Estuaries and seas

Scottish marine and coastal biodiversity is rich, diverse and fragile. Sustainable management will improve the health of our seas and the dependent Scottish communities

Summary

Scotland's marine and coastal biodiversity is a major asset. Our marine and coastal ecosystems consist of a wide range of habitats, from open seas to sheltered sea-lochs, and from underwater cliffs and gorges to wide expanses of sand and mud. These provide niches for thousands of species. Many Scottish people depend on marine and coastal biodiversity, for example, for tourism and fishing. It is essential to recognise our relationship with this ecosystem and to sustainably manage the resource.

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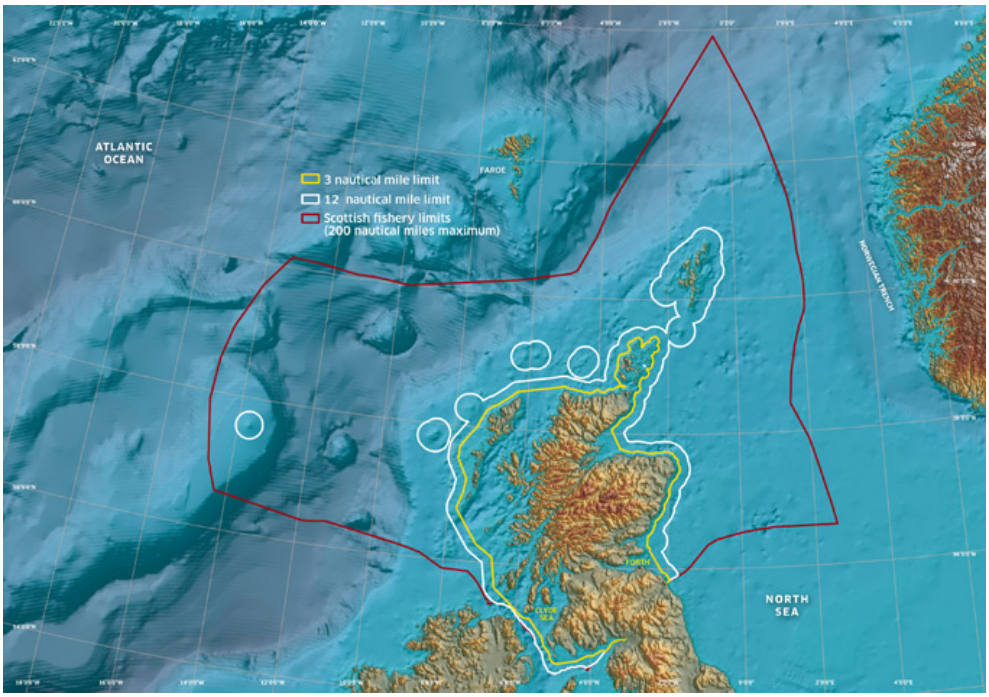
Introduction

Scotland's marine and coastal resources are enormous. Scotland has an estimated 18,672 km of coastline, which makes up 8% of Europe's coast. There are 53,638 km2 of open sea within Scotland's 12 nautical mile territorial limit (Figure 1) and 34,810 km2 of internal waters – making over half of Scotland's administrative territory marine in nature. Scotland is also responsible for managing marine renewables and protecting biodiversity out to 200 nautical miles (Figure 1) – an area of around six times the land area of Scotland.

Figure 1: Scotland's seas: marine responsibilities



The Crown Estate owns much of Scotland's seabed and coast; however, many people's livelihoods depend on the sea and, thus, they feel a sense of ownership. It is estimated that one-fifth of the Scottish population lives within 1 km of the sea and many people enjoy the sea, whether it is just walking along a coastal footpath or taking part in water sports.

Marine and coastal biodiversity provides us with a number of benefits, including producing food, boosting recreation and educational interests.

A number of industries rely on healthy biodiversity, including fishing, tourism and aquaculture. In 2004, the value of marine biodiversity-related industries was estimated to be over £1.2 billion.

