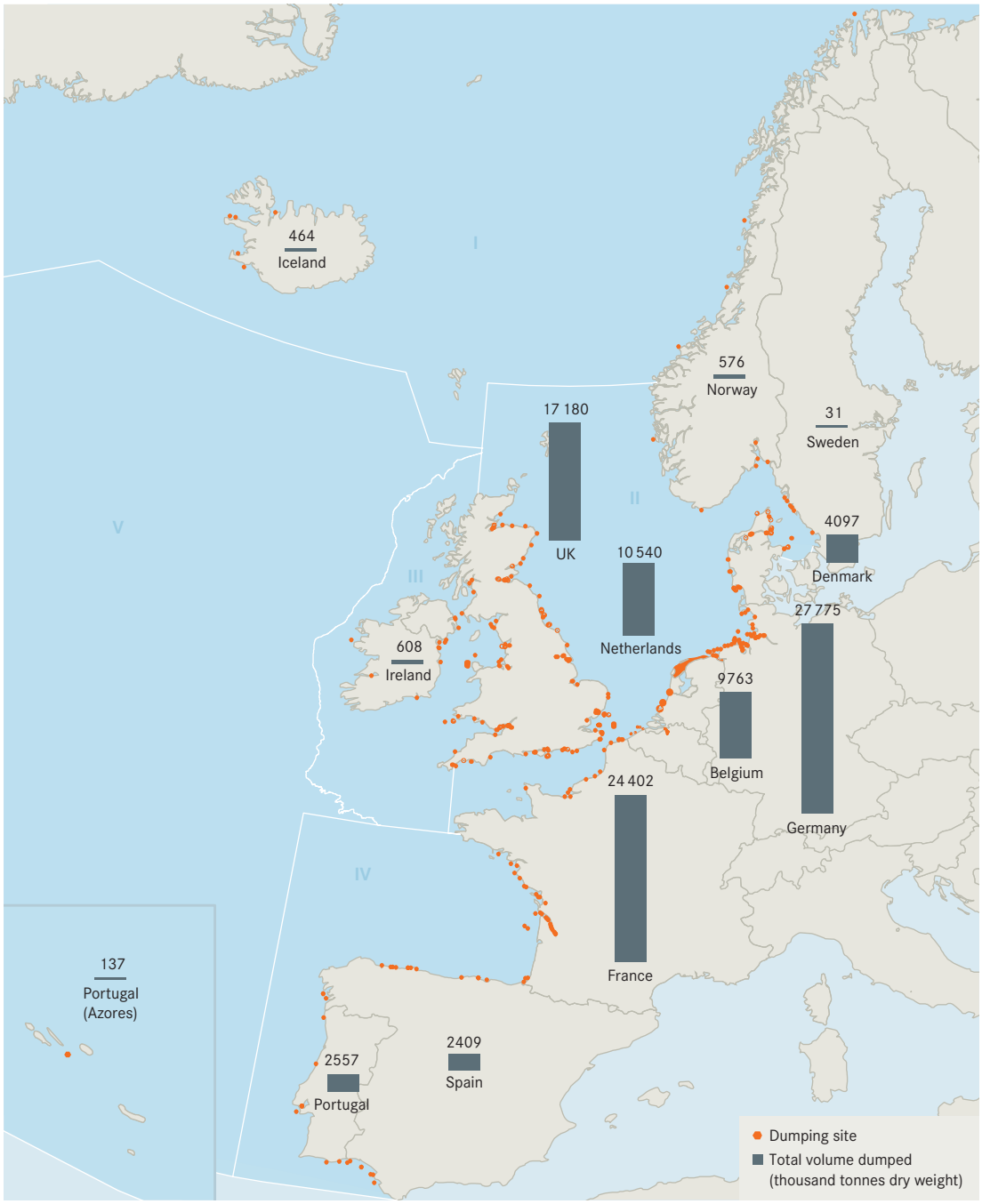


FIGURE 9.11 *Dumpsites for dredged material and volumes dumped in 2007.*

DUMPED MUNITIONS

The vast amounts of dumped munitions in the sea are a historical legacy representing a risk to fishermen, other coastal users and marine species.

Key OSPAR assessment → Environmental impact of dumped conventional and chemical munitions

Vast amounts of munitions were dumped at designated sites or randomly jettisoned into the sea following the First and Second World Wars. These included conventional munitions such as bombs, grenades, torpedoes and mines, as well as incendiary devices and chemical munitions.

The presence of munitions in the sea is a risk to fishermen and coastal users. As recently as 2005, three fishermen were killed in the southern North Sea when a Second World War bomb exploded on their fishing vessel after having been caught in their nets. There are also concerns over the many chemicals used in the munitions, which may be released as the munitions degrade with the possibility of risks for the marine food chain. However, there is no evidence of this in the OSPAR area at present. The few data that are available indicate little or no contamination of fish, shellfish or sediments near the dumpsites. A study at the *Beaufort's Dyke* dumpsite in the Irish Sea (Region III) in 1996 found no evidence of chemicals from conventional and chemical warfare agents in sediments, fish or shellfish. Levels of naturally occurring metals used in munitions, such as arsenic and heavy metals, were within the range expected around the UK. Belgian studies have shown that contamination of sediment with mustard gas from a Second World War shell is limited to 3 cm from the shell. Explosion of munitions may be a greater environmental concern both through release of hazardous substances and the impacts of noise. The high sound pressure generated by spontaneous or controlled explosions of munitions can injure or kill marine mammals and fish. Harbour porpoises have been reported killed within 4 km of explosions and suffering permanent hearing damage up to 30 km away.

Information on the amounts and locations of dumped munitions is recognised to be incomplete, but the existence of dumped munitions should be a consideration in marine spatial planning.

In 2004, OSPAR began a programme to establish the extent of munitions dumping and to monitor the frequency of encounters → **FIGURE 9.12**. This has revealed that munitions were dumped at 148 sites and that 1879 encounters with munitions have occurred since 2004. Around 58 % of reported munitions were encountered by fishermen and 29 % found on the shore. Most (76 %) were removed from the sea or neutralised; 11 % were returned to the sea for safety reasons.

