Scotland's seas

Overall, Scottish seas are clean, safe, healthy, biologically diverse and productive. But increased and varied use may mean competition for sea space.

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Summary

Scotland's seas are mainly clean and safe although there are some localised areas of concern.

The seas support a diverse array of habitats, and nationally and internationally important populations of certain species.

The seas are also economically productive with a wide range of human activity taking place.

There are two significant pressures on the marine area which are widespread:

- human activity contributing to climate change;
- fishing, which impacts on the seabed and species.

Decision-making is being improved through the adoption of Marine Planning and the development of a National Marine Plan.

Introduction

Scotland's seas extend from 3 nautical miles (the Water Framework Directive limit) to 200 nautical miles (the fisheries limit) with a sea area of 420,863 km^2. Within this, the limit of territorial waters is at 12 miles (Figure 1 and Table 1). Scotland's seas include the area seawards of the 12 mile limit which is usually referred to as "offshore waters", as well as that area of territorial waters between 3 and 12 miles and seawards of the WFD Coastal waters.

Figure 1: Scotland's marine limits

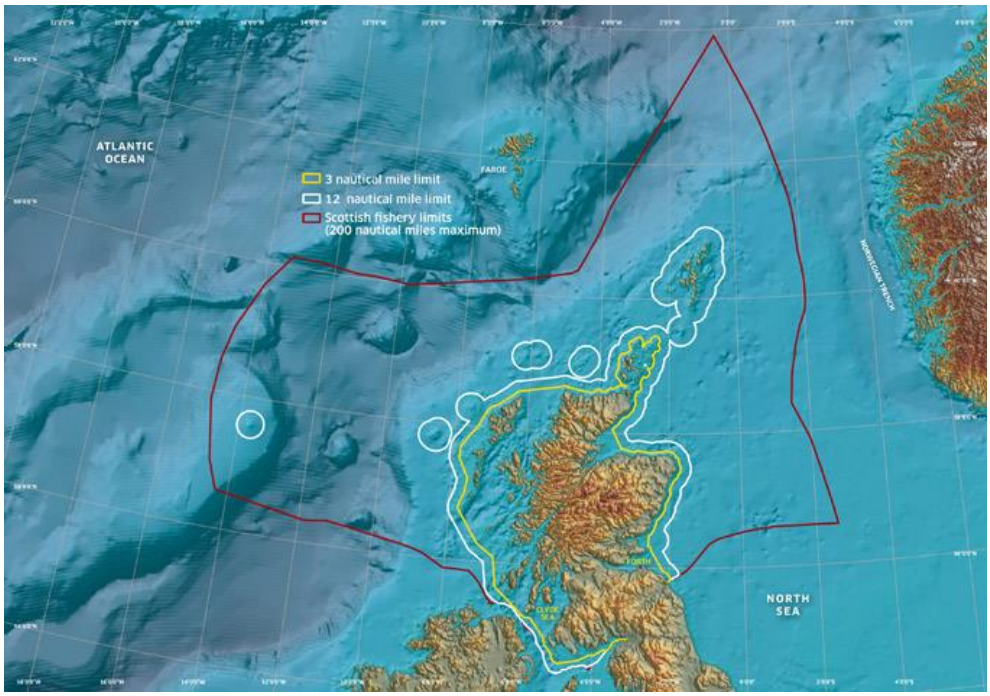


Table 1: Scotland's sea areas

Description of Sea Area	Geographical Limit	Area of Sea Covered (km^2)	Legislative Description
Waters covered by WFD	High water mark to yellow line in Figure 1	48,131	Limit to which Water Framework Directive measures have been implemented
Territorial waters outside WFD limits	Yellow line to white line in Figure 1	40,317	Territorial sea limit – limit of Scotland as defined in the Scotland Act
Territorial Waters	High water mark to white line in Figure 1	53,638	
Offshore Waters	White line to red line in Figure 1	380,546	
Scotland's Seas	Yellow line to red line in Figure 1	420,863	
Area within fishery limits	High Water Mark to red line in Figure 1	468,994	Maximum limit for fisheries and renewable energy powers

Scotland's seas range from shallow shelf seas (<200 m deep) to deep oceans (>2000 m deep). The shelf seas contain features such as banks and deep channels, whereas the deep oceans have a complex bathymetry broken up by steep ridges, seamounts and banks. The continental slope at the western edge of the continental shelf is the transition between the shelf seas and the deep oceans.