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Description of estuaries and seas wildlife

The marine and coastal environment is described in Scotland's Marine Atlas. This details, among other parameters, the extremes of temperature, wave exposure, salinity and acidity of our seas. Marine and coastal waters vary from the offshore clear-blue oceanic waters found off St Kilda that are light at 50 metres deep, to the dark and green-tinged waters of our coasts. Underwater, the sea bed itself is complex, ranging from cliffs and mountains to valleys, boulder slopes, and vast areas of gravel, sands and mud. The majority of Scotland's marine and coastal habitats are unsurveyed – simply because they are difficult to reach.


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Marine plants and animals

Scotland's seas are among the most biologically diverse and productive in the world. It is estimated that there are 6500 marine species of animals and plants (excluding microbial flora), ranging from large marine mammals to fingernail-sized shrimps. The nature of the sea means that there are very few physical boundaries or barriers to species movement, allowing many species to exist all around our shores.

1. of the 325 fish species recorded in UK and Irish waters, SNH estimated that 250 fish species are found in Scottish waters. These include common species such as butterfish and sand eels, northern species such as wolf fish, colourful species such as leopard spotted goby as well as the more familiar commercially caught fish species, mackerel, cod and herring, and fish caught by Scottish anglers such as tope, wrasse or skate;
2. the Scottish seas and coastline provide food and shelter for many sea and shore birds. Many are transient; resting onshore or rafting at sea during their migration. Some species come specifically to breed. For example, gannets have formed the largest single rock colony in the world on the Bass rock in the Firth of Forth. However, the long-term trend in seabird populations has shown a marked decline, although it is unknown whether this decline is due to breeding failure, habitat loss or even food web disruption caused by climate change;
3. **marine reptiles** – Marine turtles are occasional visitors to Scottish Waters and species such as leatherback turtles have been reported all round our coasts;
4. **marine mammals** – some marine mammal populations thrive in Scottish sea, for example the number of grey seals increased between 1995 and 2009; whereas others have declined, for example harbour seals have declined inexplicably since 2001. Twenty-three species of cetaceans (the collective name for whales, dolphins and porpoises) have been recorded in Scottish waters over the last 25 years. Of these, 11 are regularly sighted and are the subjects of a thriving wildlife tourism industry;
5. the most obvious marine plants are seaweeds (macroalgae), found on Scotland's shores and in clear waters. In coastal lagoons there are also seagrasses and tassleweeds. Offshore marine plants are represented by phytoplankton, mostly microscopic plants that drift in the sea and are the basis of marine food-webs and oxygen cycles. All these marine plants are the source food and shelter for many marine animals;
6. marine plankton lives throughout the sea and is made up of small plants, phytoplankton and small creatures, such as copepods, and larval forms of marine animals that form the basis food stock for much of our marine life, including herring and basking sharks and filter-feeders such as oysters and tubeworms;
7. **marine invertebrates** – animals without backbones make up the most colourful and prolific proportion of Scotland's marine animals. Examples include: breadcrumb sponges; sea-anemones; coldwater corals; candy-striped worms; sea-cucumber and sea-urchins; crabs and lobsters; starfish; sea-slugs; scallops and octopuses.

Designated sites

1. many examples of Scotland's marine and coastal habitats and species are included in protected areas such as Sites of Special Scientific Interest (SSSI), National Parks, National Nature Reserves and National Scenic Areas;
2. european Natura sites, such as Special Protection Areas (SPAs) and Special Areas of Conservation (SAC), have been designated to look after fragile Scottish habitats, such as Maerl ('Scottish Coral'), or living structures, such as horse mussel beds, deep water corals or, unique to Scotland, serpulid reefs;
3. marine species protected within Scotland's marine SACs include harbour seals, grey seals and bottlenose dolphins. Some marine species are so wide ranging or mobile that they do not have specific protected areas designated for them (e.g. basking sharks and harbour porpoise) but are listed as European protected species and are fully protected under UK legislation;
4. a number of projects have been undertaken to map the distributions of habitats and marine life in order to help us understand the marine and coastal environment and to inform marine policy and planning. Scottish Natural Heritage's Broad-Scale Mapping programme has been used to locate and manage protected areas such as the Sullom Voe, Moray Firth and Loch Sunart SACs, as well as firths, such as the Firth of Lorn and Firth of Forth.