To reduce risk to fishermen and coastal users, OSPAR prepared a framework for the development of national guidelines on what to do when munitions are encountered. There are serious safety risks associated with the clean-up of dumpsites, as well as increased risk of dispersing hazardous substances. The most common management practice is to leave munitions on the seabed and allow them to disintegrate naturally. If munitions must be removed from the seabed, the potential of new techniques which allow neutralisation without explosion should be considered.

Although knowledge has increased, OSPAR should continue to collate data on encounters with dumped munitions and keep under review new techniques for managing the risks from munitions. Planning and management of marine activities should take into account the risks from dumped munitions. Explosions should be avoided due to concerns over underwater noise and the spread of hazardous substances. National guidelines should be issued for fishermen and other coastal users on what to do when munitions are encountered. National authorities should consider supplying fishermen with sub-surface marker buoys to use in the case of encounters. OSPAR should encourage the development of techniques for safe removal and neutralisation without explosion and promote the monitoring of possible effects of dumped munitions in the North-East Atlantic.

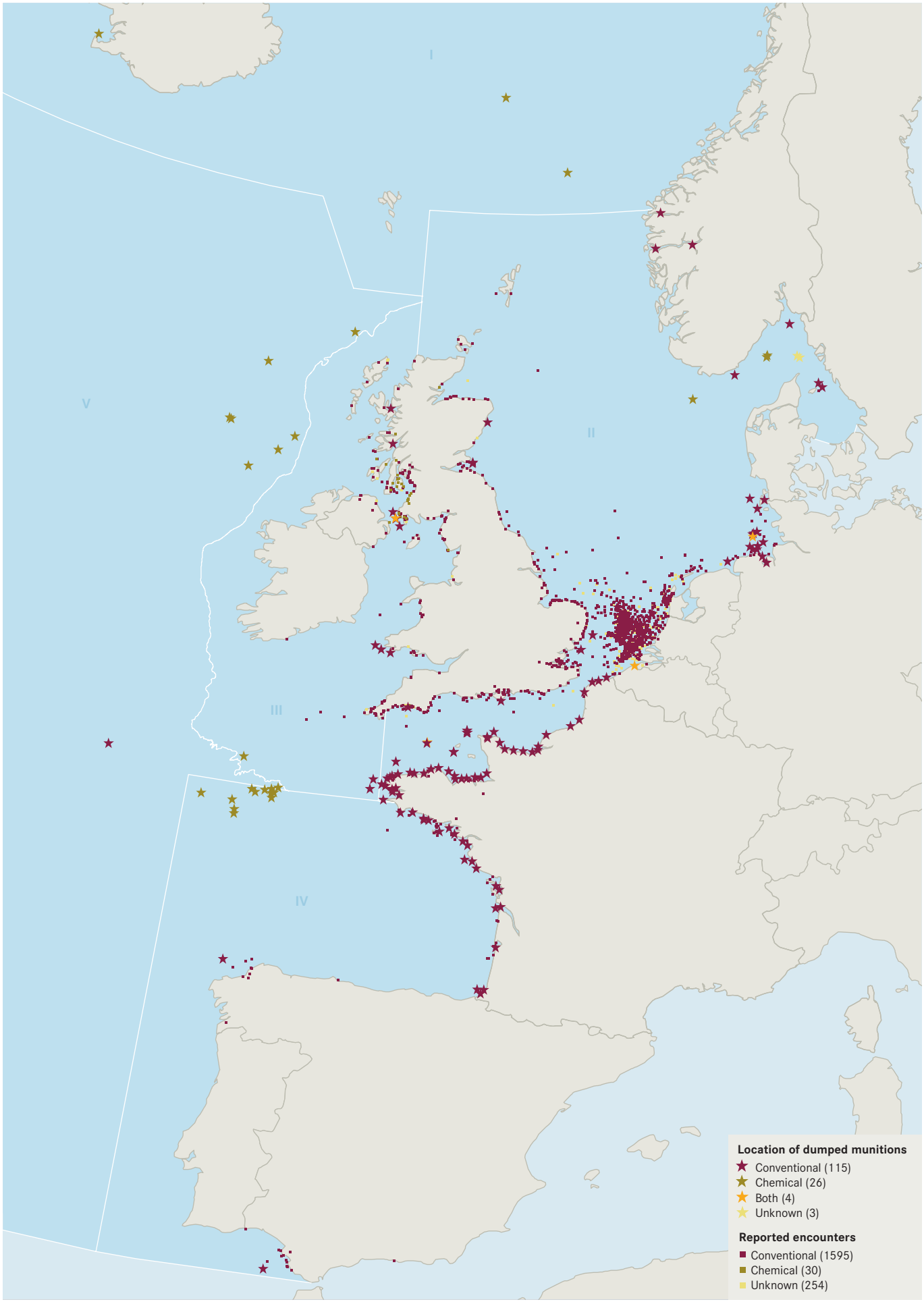


FIGURE 9.12 *Location of dumped munitions and reported encounters between 1999 and 2008.*

MICROBIOLOGICAL CONTAMINATION

Microbiological contamination from humans and animals presents a risk for recreational activities and shellfish quality. National legislation has driven improvements. OSPAR Contracting Parties should cooperate to further identify and control sources.

Key OSPAR assessment → Environmental impact of microbiological contamination

Pollution with germs from faecal material is of concern in coastal zones. Sources include treated and untreated sewage discharges from land or ships and animal excrement (e.g. from wildlife and farm animals in coastal catchments), storm water discharges and other diffuse sources. Bathers, pets and contaminated marine sediments also contribute. Impacts depend on weather, turbidity and hydrodynamics.