Scotland's seas support a wide biodiversity of species and habitats, which form the foundation for a range of economic activities that benefit the people of Scotland. An alternative economic view is the concept of ecosystem goods and services and a UK National Ecosystem Assessment (NEA) has now been published.

Habitats and species (Biodiversity)

Biodiversity at its simplest means the variety of life (species) and living conditions or environments (habitats). Scotland's seas support a wide variety of habitats and species, due in part to the geographical position of Scotland, with influences from warm Gulf Stream waters in the west and cooler waters from the Arctic in the north and east.

Scotland's seas contain a variety of habitats supporting a wide variety of species. A very simplified division of the offshore area is as follows, but each area will have its own complexities such as rocky areas in muds:

- North Sea – mud, sand and coarse sediment;
- West of the Hebrides and north of Scotland – mud, sand and coarse sediment;
- to the far west and north of Scotland – mud and fine clay, with coarser sediments in shallower water and on banks and seamounts.

The mud and sand habitat of the North Sea is home to the Norway lobster or Scottish langoustine (*Nephrops norvegicus*), which is an important commercial catch in Scotland. In addition to commercial species, there are a number of other important species, such as the ocean quahog (*Arctica islandica*), which is the longest-living mollusc known and may live up to 400 years or more. These are found in sandy and muddy sediments between 10 and 280 m depth all around Scotland and the northern North Sea.

There is limited but increasing knowledge of the habitats out in the deeper (>200 m depth) waters to the west and north of Scotland. These habitats comprise cold water coral reefs, coral carbonate mounds, submarine canyons, seamounts and deep sea sediments.

Fishing

Scotland has a long fishing history and it is important to the economy for the value of the catches landed and as a provider of employment, often in more remote communities where employment opportunities may be scarcer. In 2009, 366,569 tonnes of fish were landed from Scottish waters, with a sale value of £416 million.

Oil and gas exploration, extraction and production

Oil and gas are Scotland's principal sources of fuel and power, meeting around 58% of our energy requirements in 2008. The principal benefit to Scotland is employment both on- and offshore, where skills gained can readily be transferred to the renewable energy sector.

Renewable energy

Development of offshore renewable energy sources will help to provide Scotland with secure, clean, energy supplies in the future. The Robin Rigg windfarm in the Solway Firth already provides around 180 MW from its 60 turbines. There are also two established 5 MW turbines in the Beatrice oilfield in the Moray Firth. Wave and tidal energy is also developing currently.

Development of an offshore green energy industry is also being driven by the EU target of achieving 20% of EU energy consumption from renewable sources by 2020. The Scottish Government also has a commitment to meet 100% of Scottish demand for electricity from renewable sources by then.

Leisure and recreation

Although many leisure and recreation activities take place along the beach and inshore coastal waters, there is still a significant sport and tourism industry in more offshore waters, for example diving on wrecks or other areas of interest. Another contributor is that of 'wildlife tourism', where marine tourism specialist operators provide access to offshore areas and certain marine species, for example dolphins, porpoises, basking sharks and seals.

