APPENDIX 3 – ENVIRONMENTAL BASELINE – SEA 7 AREA

This section consists of a series of appendices which provide further information and figures to augment the brief descriptions produced in *Section 4.2 Environmental Baseline*.

For ease of use, the appendices are arranged in the same order as the headings under which the environmental characteristics were described in *Section 4.2*:

Appendix 3a - Biodiversity, habitats, flora and fauna

To facilitate access and understanding, the following appendix has been sub-divided into a number of subsections:

A3a.1 Ecological characteristics of the SEA 7 area
Provides a summary of the main ecological characteristics of the SEA 7 area including plankton; benthos; cephalopods; fish and shellfish; marine reptiles; seabirds and coastal waterbirds, and marine mammals.

A3a.2 Sites and species of nature conservation importance in SEA 7
Provides details of relevant nature conservation sites and species of international and national importance.

Within each subsection, information is presented at a level appropriate for the strategic environmental assessment and clear signposts are given as to where further information can be found. The aim of the following appendix is to provide the reader with a general high level summary of the *Biodiversity, habitats, flora and fauna* present within the SEA 7 area (particularly those aspects identified as important for nature conservation) and where possible, identify relevant issues and vulnerabilities that may affect them.

A3a.1 Ecological characteristics of the SEA 7 area

A3a.1.1 Plankton

Marine plankton includes plants (phytoplankton), animals (zooplankton) and bacteria (bacterioplankton) with the majority ranging in size from 0.2µm to >20mm. In general, planktonic organisms form the basis of marine food webs and constitute a major food resource for many commercial fish species. Changes in plankton populations may therefore have important ecological and economic consequences. Much of the information in the following section comes from the underpinning report (Kennington & Johns 2006).

Phytoplankton

Phytoplankton biomass generally follows the same pattern of distribution as the nutrient salts with highest coastal chlorophyll concentrations found in the Clyde Sea region and decreasing northwards. It is thought that much of the nutrient fuelling production in the sea lochs of the west of Scotland originates in the Clyde Sea/Irish Sea area (Rippeth & Jones 1996). However, water column stability and a favourable light regime in the spring can also produce high chlorophyll concentrations in these northern sea lochs (Kennington & Johns 2006).

During winter, the open North Atlantic is mixed to depths of several hundreds of meters and the water column over the shelf is mixed to the bottom. Thermal stratification on the shelf starts during the spring, bringing with it the potential for the development of fronts between the mixed and stratified waters especially around the islands of western Scotland or near the shelf break. The development of stratification on the outer shelf can cause frontal systems to migrate inshore during the spring and offshore during the autumn (Longhurst 1998). Productivity at these fronts is often greater than the surrounding regions as a result of nutrient enhancement via upwelling and diffusion processes. Enhanced primary production has also been observed around seamounts possibly as a result of deep water mixing processes over the seamount (White *et al*. 2004).