Bacteria and viruses from humans and animals can affect water quality and marine organisms. Their accumulation in shellfish is a major concern. Gastroenteritis and Hepatitis A are the most important microbial diseases transmitted to humans through shellfish. Contaminated water can also transmit diseases to bathers. Over the past 15 years the quality of bathing waters has improved significantly in most OSPAR countries as a result of increasing compliance with EU requirements. In 2006, around 5 % of Europe's bathing waters did not meet the mandatory level of microbiological quality, in some cases despite sewage treatment. This shows that diffuse pollution is a problem which is difficult to manage.

Limited information prevents an overall assessment of trends in water quality in shellfish areas, but there are examples of improvement following better urban waste water treatment → BOX 9.7. Recently, outbreaks of shellfish disease have been detected in shellfish that met bacteriological standards. One explanation is that existing indicators are not good at detecting viruses.

Since the QSR 2000, European legislation has been reinforced to address the sanitary risk to humans. This has been achieved by setting quality standards for bathing waters (Bathing Water Directive) and shellfish growing areas (Shellfish Water Directive), as well as requiring better urban waste water treatment. The Water Framework Directive and the Marine Strategy Framework Directive are also driving improved water quality.

OSPAR should promote international actions to improve detection of pathogens in seawater and seafood and the assessment of associated risks through expanded monitoring, modelling and development of suitable molecular tools. OSPAR countries should fully identify and quantify sources of microbial pollution. Further reductions in faecal inputs to coastal waters are needed, such as through better sewage collection and treatment and best practices for agricultural uses of sewage and manure. Early warning systems based on the latest technological standards need to be implemented.

BOX 9.7 Improved quality of shellfish areas in the Morlaix estuary

The Bay of Morlaix is a major shellfish harvesting area in northern Brittany (France), producing 5000 tonnes of oysters from 100 mariculture farms each year. Microbiological contamination occurs in the southern part of the catchment. In the early 1990s, poor water quality led to the risk of farm closures. Modelling studies clearly identified the Morlaix waste water treatment plant as one of the main sources of pollution. Water treatment has since been progressively improved. An upgraded treatment plant began operation in 1996. Lower levels of suspended matter alone resulted in a decrease in *E. coli* numbers at the outfall by two orders of magnitude and microbiological contamination has been reduced even further since 1996. The quality of the shellfish areas has improved significantly. Since 1999, they have been classified A (highest quality) under the EU Shellfish Water Directive and have enabled the sustainable use of the bay for oyster farming.

UNDERWATER NOISE

Levels of underwater noise are thought to be increasing internationally. Regions II and III seem to be the most affected by noise-generating human activities and there are signs of effects on marine life. Levels of noise in Regions II and III are likely to increase. OSPAR Contracting Parties should cooperate to monitor and investigate these effects and develop guidance on options for mitigation of noise and its effects.

Key OSPAR assessments

→ Overview of underwater noise
→ Environmental impact of underwater noise

Marine mammals, many fish species and even some invertebrates use sound in communication – to find mates, to search for prey, to avoid predators and hazards, and for navigation. Many of the human activities described in previous sections generate sound and contribute to the general background level of noise in the sea. For example, offshore construction, sand and gravel extraction, drilling, shipping, use of sonar, underwater explosions, seismic surveys, acoustic harassment devices and scarers (pingers).

Underwater sound from anthropogenic sources has the potential to mask biological signals and to cause behavioural reactions, physiological effects, injuries and mortality in marine animals. Impacts depend on both the nature of the sound and the acoustic sensitivity of the organism. There are difficulties in quantifying the extent and scale of the impacts as there is great variability in the characteristics of the sounds, the sensitivities of different species and the scale of noise-generating activities. Ambient or background noise is not range-dependent and remains constant irrespective of location. The perception of localised noise sources reduces with increasing distance from each source, eventually becoming indistinguishable from ambient noise → **FIGURE 9.13**. Data on all these aspects are generally scarce, but with the relatively intense concentrations of human activities in some parts of the OSPAR area, especially in Regions II and III, and the probability that these will increase, it is important that the effects of increased levels of underwater sound are fully considered. Studies show that noise does affect marine organisms, but so far there is a lack of knowledge on specific effects and possible cumulative effects, which makes understanding of dose-response relationships difficult.

OSPAR is working with other international organisations (e.g. the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas, ASCOBANS) to investigate the problems and identify future actions to address underwater noise. Guidelines and regulatory controls are already used in several OSPAR countries, such as noise reduction measures during pile driving (UK), a ban on pile driving during key reproductive periods for particular species (Netherlands) or the mandatory use of thresholds to limit man-made emissions with certain acoustic characteristics (Germany).

Research is needed on the propagation and effects of underwater sound on marine life, as well as behavioural and auditory studies, programmes to monitor the distribution of sound sources and the relevant marine species, and anthropogenic sound budgets. There is an urgent need to standardise methods for assessing the impacts of sound on marine species and to address the cumulative effects of different sources. OSPAR should facilitate the sharing of information, the coordination of data and measures specific to the Regions, and the standardisation of measurements. OSPAR should increase efforts to develop, review and apply mitigation measures to reduce the impacts of underwater noise and develop guidance on best environmental practices (BEP) and best available techniques (BAT) for mitigating noise emissions and their environmental impacts.