Condition and trends

The marine environment is complex and we are only starting to understand it. The UK has developed a set of indicators that measure the trends in biodiversity health at a national level. These overall assessments have been informed by monitoring and survey work, such as:

1. SNH's Designated sites condition monitoring;
2. Marine Scotland's commercial fish stock assessments;
3. plankton monitoring and copepod monitoring undertaken by Marine Scotland;
4. SEPA's Water Quality Monitoring results, e.g. National Marine Monitoring Buoy Network;
5. SEPA's Protected Areas monitoring;
6. SEPA's Bathing Waters Classification.

Scotland's marine biodiversity indicators, marine phytoplankton, estuarine fish and marine non-native species, have all shown a decrease in status since the 1970s. Indicators of marine ecosystem health, such as the size of fish caught in the North Sea, have shown a distinct long-term decline. The proportion of large fish declined most rapidly from the mid-1980s to the mid-1990s but stopped declining in the late-1990s and there has been little overall change since 2000. Estuarine fish and breeding seabirds have also shown a small recovery, which may be attributed to a trend towards more sustainable fisheries in Scottish waters.

Pressures on estuaries and seas wildlife


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Although certain pressures on Scotland's seas, such as pollution, are being reduced, which may provide a better quality environment for biodiversity; crucial habitats that support species are being lost. Intertidal and coastal habitats can be especially at risk due to inappropriate coastal development.

In general, humans have the biggest impact on the marine and coastal environment. The European Environment Agency has identified the key pressures on marine biodiversity as climate change, pollution, acidification, marine litter, over-exploitation of fish stocks and invasive non-native species. At a UK level, fishing, dredging and aquaculture (commercial farming of marine species) have also been highlighted as pressures.

1. **climate change** – sea surface temperatures and sea levels have risen over recent times. At the same time, changes in the biological components of the seas have been observed;
2. in Scotland the marine carbon sinks (saltmarsh and seagrass beds) are under pressure and changes to species ranges have been seen in the North Sea;
3. **hazardous substances** – concentrations of hazardous substances (chemicals of concern) are decreasing, and water quality is improving, as seen in the Water Framework Directive monitoring results and Clean Seas Environment Monitoring Programmes;
4. increased concentrations of nutrients (nitrogen and phosphorus) continue to be a localised problem within Scotland's coastal waters. Nutrient inputs from aquaculture predominate on the west coast, whereas on the east coast diffuse run-off from agriculture and urban discharges are the main sources of nutrients;
5. ocean acidification describes the ongoing decrease in ocean pH caused by increased CO_2 in the atmosphere dissolving in seawater making it more acidic. This has major implications for organisms whose shells or skeletons are made of calcium carbonate;
6. **marine non-native species** – when combined with other pressures, the introduction of non-native species represent the biggest threat to biodiversity worldwide. They can alter entire ecosystems and have an impact on the fish-farming of native species, inshore fisheries and local biodiversity, causing serious problems to both the environment and dependent economy. In Scotland a number of non-native species are reported as widespread and well established;
7. **fishing** – there is a general move in Scotland towards methods that reduce fishing impacts on the marine environment. Most obviously the impact on biodiversity is the removal of target and non-target species, but destructive fishing methods can also impact by disturbance or removal of the seabed, abrasion, scouring and smothering of habitats, and damage to bottom-dwelling species;
8. **aquaculture** – Scotland has a large-scale aquaculture industry for shellfish, crustaceans and fin-fish. Although the industry is moving towards sustainable and low impact methods, the pressures (particularly from fin-fish) include the collection of other fish species as feed material, and localised effects from licensed discharges include nutrient and waste inputs, and contamination from veterinary chemicals. Biological contamination is caused by associated sea lice and micro-organisms, as well as a risk of introducing non-native species either escaped from cages or accidentally transported by aquaculture activities;
9. marine litter impact on marine life is a global cause for concern. On Scottish beaches litter is persistent and mostly made up of non-biodegradable plastics that blow around shores, float on the water surface, drift in the water column, and get entangled on shores and seabed. Litter harms plants and animals by smothering, abrasion or through choking and starvation. Around the world species have been reported as dying each year from entanglement in, or ingestion of, litter. Off the Isle of Mull, a Whale & Dolphin Society study found evidence of minke whales ingesting marine litter;
10. **renewables** – Scotland's coasts and seas have a vast potential for electricity generation from wind, tide and wave resources. However, the construction and operation of such developments is likely to impact biodiversity. There is a dedicated research programme funded by the Scottish Government to better understand the potential environmental impacts of marine renewable energy;
11. **oil and gas** – North Sea oil and gas makes a huge contribution to the Scottish and UK economies. They can, however, impact upon biodiversity through noise and disturbance, particularly during exploration, as well as through accidental spills during production and decommissioning;
12. **shipping and navigation** – impacts on biodiversity range from pollution and chemical contamination, noise and physical disturbance as well as potential for collision with mobile species. In addition, the risk of introduction of marine non-native species through shipping is high.