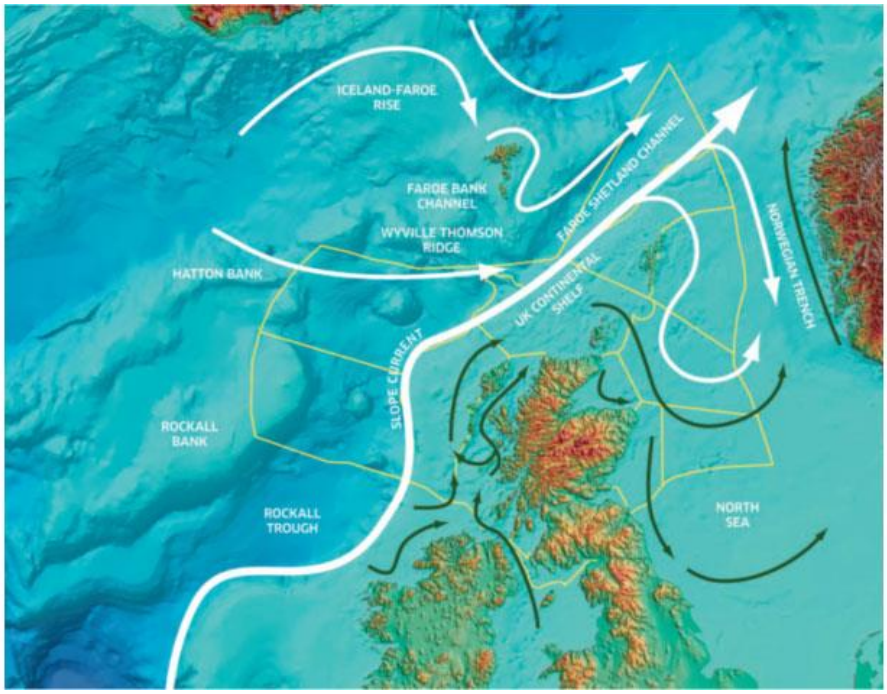
Description of Scotland's seas

Scotland's Marine Atlas: Information for the National Marine Plan is a web-based information resource on Scotland's seas, including offshore areas. The key data on the condition of the environment are summarised below.

Seawater circulation in Scotland's seas

Scotland's position on the continental shelf means that the seas around Scotland are directly affected by oceanic currents (Figure 2). Processes that cause mixing of oceanic and shelf waters are complex but have a significant impact on conditions in Scottish waters. For example, processes in the sea to the west of Scotland cause mixing and nutrients are brought closer to the surface. This enhances plankton growth and forms an important habitat for commercial fish stocks around Scotland.

Figure 2: Scotland's seawater circulation



Offshore habitats and species (Biodiversity)

Scotland's seas support a huge diversity of marine life and habitats, with around 6,500 species of plants and animals. These include species such as:

- **seabirds** – In breeding colonies around the coasts of Scotland;
- **seals** – Harbour and grey seals;
- whales, dolphins and porpoises, collectively known as cetaceans;
- sharks, rays and skates, including the basking shark, which is the world's second-largest fish;
- deeper water species such as cold water corals and sea fan communities;
- occasional visitors, e.g. leatherback turtles and bearded seals;
- **plankton** – Microscopic plants and animals at the base of the food chain.

Scotland has internationally important numbers of 24 species of breeding seabirds that are important indicators of the state of the marine environment. These are monitored around Scotland as part of the UK Seabird Monitoring Programme. This monitoring shows a decline in the abundance of seabirds since the early 1990s, stabilising in the last three years to approximately 72% of the 1986 level.

Harbour seals are declining in all regions, but grey seal numbers are relatively stable.

Cetaceans are very mobile and some can range widely, whereas others are more localised. Their greatest diversity in Scottish waters is found off the continental shelf to the north and west of Scotland.

Sharks, rays and skates are all on the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic list of threatened and declining species due to their removal as target and non-target species.

Less is known about deeper water species such as cold water corals, and it is difficult to estimate their state.

Monitoring of plankton occurs mainly in coastal waters, and changes have been observed that may be linked to climate change.

A number of non-native species are already present in Scottish waters and some are considered to be invasive, such as acorn barnacles and wireweed.

Overall, the assessments of habitats and species show declines in many areas, pointing to changes in biodiversity throughout Scotland's seas.

Hazardous substances in Scotland's seas

Contaminants are hazardous substances that accumulate in the environment and have an impact on wildlife and humans. Hazardous substances are released to the environment as a result of human activities or natural processes. They can be present in the water column, sediment and wildlife (including fish).

Hazardous substances include:

- polychlorinated biphenyls (PCBs);
- polybrominated diphenyl ethers (PBDEs);
- trace metals (e.g. copper, zinc, lead, cadmium, arsenic);
- endocrine disruptors.

There are difficulties in monitoring offshore areas, particularly the deep seas to the west of Scotland, but the limited monitoring data for hazardous substances in the offshore environment do not show any problem areas.

For example, deep water fish (currently non-commercial species in Scotland – black scabbard, black dogfish and roundnose grenadier) caught at depths of 400–1500 m off the west coast of Scotland have low concentrations of PCBs and PBDEs. These concentrations are probably due to diffuse atmospheric inputs.

Commercial fish and shellfish stocks

The seas around Scotland support significant populations of commercially important fish and shellfish species.