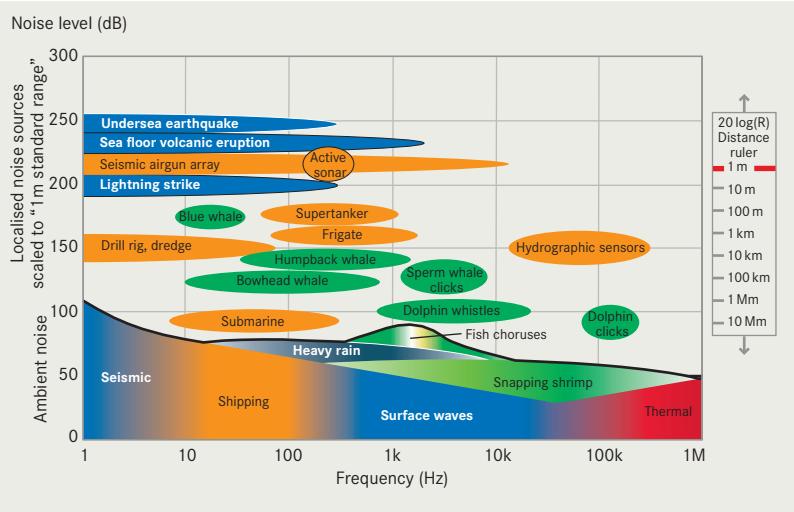


FIGURE 9.13 *Levels and frequencies of anthropogenic and naturally occurring sound sources in the marine environment. Spectrum Noise Level ("Acoustic Intensity per Hertz") versus Frequency (measured in Hertz or "cycles per second"). The vertical axis is expressed in decibels (dB; the reference for the dB calculation is the acoustic intensity of a sound wave, in water, of root-mean-square pressure 1 µPa). While ambient noise sources do not need to be corrected for range, localised noise sources are all scaled to "1 m standard range". The scaling ruler on the right-hand side of the figure may be used to gauge the loss corresponding to the distance from any localised noise source assuming spherical spreading. Colour scheme: anthropogenic (man-made) noise sources are depicted in orange, biological underwater noise sources in green and environmental noise sources in blue. Source: Coates, 2002 © Seiche Ltd. 2006*

MARINE LITTER

Marine litter is a persistent problem that affects the entire marine environment and its ecological effects are not fully understood. OSPAR should extend marine beach litter monitoring to all Regions.

Key assessments

- → OSPAR pilot project on monitoring marine beach litter
- → OSPAR/UNEP/KIMO report on marine litter in the North-East Atlantic Region

Marine litter is a collective term for any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. It includes a wide variety of slowly degradable items. The main sources from land include tourism, sewage, fly-tipping, local businesses and unprotected waste disposal sites. The main sea-based sources are shipping and fishing, including abandoned and lost fishing gear.

Marine litter is a persistent problem affecting the seabed, the water column and coastlines. It poses risks to a wide range of marine organisms, such as seabirds, marine mammals and turtles, through ingestion and entanglement, and has economic impacts for local authorities and on a range of sectors, for example aquaculture, tourism, power generation, farming, fishing, shipping, harbours, and search and rescue. Sixty-five percent of items monitored on beaches are plastic. These degrade very slowly over hundred-year time scales and are prone to breaking up into small particles. The widespread presence of microscopic plastic particles and their potential uptake by filter-feeding organisms is of increasing concern given the capacity of plastic particles to absorb, transport and release pollutants.

International and EU legislation addressing sources of litter includes the MARPOL Convention Annex V, and the EU Port Waste Reception Facilities Directive. In 2007, OSPAR published Guidelines for the implementation of Fishing for Litter projects in the OSPAR area → **BOX 9.8**.

Since 1998, OSPAR has monitored levels of beach litter, initially through a pilot project and then through a voluntary monitoring programme. Despite initiatives to reduce the amount of marine litter in the OSPAR area, overall levels in areas monitored are frequently unacceptable. Beaches in the OSPAR area have an average of 712 litter items per 100 m. Levels have remained relatively constant, but with a slight increase in input from the fishing industry. Region III and the northern part of Region II have more litter than Region IV and the southern part of Region II → **FIGURE 9.14**.

There are limited data on seabed and floating litter, but those studies that do exist show that the amounts of litter on the seabed can vary widely and that litter may accumulate in certain areas. Marine litter also finds its way to the deep sea, and is regularly observed by scientists studying the seabed with submersibles or remotely operated vehicles.

BOX 9.8 Fishing for Litter

Fishing for Litter (FFL) is one of the most innovative and successful initiatives to tackle the problem of litter in the sea. FFL aims to reduce marine litter by involving one of the key stakeholders, the fishing industry. FFL not only involves the direct removal of litter from the sea, but also raises awareness of the problem inside the industry as a whole.

Participating vessels are given large (1 m^3) hard-wearing bags to store marine litter that collects in their nets during normal fishing activity. Operational or galley waste generated on board, which is the responsibility of the vessel, continues to go through the established harbour waste management system. Full bags of litter are deposited on the quayside where the participating harbours monitor the waste before moving the bag to a dedicated skip for disposal. Bags are provided and waste costs need to be met, but fishermen and harbours volunteer their time. FFL has two main aims: first, the physical removal of marine litter that sinks to the seabed and, second, to raise awareness within the fishing industry that it is no longer acceptable to dump litter overboard. The concept of FFL has received a lot of support within the fishing industry. The number of vessels involved has increased over the past seven years. Around 190 vessels participate in Regions II and III, removing 240 tonnes of waste per year. Other stakeholders also support the FFL initiative.

The FFL initiative has demonstrated that the objectives and aims of the scheme can gain the support of the fishing industry, port authorities and local authorities. This has helped contribute to changing practices and culture within the fishing sector, while providing a means for removing litter from the sea and seabed.

An Ecological Quality Objective (EcoQO) for the North Sea on plastic particles in seabirds' stomachs has helped to identify the extent of floating litter at sea. Associated studies have shown that 94 % of birds have small pieces of plastic in their stomach and a high percentage have more than the level set for the EcoQO → **BOX 9.9**

Additional efforts are needed to stop litter entering the marine environment both from sea-based and land-based sources. Efforts to address sea-based sources include environmental education for professional seafarers, methods to prevent abandoned fishing gear, cooperation on enforcement and awareness-raising, as well as FFL initiatives. For land-based sources, improved waste management, including waste reduction and recycling, will help reduce the problem. OSPAR should extend its marine litter monitoring on beaches to all Regions and consider including it in its Coordinated Environmental Monitoring Programme, taking into account the monitoring requirements of the EU Marine Strategy Framework Directive. This may result in a requirement to monitor the water column and the seabed. OSPAR should support the implementation of international and EU legislation, initiatives such as UNEP's (Regional Seas Programme) work on marine litter, and ongoing research into litter in the deep sea and the ecological effects of microplastics.