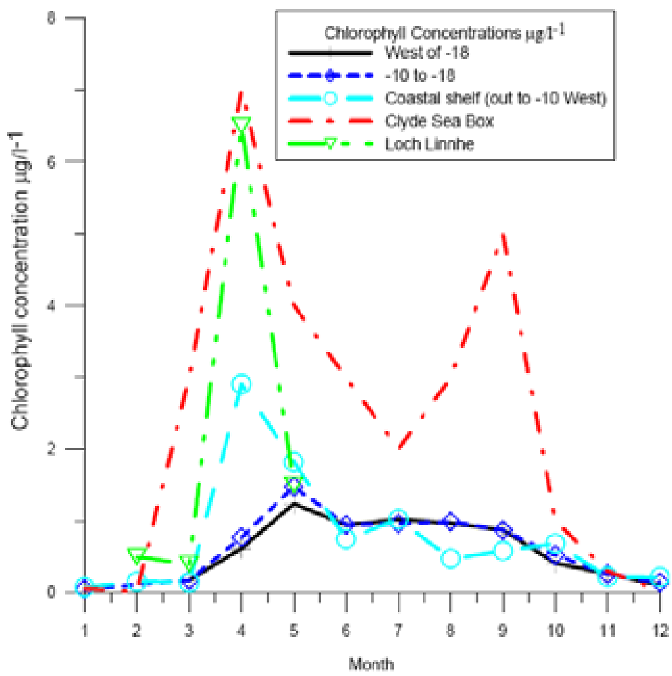


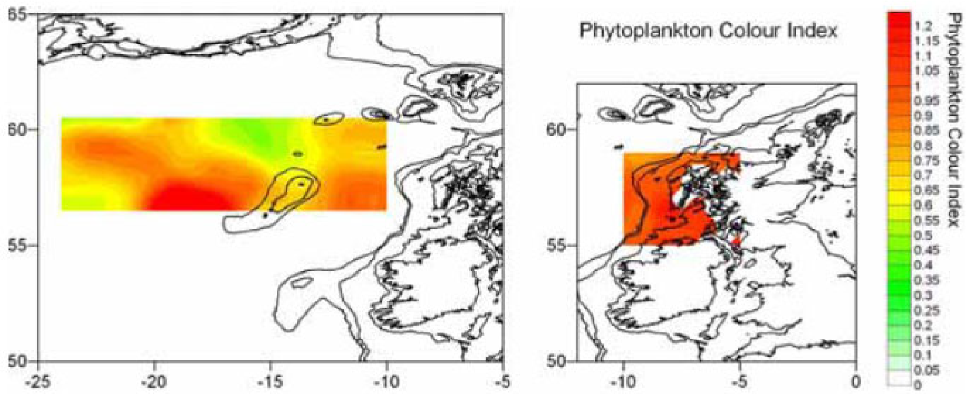
Figure A3a.1 - Chlorophyll concentrations for different water masses in SEA 7

Source: as in Kennington & Johns (2006).

Chlorophyll concentrations during the spring decrease offshore with waters on the shelf being approximating half of that recorded in the sea lochs (Figure A3a.1). The phenology of the spring bloom on the shelf and in the sea lochs are similar with maximum concentrations being recorded during April. However, unlike the sea lochs the autumnal production on the shelf is reduced and is more similar in character to production in more offshore waters. Mean chlorophyll concentrations during the spring in waters off the shelf edge are significantly lower than those recorded on the shelf or in the sea lochs and the spring bloom occurs approximately one month later during May. The Clyde Sea area also has elevated chlorophyll concentrations during the late summer/autumn as a consequence of the breakdown of stratification and re-supply of nutrients to the surface waters.

From Continuous Plankton Recorder (CPR) data, the phytoplankton colour index (Figure A3a.2), another proxy indicator for phytoplankton biomass is generally highest in coastal waters and decreases offshore. Considerable variation in the colour index in offshore waters is most likely an artefact of the relative position of frontal systems which are known to stimulate primary production through processes such as upwelling. [how consistent are he location of these?]

Figure A3a.2 - Phytoplankton colour index from the CPR, 1970-2000



Phytoplankton can be divided into diatoms (autotrophic, producing energy from photosynthesis), dinoflagellates (generally heterotrophic though some are capable of photosynthesis) and smaller flagellates such as the coccolithophorids. Waters of the northern sea lochs during spring are dominated by diatoms (e.g. *Skeletonema costatum*) and to a lesser degree phytoflagellates (Wood *et al*. 1973). During the early summer months the continued replenishment of silicate to these sea lochs can prolong diatom dominance and other diatoms such as *Rhizosolenia* spp. and *Chaetoceros* spp. can be important in the sea lochs and further offshore in regions such as the Islay Front (Simpson *et al*. 1979).

During the summer months the phytoplankton assemblage of Scottish coastal waters is generally dominated by dinoflagellates. In Loch Eriboll the most abundant dinoflagellates during the early summer months were heterotrophic species such as *Protoperidinium ovatum*. As the summer progressed autotrophic species such as *Ceratium* spp. became dominant (Dodge 1995). Smaller nano-plankton can be a significant component of the phytoplankton community throughout the year.