These can be divided into:

- **widely distributed stocks (around the north and west of Scotland** – Of which the most important species are mackerel and blue whiting, with lesser fisheries for megrim, anglerfish, saithe, hake and Atlanto-Scandian herring. The mackerel is the most important commercially and is in good condition, as are the stocks of Atlanto-Scandian herring, but current blue whiting stocks are giving cause for concern. The status of megrim and anglerfish stocks are currently under assessment, but recent surveys point to an increase in the megrim stock and the anglerfish stock is generally stable;
- **North sea stocks** – Some of the most important and longstanding fisheries are located in the North Sea, with cod, haddock, whiting, herring, sole and plaice being the six main stocks. Herring, haddock and plaice are being fished sustainably, but sole and cod are being fished above sustainable limits. For whitefish there are severe assessment challenges and the status of this stock is unknown;

- **West of Scotland stocks** – The overall picture here is less positive than in the North Sea, with the two haddock stocks (geographically separated) fished close to limits and the cod stock in very poor condition. West coast herring is fished at a broadly sustainable rate and data for the whiting fishery are sparse, but the indications are that the stock is in a very poor condition;
- **shellfish** – Nephrops, scallops, lobster, brown crab and velvet crab represent almost one-third of the value of all landings by Scottish vessels in 2009. The geographical distribution of suitable habitats around Scotland is highly complex and, as the different species have different habitat requirements, the consequence is that the shellfish populations are in discrete aggregations but have a patchy distribution. Most of the edible crab stocks are fully exploited or overexploited, as are lobsters. For brown crabs there are underexploited stocks to the north and west of the Hebrides. The nephrops stocks in the North Sea are also underexploited. Scallops are the second-most valuable shellfish species. Stocks to the west of the Hebrides and off the North East coast are overexploited or nearly so, whereas stocks in the Shetland Isles appear to be the most healthy.

Eutrophication

Eutrophication occurs when the enrichment of nutrients in water increases the growth of algae and plants in the water and may lead to undesirable disturbances, such as fish deaths due to the removal of oxygen by decaying algae. The key nutrients in marine waters are those of nitrogen and phosphorus. Nutrients are naturally occurring but their concentrations can be affected by man-made inputs (e.g. domestic wastes and agricultural run-off). This can affect coastal waters the most, therefore most monitoring of nutrient concentrations is carried out in coastal waters. Some monitoring of offshore waters has been carried out in the northern North Sea and the nutrient concentrations do not show any problem areas.

Litter

Marine litter is defined as 'any persistent manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environments, including material lost at sea in bad weather'. Plastics constitute the main type of litter found in the seas, including increasing quantities of microplastics. Other types of litter are paper, textiles, rubber, wood and metal. Marine litter in Scotland's seas originates from the land, shipping, fishing vessels and is carried by currents from other countries. Litter on beaches is recorded by the Marine Conservation Society. Data on the amounts and types of offshore litter are limited due to the relatively limited monitoring offshore. The KIMO (Kommunenes Internasjonale Miljøorganisajon – Local Authorities International Environmental Organisation) Fishing for Litter project provides fishing boats with bags to collect marine litter coming up in nets and fishing gear. This is then brought ashore and weighed. Plastic and polystyrene makes up the bulk of this litter.

Noise

For most marine mammals, many marine fish and possibly shellfish, sound is important for communication and navigation, searching for prey and for avoiding predators and hazards. There are many sources of man-made sound (noise) in the sea:

- shipping;
- seismic surveys;
- offshore construction/industrial activities;
- sonars (sound navigation and ranging).

The frequencies of wind- and wave-generated noise and man-made sources of noise overlap the range of frequencies of underwater sound that can be heard by marine life. There are currently not enough data to produce a quantitative assessment of noise in Scottish waters and we need to develop effective systems for monitoring noise in the sea and to quantify the associated risks to marine life.

Pressures affecting Scotland's seas

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Scotland's seas are subject to a range of pressures, but most are at a small scale. However, these small-scale pressures could have an impact at the local scale if rare species and/or habitats are involved.

There are two significant pressures on the Scottish marine area which are widespread:

- human activity contributing to climate change;
- fishing, which impacts on the seabed and species.

Other pressures which could have an impact are (in no particular order):

- marine litter;
- offshore renewable energy;
- oil and gas industry;
- oil and chemical spills;
- noise;
- non-native species;
- disposal of dredged material at sea.

Commercial fishing

Many commercial fisheries are multi-species fisheries and therefore by-catch (catching non-target species in addition to the target species) may be unavoidable. This may introduce pressures on the non-target species stocks and cause a loss of revenue for the fisherman.

Ghost fishing (fish trapped in lost or abandoned fishing nets or lobster creels) can also add to the pressure on fish stocks.