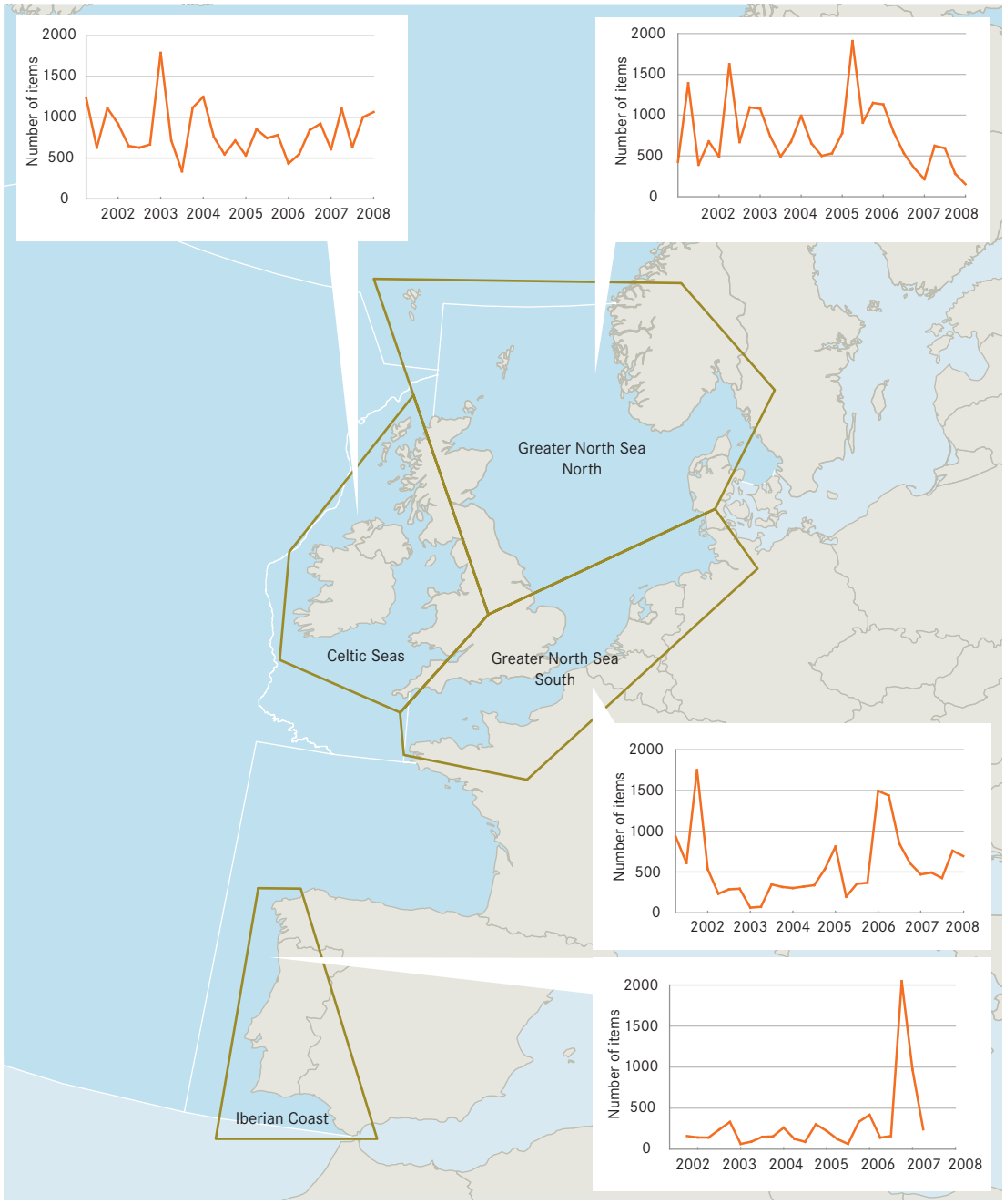


FIGURE 9.14 *Trends in the average number of items of marine litter collected on reference beaches in three-month periods in Regions II, III and IV.*

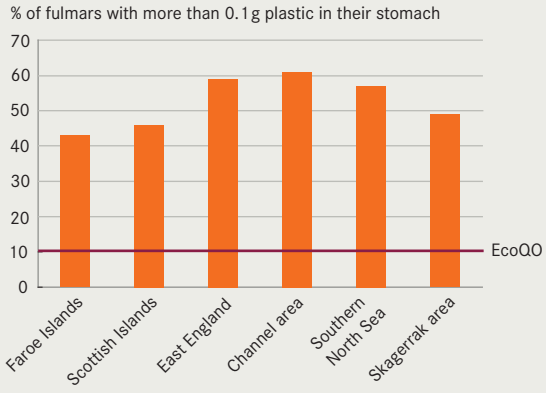
BOX 9.9 OSPAR EcoQO on plastic particles in seabird stomachs

North Sea EcoQO: There should be less than 10 % of northern fulmars having more than 0.1 g of plastic particles in the stomach in samples of 50 to 100 beach-washed fulmars found from each of four to five areas of the North Sea over a period of at least five years.

The northern fulmar is distributed throughout the northern part of the OSPAR area, including Region II. Fulmars forage exclusively at sea, capturing prey from the sea surface. They frequently ingest floating litter, including plastic items, presumably confusing them with food. Because fulmars do not regurgitate these small plastic items, the amount in their stomachs indicates the abundance of litter encountered at sea. Ingested plastics may reduce food intake and the birds' ability to process food, leading to a deterioration in body condition, increased mortality and reduced breeding success.