Consequences of a change in estuaries and seas wildlife

The marine and coastal ecosystem is so complex and poorly understood that the likely consequences of a change in marine and coastal biodiversity can only be envisaged; the effects may be more significant than currently thought.

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1. the consequences are unknown of the loss of a species or group of species, but population declines of birds and other top predators dependent on a single marine food stock have been seen following the decline of their prey;
2. the removal or loss of nursery habitats supporting species could lead to the reduction of numbers or even loss of these species from Scottish waters. The loss of harvested species could directly affect Scotland's well-being and economy, as well as impacting directly on aquaculture and inshore fisheries and consequently on local coastal communities;
3. the loss of living habitat such as kelp forest could not only be biologically and economically damaging, but may also be physically damaging as the loss of kelp and reef communities in the west coast of Scotland would lead to a reduction of physical shelter from the westerly storms;
4. loss of species may lead to a change in the balance of the species in the marine ecosystem. It is thought that ecosystem imbalances have led to increased occurrences of jellyfish swarms, which can affect human well-being, and in 2011 disrupted power generation;
5. an increase in particular species, for example harmful algal blooms, could be a risk to human health as well as cause sudden die-back of other marine species.

Response by society

Much of society's response has been through the development and implementation of European and International Marine legislation, but in Scotland the biggest responses by society have been by people acting on issues affecting their activities.


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1. **fishing** – the implementation the of European Common Fisheries Policy has had a negative impact on marine biodiversity and the current round of reforms has attracted the highly publicised sustainability campaign, Fish Fight. Within Scotland there has been a strong movement towards a sustainable fisheries strategy by the Scottish Inshore Fisheries Advisory Group (SIFAG), and the development of a Scottish fleet discard scheme. In addition, the Scottish Fisheries Council (SFC) has developed the Scottish Scallop Strategy and the Crab & Lobster Strategy. The Scottish seafood industry and the Marine Stewardship Council (MSC) have created the Scottish Fisheries Sustainable Accreditation Group to take North Sea fishing through the accreditation process that demonstrates responsible and sustainable operations;
2. **marine non-native species** – the GB Non-Native Species Secretariat (GBNNSS) has responsibility for helping to co-ordinate the approach to invasive non-native species in Great Britain. It issues species alerts (e.g. for the carpet seasquirt, first found in Scotland in 2009) and asks the public to report sightings. It is recognised that the best way of preventing non-native species from spreading is through good biohazard management, and good examples of such advice drawn up by industry and interested parties include that from:
   - The Green Blue advice for boat owners;
   - Scottish Canoe Association advice to paddlers;
   - Alien invasive species and the oil and gas industry advice;
3. marine litter is not just an issue for Scotland. At the UK level, groups, such as Surfers Against Sewage (SAS), have long promoted awareness of sewage and sewage-related debris found on UK beaches. The Marine Conservation Society (MCS) runs the Beachwatch project, a beach litter survey that records rubbish on beaches, and the information gathered by this project has provided the evidence-base for the marine litter chapters in both Scotland's Marine Atlas and Charting Progress 2 and is the basis of the information behind their anti-litter campaigns. More recently, the Scottish Government is developing a Marine Litter Strategy for Scotland to co-ordinate and support initiatives tackling this issue;
4. **aquaculture** – generally this still has a localised impact on the marine environment, but within the industry codes of conduct have been adopted to reduce impacts. Good practice includes; decreased stocking densities and increased length of, or even synchronised, fallow periods in some sea-lochs. Organically grown fin-fish are becoming more favoured by the market, but there is still an issue that wild-fish harvesting is required as a protein food source for farmed fish.