Seabed (and habitat) damage can be caused by fishing gear dragging along the sea bed.

Physical pressures include noise and litter, although the impacts of these on marine life are, as yet, not fully understood.

The impact of the renewable energy sector is also unknown, but it is possible it will have an effect on fishing activity, mainly due to competition for sea space.

Climate change

The climate of Scotland's seas is largely defined by their water temperature, salinity, circulation patterns and the exchange of heat, water and gases with the atmosphere. Changes in these climatic factors and other factors such as acidification affect the functioning of Scotland's seas. In the last decades Scotland's seas have become warmer and the shelf seas and ocean waters to the north and west of Scotland have become more saline. As a consequence of this, cold water species such as monkfish have moved northwards and the likelihood is that warmer water species will move into Scotland's seas. Acidification is also increasing and this is a particular pressure for marine ecosystems and organisms that require calcium carbonate for their shells. Warmer conditions in the North Sea have meant a change in plankton abundance and distribution, and this has had a knock on effect for some seabird species due to reduced availability of prey.

Offshore marine litter

The damaging effects of marine litter are found throughout the seas. Wildlife can be affected due to ingestion of litter or entanglement. There is also emerging concern that plastics and microplastics can transport hazardous substances around the world's oceans. Alien species can also be transported on marine litter. Health and safety issues can result from, for example, navigational hazards such as losing power due to propeller entanglement in litter.

Offshore renewable energy

For Scotland's seas the main pressures on the environment from renewable energy will be those of noise and habitat losses or changes. Noise can be generated by the devices themselves (air turbine, tidal or wave). Habitats could be lost or damaged due to construction activities, smothering due to suspended sediment settling out and changes in habitats within the footprint of the devices. Other pressures could be ship collisions with renewable energy installations and pollution due to spillage of fuel or lubricating oils or construction materials. There also might be conflict in the competition for sea space.

Oil and gas industry

The oil and gas industry has been a source of major activity in Scottish waters since the late 1960s. Except for the Beatrice Field in the Moray Firth, most oil and gas activity is centred on the Fladen and Forties areas of the North Sea, the East Shetland Basin and the Clair field to the west of Shetland.

The main pressures arising from this industry are:

- habitat damage or losses arising from the physical presence of structures and pipelines;
- pollution due to accidental spills;
- noise (see noise below).

Marine Scotland Science has carried out several surveys on the Fladen Ground and the East Shetland Basin, focussing on the concentrations of hydrocarbons in surface sediment, which give an indication of the amount of oil released in waste drill cuttings. These surveys have shown that the concentrations of hydrocarbons outwith 5 km from oil installations have decreased since the first surveys in 1986. The overall assessment is that there are few or no concerns and that there is no indication of hydrocarbon contamination >5 km from any oil installation.

Another pressure is from the oil/diesel-contaminated drill cuttings, prohibited from disposal by dumping into the sea since 2000, but there may be legacy problems from previously dumped drill cuttings piles close to many oil installations. More intensive studies of the drill cuttings piles[1] have shown that there is a decrease in time of the spatial extent of pollution and associated biological effects around platforms, and that there are clear signs of recovery at >500 m from the platform.

Oil and chemical spills

Oil and chemical spills are reported from vessels and offshore oil and gas installations operating in UK waters in the UK Pollution Control Zone (UKPCZ). The Advisory Committee on Protection of the Sea produces annual reports on the incidence of oil and chemical spills in coastal and offshore UK waters.

Oil and chemical spills are monitored to manage any contamination of the sea or harm to wildlife. The Maritime and Coastguard Agency (MCA) is the UK body responsible for taking action in relation to oil and chemical spills. Most offshore spills occur at oil and gas installations, which are located mainly in the East Shetland, Fladen and Forties sea areas. There are very few spills elsewhere. The most recent published data are for 2008 (ACOPS 2008), and these reported that the spills were minor. These had no significant impact, with many of them being so small that they dispersed naturally without any intervention.

Noise

The increase in offshore construction will have had at least a local impact on noise levels in the sea. There is also noise generated at offshore installations as well as by shipping.

Invasive non-native species

Alien species are non-native species introduced accidentally or deliberately into the Scottish marine environment. Ballast water from ships is an important route for the introduction of alien species. Alien species become invasive when they are established, proliferate and spread in ways that cause damage to native species. It seems likely that Scottish waters will become increasingly more threatened by invasive species, in particular due to the effects of climate change, with warming and more saline waters allowing non-native species to proliferate.