Over the period 2002 to 2006, the stomachs of 1090 beached fulmars from the North Sea were analysed. The percentage of fulmars with more than 0.1 g of plastic in the stomach ranged from 45 % to over 60 % (see figure). The Channel area is the most heavily polluted area while the Scottish Islands are the 'cleanest' with a mean mass for plastics in fulmars of about a third of the level encountered in the Channel. Data from the Faroe Islands (Region I) are included for comparison. The EcoQO is probably only achieved in Arctic populations. A long monitoring series from the Netherlands shows a significant reduction in plastic abundance from 1997 to 2006, mainly through a reduction in raw industrial plastics.

To meet the EcoQO, refinements may be needed on the implementation of the EU Directive on Port Reception Facilities and MARPOL Annex V, as well as specific measures on lost fisheries materials.



NON-INDIGENOUS SPECIES

Non-indigenous species, mainly introduced by shipping and mariculture, have economic and ecological effects on the OSPAR area. OSPAR Contracting Parties should cooperate in support of current international efforts to prevent further introductions.

Key assessment → ICES assessment of non-indigenous species in the OSPAR area

Non-indigenous species may cause unpredictable and irreversible changes to marine ecosystems, such as predation or competition for indigenous species, modification of habitats and trophic impacts. A variety of economic or human health impacts are possible through, for example, fouling, harmful non-indigenous algal blooms or damage to structures. Over 160 non-indigenous species have been identified in the OSPAR area, but the actual number of introduced species is likely to be greater. This is because long-term monitoring and recording data are limited and identifying the species taxonomically can be difficult. Some species are currently misidentified.

ICES has identified 30 non-indigenous species that have had adverse impacts on ecosystems or human health within the OSPAR area → **TABLE 9.1**. Most of the non-indigenous species identified are present in two or more Regions (especially Regions II, III and IV). Data for Region V are mainly absent. The main vector for the initial introduction of these species has been mariculture, followed by ballast water from ships, hull fouling and fishing. The most important and widespread impacts are changes to habitats and competition for food and space with indigenous organisms. Many of these species also have economic impacts → **BOX 9.10**. Almost all the species concerned were introduced before current measures, some as much as several hundred years ago.

The risk of introductions by ballast water has been addressed by OSPAR and HELCOM taking action to ensure the early application of standards consistent with the IMO Ballast Water Convention. Environmental risks related to movements of non-indigenous aquatic species are addressed within the EU by the Regulation concerning use of alien and locally absent species in aquaculture. There are also international risk assessment protocols for assessing the risks of using non-indigenous species in aquaculture.

Ratification and implementation of the IMO Ballast Water Convention should be expedited and followed up with effective enforcement. There is a need to monitor the effectiveness of this and other recently implemented measures on reducing introductions of non-indigenous species. Work under the EU Marine Strategy Framework Directive will provide a focus for this in seeking to ensure that non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.

TABLE 9.1 *Non-indigenous species in the OSPAR area that have been identified as problematic.*

	Taxonomic group	Common names	Regions affected	Vector	First reported	Probable impacts
Plants, algae and phytoplankton	*Spartina anglica*	Common cord-grass, Townsend's grass or ricegrass	I, III, IV		France 1906	
	Sargassum muticum	Wireweed, Japweed, Strangleweed	II, III, IV		UK 1973	
	Undaria pinnatifida	Wakame, Japanese kelp	II, IV		France 1972 France 1983	
	Gracilaria vermiculophylla	Asian red alga	II, III		France 1996	
	Codium fragile ssp. *fragile*	Green sea fingers	I, II, III, IV		Netherlands ~1900	
	Bonnemaisonia hamifera	Red alga	I, II, III, IV, V		UK 1893	
	Coscinodiscus wailesii	A centric diatom	II, III, IV		UK 1977 Norway 1979	
Invertebrates	*Mnemiopsis leidyi*	A comb jelly	II		Netherlands, Sweden, Norway 2006	
	Marenzelleria spp. (complex)	Red gilled mud worm	II, III		UK 1979	
	Crepidula fornicata	Slipper limpet	II, III, IV		UK 1872	
	Ensis americanus (=*directus*)	Jackknife clam, razor clam	II		Germany 1979	
	Crassostrea gigas	Pacific oyster	II, IV		France 1980s	
	Mya arenaria	Soft-shelled clam, soft clam, long-necked clam	I, II, III, IV		1245	
	Rapana venosa	Rapa whelk, veined whelk	IV		France 1997 North Sea 2005	
	Venerupis philippinarum	Japanese clam, Manila clam	II, IV		UK 1992	
	Teredo navalis	Ship worm	II, III, IV, V		Netherlands >1730	
	Eriocheir sinensis	Chinese mitten crab, Mitten crab, Chinese freshwater edible crab	II, III, IV		Germany 1912	
	Hemigrapsus sanguineus	Asian shore crab	II, IV		France 1999	
	Hemigrapsus takanoi	Asian shore crab	II, IV		France 1994	
	Paralithodes camtschaticus	Red king crab	I		Norway 1976	
	Marsupenaeus japonicus	Kuruma prawn	IV	?	Portugal 1985	
	Ficopomatus enigmaticus	A tubeworm	II, III, IV		France 1921	
	Austrominius (=*Elminius*) *modestus*	An acorn barnacle	I, II, IV		UK 1945	
	Caprella mutica	Skeleton shrimp	II, III, IV		Belgium 1998	
	Telmatogeton japonicus	A chironomid (insect)	II, III		Germany 1963	
	Bugula stolonifera	A bryozoan	II, IV, V		Netherlands 1993	
	Styela clava	Leathery sea squirt, Asian sea squirt	II, III, IV		France 1968	
	Didemnum vexillum	A sea squirt or tunicate	I, III		Netherlands 1991	
	Tricellaria inopinata	A bryozoan	II, IV		Spain 1996 UK 1998	
Protozoa	*Bonamia ostreae*	None	II, III, IV		France 1976	