The future: Protection and management of Scotland's marine and coastal biodiversity

This can be considered on two scales: (1) National and international scales and (2) local and individual scales.

(1) National and international scales

Protection and management of marine and coastal biodiversity on international and national scales has been driven by the development of the EU Marine Strategy Framework Directive, which holds biodiversity and ecosystem services central to the management of EU territorial waters. Its implementation has led to changes in Scottish Laws and Policies.

The EU Marine Strategy Framework Directive requires Member States to prepare national strategies to manage their seas to achieve or maintain Good Environmental Status (GES) by 2020. Because of the nature and use of the Scottish marine environment, there is a high emphasis on international co-operation.

1. the European Common Fisheries Policy is currently being reformed and this reform requires compliance with the EU Marine Strategy Framework Directive;
2. **the Marine (Scotland) Act 2010** – the act introduces a new system of marine planning for the sustainable management of seas around Scotland, ensuring that the need to protect our seas is integrated with economic growth of marine industries. The new marine planning system provides a framework to balance the many competing demands on Scotland's seas. Marine plans will promote development that supports the move towards a more economically, social and environmentally sustainable society, and will be managed using an ecosystem-based approach;
3. **social inclusion** – the Marine Strategy Forum was established in July 2009 to give members of the public *equal opportunity* to contribute to the planning process. The forum's diverse membership allows the needs of marine leisure, conservation, aquaculture, fishing, transport, industry and public bodies to be considered.

(2) Local and individual scales

Many individuals and groups of people take voluntary action to protect marine and coastal biodiversity, including through formal reporting of citizen science to informal reporting as a result of recreational activities.

1. **citizen science** – many people will give up their weekends and evenings to partake in formal specialist recording programmes. For example, the Scottish Sea Anglers Conservation Network (SSACN) Shark Tagging programme; the MCS's

lead in Scotland for the UK's Seasearch programme; and the British Trust for Ornithology (BTO) organises several bird surveys for volunteers including the BirdAtlas, the Wetland Birds Survey (WeBS) and with the RSPB, the Breeding Bird Survey, which all include coastal bird counts as well as observation of the impacts of marine litter on coastal and marine birds. More recently, Jellywatch launched an international appeal for the public to report and photograph sightings of jellyfish swarms;

2. many people will actively report on wildlife seen during recreational activities, such as coastal walkers, or scuba-divers in the St Abbs & Eyemouth Voluntary Marine Reserve facebook page and blog, and can ask experts to identify findings via forums like i-spot. The Marine Conservation Society records sightings of basking sharks, marine turtles and jellyfish Scottish waters by the public through their Wildlife Sightings initiative;
3. **the Responsible Recreation Industry** – skippers can follow Green Blue's boat protocol, *Prevention of spread of marine non-natives*; the marine wildlife watching industry follow the Scottish Marine Wildlife Watching Code; and canoeists and kayakers have a code of conduct. Sea anglers have handling and tackle advice to reduce the impact on fish returned to the sea;
4. local communities of marine users have set up conservation management measures for their local marine and coastal areas, for example the Community of Arran Seabed Trust (COAST) and St Abbs & Eyemouth Voluntary Marine Reserve. Scottish Local Biodiversity Action Plan Groups are made up of the public and local officers, who deliver local plans and projects on biodiversity. Where possible, they work with local coastal fora to deliver on marine actions;
5. the Scottish Coastal Forum is a national group made up of local coastal fora that act as co-ordinated central points of communication for people living and working in marine and coastal areas, and where people may have a voice regarding marine and coastal issues. Local coastal partnerships include: Coast Hebrides, the East Grampian Coastal Partnership, the Firth of Clyde Forum, the Forth Estuary Forum, the Moray Firth Partnership, the Solway Firth Partnership and the Tay Estuary Forum.