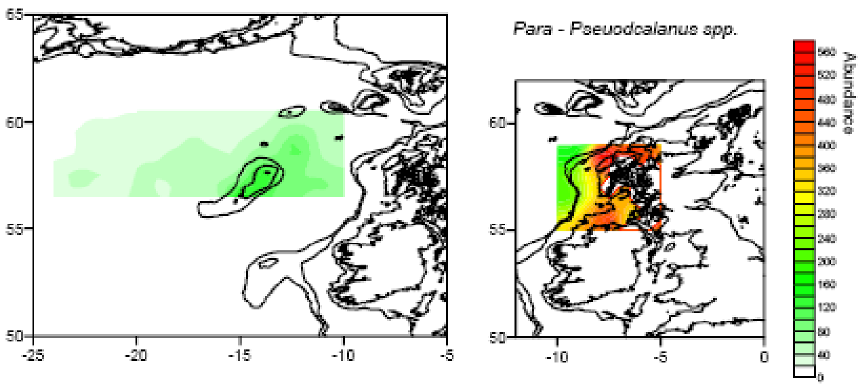
To the west of the islands and Scottish coast the phytoplankton community composition is governed by the dynamic interplay between the Scottish coastal currents and waters moving onto the shelf from the open Atlantic.

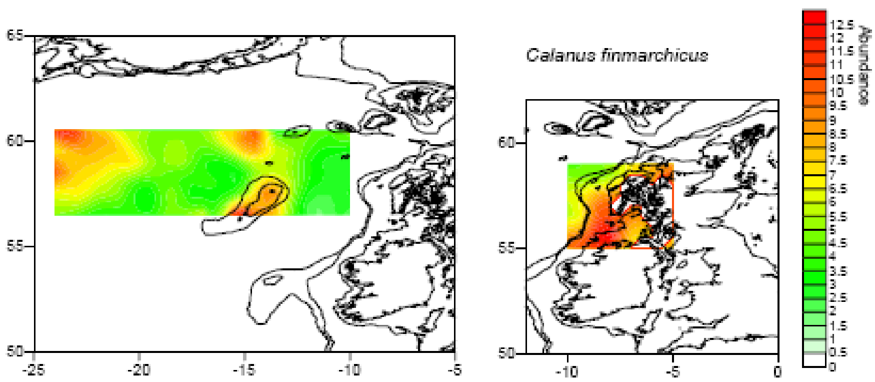
During the early spring diatoms dominate the oceanic phytoplankton assemblage. By June however, coccolithophorids are numerically dominant although diatoms still contribute significantly to the assemblage. As the summer progresses all groups decline in abundance with coccolithophorids, diatoms and dinoflagellates co-dominating between July and September. Small flagellated algae reach maximum abundances during July but remain less abundant than the other plankton groups during this time. There may also be late summer blooms of coccolithophorids (Longhurst 1998).

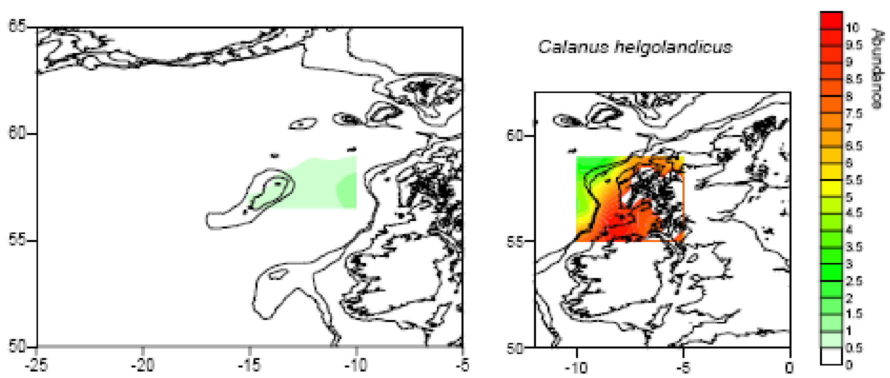
Zooplankton

The shelf zooplankton community is dominated by Calanoid copepods, in particular the smaller taxa *Para-pseudocalanus*, as well as the two large *Calanus*, *helgolandicus* and *finmarchicus*. The importance of *Calanus* as a major food resource for many commercial fish species has been explained in previous SEAs. Off shelf, the most frequently recorded taxa are Euphausiids, with lower numbers of Calanoid copepods. Table A3a.1 provides summary details of the distribution and seasonality of a number of the most abundant zooplankton species and groups.