Vectors for introduction have been classified as: Planting; Secondary spread; Importation for aquaculture; Ballast water; Fishing nets; Fouling; Aquaculture; ? Not known **Probable impacts have been classified as:** Habitat modification; Damage to structures; Biodiversity loss; Competition; Food web impacts; Predation; Fouling; Nutrient regeneration; Algal blooms

BOX 9.10 Examples of non-indigenous species known to have adverse effects

The **Pacific oyster** was introduced throughout Europe in the 1970s for cultivation purposes to replace declining populations of the native oyster and the Portuguese oyster. It was assumed that Pacific oysters would not spread to higher latitudes (such as the UK, the Netherlands and Germany) because the waters would be too cold for reproduction. However, the species can tolerate a wide range of temperatures and the free-swimming planktonic larvae can spend up to three weeks in the water column before finding a suitable substrate to settle on. This gives Pacific oyster a wide dispersal range. It is now established or has been detected in Belgium, Denmark, France, Germany, Ireland, the Netherlands and the UK and established populations are reported as far north as Norway and Sweden. In the Wadden Sea, where hard substrate is rare except for mussel beds and oyster shells, blue mussel beds are declining, while populations of reef-habitat building Pacific oysters appear to be increasing. Community structure differs between habitats created by oysters and mussels, with implications for their overall function in the marine environment.

From top: Pacific oyster, red king crab, leathery sea squirt

The **red king crab**, a native of the northern Pacific, was intentionally introduced into Russian waters in the 1960s and by 1976 had migrated to Norway. It is now found in coastal waters throughout northern Norway, where it competes with local predators, modifies habitats and may affect the shellfish industry.

The **leathery sea squirt**, native to the Pacific coast of Asia, was probably introduced to Europe through fouling on warships during the Korean War. Once introduced to Europe, it was reported on the hulls of ships and leisure craft and may have been spread through movements of oyster stocks and floating port structures on which it is a fouling organism. This species can create a high biomass in sheltered areas that result in competition with other filter-feeders. Young individuals often attach to larger specimens (up to 200 mm) to form clusters and thus the long-lived sea squirt may serve as substrate for other non-indigenous species. Economic impacts arise as a result of fouling, for example on artificial structures in ports or mariculture installations. Some people develop respiratory problems from sprays produced from damaged tissues when removing sea squirts from oysters.

TOWARDS INTEGRATED MANAGEMENT

The multiple pressures on the marine environment are increasing. Understanding the relative and cumulative environmental impact of human activities and their integrated management remains a challenge.

The demand for marine resources and space is increasing and there is a growing necessity to balance the needs of different sectors and conservation. New activities, such as offshore wind farm development, alongside increased demands for marine sand and gravel, and growing marine transport, tourism and leisure activity, mariculture and fishing are the main forces driving these demands. OSPAR needs to keep under review the development of pressures from these different activities and the extent of their impacts. Understanding of cumulative impacts is needed. Effective implementation of integrated management, including marine spatial planning, is required to avoid or minimise negative effects on the marine environment and conflicts between different users.

More efforts are needed to move towards integrated management, building on existing achievements

Although integrated management of human activities has not yet been achieved throughout the North-East Atlantic, there are examples of good practice in some parts of the OSPAR area (e.g. Norway → BOX 9.11, Germany and the Netherlands) and this has led to substantial expertise in marine spatial planning. OSPAR should promote transboundary and cross-sectoral cooperation on integrated management by the following:

- Developing and implementing a regionally-based integrated approach to the management of human activities, which meets the requirements of the OSPAR Convention and the EU Marine Strategy Framework Directive. This should apply the ecosystem approach, making best use of tools such as marine spatial planning, integrated coastal zone management, cumulative impact assessments, adaptive management and economic and social analysis.
- More coherent implementation of measures across the OSPAR area. Special attention should be given to the assessment and management of human activities in Regions I and V, particularly in areas beyond national jurisdiction, in cooperation with other competent authorities.
- Intensifying cooperation and communication on the management of the marine environment with other competent authorities, such as the International Maritime Organization (IMO), the International Seabed Authority and the North

East Atlantic Fisheries Commission. Where appropriate, close cooperation on monitoring and assessment should be developed, for example with the Arctic Council.
- Cooperating with the IMO and other international organisations to reduce further the environmental impacts of shipping and to promote maritime safety. In particular, to implement further the commitments from the Gothenburg Declaration 2006 and work towards an integrated approach to sustainable shipping.
- Supporting actions and measures on activities or pressures that are not yet adequately covered by other international bodies and/or legislation and have been assessed as requiring such measures. Issues that need such consideration include litter and noise.

Gaps in knowledge make a comprehensive assessment difficult

In spite of progress made in scientific research and more comprehensive assessment and monitoring programmes, some of the gaps in knowledge on the effects of human activities recognised in the QSR 2000 still remain. Key shortcomings are as follows:
- Data on spatial and temporal trends of some human activities and their effects on the marine environment are incomplete or lacking.
- Much effort has been put into developing approaches for assessing cumulative effects, but standard methods have yet to be agreed and only very few data on cumulative effects of human activities are available.
- Limited transboundary and cross-sectoral cooperation, for example, on site selection and mitigation measures for wind farm development.
- Information from EIAs and related monitoring programmes is often inaccessible to the public. Its use for sub-regional or OSPAR-wide assessments of human activities is also hampered by limited comparability of the data.