Disposal of dredged material at sea

Dredging of harbours and navigation channels is essential to keep ports and harbours open, but the disposal of the dredged material at sea can cause environmental problems. The dredged material may contain contaminants, which, in addition to possible resuspension at the dredge site, may also be redeposited at the disposal site. There may also be habitat changes due to the introduction of 'foreign' material and/or smothering of habitats. The disposal of dredge material at sea is closely regulated and monitored, and there is no significant impact outwith the disposal site. Within the disposal site impacts may be restricted to, for example, increased water turbidity over a short period of time.

[1.] *Breuer E, Howe JA, Shimmield GB, Cummings D, Carroll J (1999)* Contaminant leaching from drill cuttings piles in the north Sea: A review. *Scottish Association for Marine Science.*

Consequences of a change in Scotland's seas

The main consequences of a change in the offshore marine environment are as follows.

- competition for sea space with other economic marine activities could mean a reduction in fishing effort and scope. Built structures in the seas (renewable energy devices, oil platforms, pipelines, cables) all take up sea space with a potential impact on fishing effort;
- **climate change** – Warming of Scotland's seas has changed plankton communities and the incidences of more southerly fish species migrating northwards has increased. The implications for the fishing industry are reduced opportunity for economic exploitation of some species. For example, it appears that the environmental conditions for cod in the North Sea are less favourable than before. It may be that the Scottish industry will begin to target some of the more 'exotic' fish species as they move into Scottish waters, thereby increasing the range of products available. If there are more severe storms, these may result in the resuspension of material from the seabed, increasing turbidity and decreasing the available light in the water;
- loss of species and habitat diversity due to physical damage such as that caused by trawl gear on the seabed or the introduction of pollutants to the environment and into the food chain;
- damage to vessels from marine litter, for example propeller entanglement, blocked engine intakes, damage to fishing gear. It is estimated that marine debris costs the Scottish fishing industry between €11.7 million and €13 million per annum;
- navigational hazards from larger items of litter (e.g. containers) or shipwrecks.

Response by society

The Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 are the key pieces of legislation covering the provision of marine planning and conservation in Scottish waters out to 200 nm. The Marine Scotland Act (2010) is a key tool for the implementation of the European Marine Strategy Framework Directive. Within the confines of these pieces of legislation, Scotland also has obligations to global and regional (North Atlantic and European) scale legislation and directives.

The European Marine Strategy Framework Directive (MSFD) requires Member States to prepare national strategies to manage their seas to achieve or maintain Good Environmental Status (GES) by 2020. The MSFD covers a wide range of environmental indicators from biological diversity to marine food webs to levels of noise and marine litter.

MARPOL Convention: The International Maritime Organisation (IMO) is the United Nations agency responsible for the security and safety of shipping and the prevention of marine pollution for ships. The legislation governing marine pollution by ships is contained in the MARPOL Convention and contracting parties have an obligation to ensure that wastes are not discharged into the sea. Annex 5 specifies the regulations for the disposal of rubbish from ships and perhaps the most important part of this legislation is the complete ban on dumping any form of plastic rubbish into the sea.

Fishing for Litter is a scheme to clean up the North Sea, which involves fishermen returning the litter caught in their trawls for quantification and proper disposal. Currently, 162 fishing vessels and 17 harbours in Scotland are signed up to this. As of March 2011, 200 tonnes of litter had been removed from the North Sea, ranging from plastic debris to mattresses and fridges.

Ballast water legislation: the International Convention for the Control and Management of Ships' Ballast Water and Sediments is also part of IMO and aims to prevent the potentially devastating effects of the spread of harmful aquatic organisms carried by ships' ballast water from one region to another.

OSPAR: the OSPAR Convention is the current legal instrument guiding international co-operation on the protection of the marine environment of the North-East Atlantic. Work to implement the OSPAR Convention and its strategies is taken forward through the adoption of decisions, which are legally binding on the Contracting Parties.

The Maritime and Coastguard Agency (MCA) responds to oil and chemical spills at sea.

Dredged material for disposal at sea is monitored for contaminants and cannot be disposed of at sea if above a certain limit. Marine Scotland Science undertakes a regular programme of monitoring at sea disposal sites and records are maintained on the material deposited. Sites and dredging operations are licensed and Marine Scotland regulates the licensing scheme on behalf of the Scottish Government.