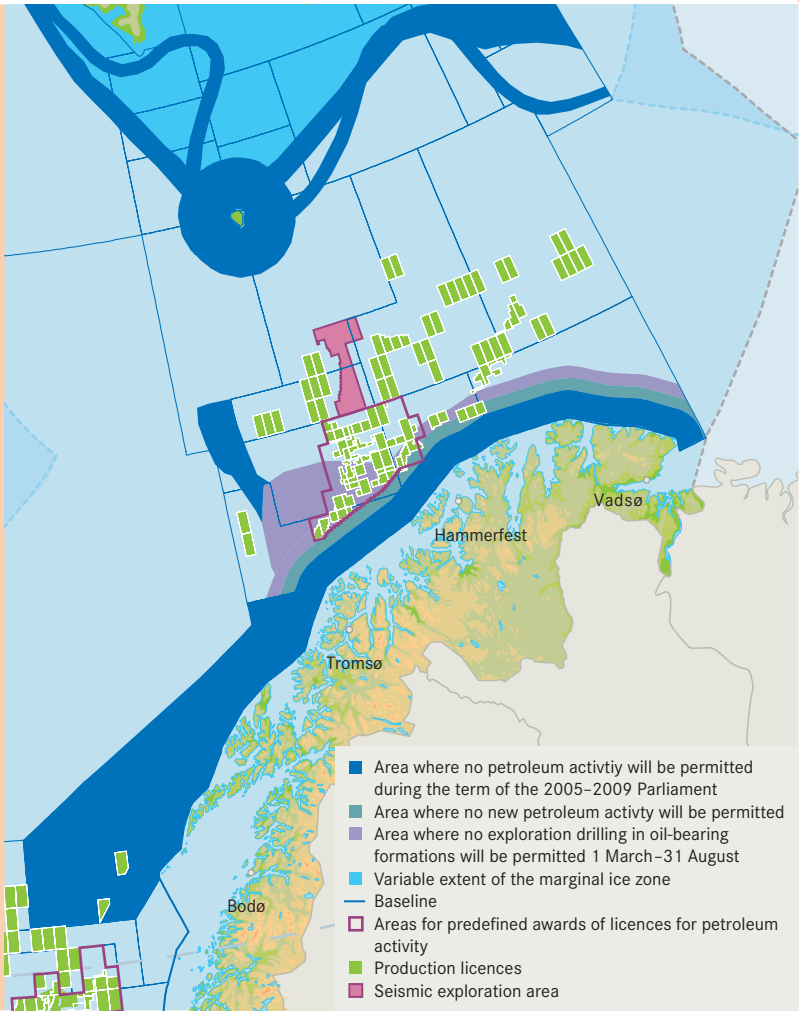
OSPAR should intensify efforts to achieve harmonised, comprehensive assessment and monitoring of human activities as a basis for implementation of the EU Marine Strategy Framework Directive and its concept of good environmental status by EU Member States. Gaps in knowledge should be filled, particularly concerning effects of human activities on biodiversity.

BOX 9.11 Integrated management and marine spatial planning in the Barents Sea

In 2006, the Norwegian government endorsed a plan for 'Integrated Management of the Marine Environment of the Barents Sea and the sea areas off the Lofoten Islands'. A similar plan for the Norwegian Sea was endorsed by the parliament in 2009.

These management plans provide the political basis for managing these important sea areas. The areas include a variety of vulnerable habitats as well as valuable marine living resources and petroleum resources. Indicators with reference values and action thresholds have been developed. Extensive co-ordinated monitoring will ensure a scientific base for management according to the defined action thresholds.

The management plans give the overall framework for both existing and new activities and facilitate co-existence between different sectors, in particular the fisheries, maritime transport and the offshore petroleum industry. Spatial planning is a core element in the integrated management plans. In order to reduce potential conflicts between activities and the protection of vulnerable habitats and species, special restrictions are set for the use of geographically defined areas and zones. These include areas and zones with restrictions on petroleum activities (see figure), mandatory shipping lanes, and areas with coral reefs where fishing with gear able to harm the corals is prohibited. The management plans will be rolling plans and will be updated at regular intervals. The Barents Sea plan will be revised in 2010.



Continued use of the precautionary approach is required

Protection of the marine environment must take into account uncertainties in understanding the effects of new activities and the ability of ecosystems to adapt and respond to changes. OSPAR should promote the following:

- Continued application of the precautionary approach to ecosystem based management of human activities.
- Adaptation of management of human activities to climate change, taking into account additional pressure on species and habitats from expected consequences such as warmer and more acidic seawater, rising sea level and more extreme weather conditions →CHAPTER 3.
- Further investment in the development and application of best available techniques (BAT) and best environmental practices (BEP). This will help safeguard sustainable use of marine resources as well as the promotion of technological progress and development.
- Continued review of developing activities, such as tidal stream and wave energy production.

Regional summary of past trends and outlook for human activities discussed in Chapter 9

Activity	Change of activity in 1998–2008					Outlook for change in activity					Main pressures
	I	II	III	IV	V	I	II	III	IV	V	
Artificial reefs	↑	↑	↑	↓		←→	↑	←→	↑		
Cables	⇧	↑	↑	↑	⇧	⇧	↑	↑	↑	⇧	
Coastal defence		↑	↑	↑			↑	↑	↑		
Construction of structures	⇧	↑	↑	↑		⇧	↑	↑	↑		
Dredging	⇦⇨	←→	←→	⇦⇨		⇧	↑	↑	⇧		
Dumping of wastes and other matter	⇦⇨	←→	←→	⇦⇨		⇧	↑	↑	⇧		O_2↓
Land reclamation	←→	←→	←→	←→		⇧	↑	↑	↑		
Munitions	←→	←→	←→	←→		←→	←→	←→	←→		
Sand and gravel extraction		←→	←→	⇦⇨			↑	↑	⇧		O_2↓
Tourism	↑	↑	←→	↑	↑	↑	←→	←→	↑	↑	
Wind farms		↑	↑			↑	↑	↑			
Shipping	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	

Direction of change: ↑ Major activity increasing; ↓ Major activity decreasing; ←→ No change in major activity; ⇧ Minor activity increasing; ⇩ Minor activity decreasing; ⇦⇨ No change in minor activity; Blank field: no relevant activity

Main pressures: Temperature changes; Local hydrological changes; Wave exposure changes – regional/national; Hazardous substances; O_2↓ De-oxygenation; Organic enrichment; Electromagnetic changes; Litter; Underwater noise; Barrier to species movement; Siltation rate changes; Habitat damage; Habitat loss; Visual disturbance; Microbial pathogens; Non-indigenous species