Table A3a.1 – Zooplankton distribution and seasonality

<table>
<tr><th colspan="2">Zooplankton distribution and seasonality</th></tr>
<tr><td colspan="2">Para-pseudocalanus spp.</td></tr>
<tr><td>
</td><td>Most abundant of the small copepods, greatest numbers found on shelf (particularly to the north), with abundance falling westwards off shelf.

Similar on and off shelf, with a peak in June. Secondary peak in August off shelf and in September on shelf.</td></tr>
<tr><td colspan="2">Calanus finmarchicus</td></tr>
<tr><td>
</td><td>Present throughout area, but abundant off shelf around Rockall and to the far west. Also high abundance on shelf.

Peak in abundance in May and a tailing off through the summer months. Lowest in November to March.</td></tr>
<tr><td colspan="2">Calanus helgolandicus</td></tr>
<tr><td>
</td><td>Confined to the shelf, with greatest abundance to the south.

Peak during June, but with values high from April to October. Lowest in January to March.</td></tr>
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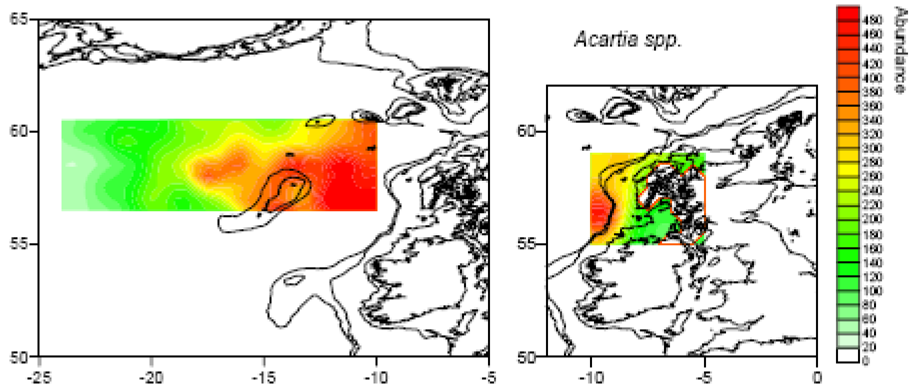
Zooplankton distribution and seasonality

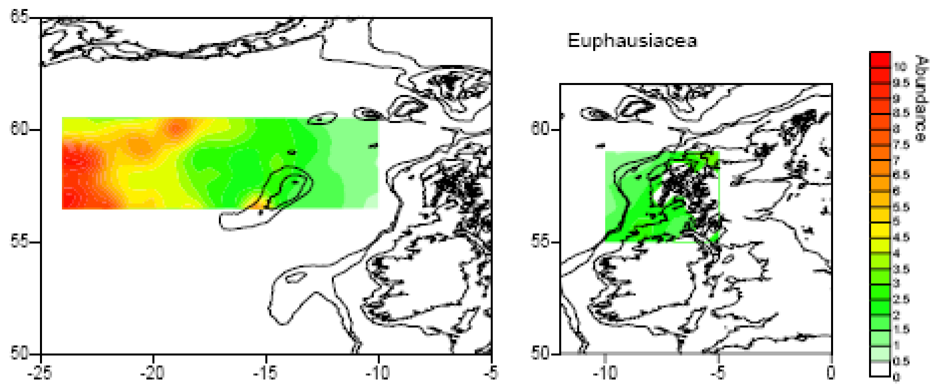
Acartia spp.



Most abundant between just off the shelf edge, and around Rockall, but present throughout SEA 7.

Distinct on shelf peak in July followed by off shelf peak in August.

Euphausiacea



Occurs mainly to the west of the SEA 7 area, with lower numbers throughout the rest of the area.

Similar on and off shelf, with a peak during May (June off shelf). Secondary increase on shelf during autumn.

Source: Kennington & Johns (2006).

Other animal groups within the zooplankton include the larval forms of large benthic crustaceans such as crabs, polychaete larvae, echinoderm larvae, and fish eggs and larvae. Chaetognaths or 'arrow worms' are also an important component of the zooplankton community. Larger zooplankton, including gelatinous forms such as thaliacea (salps and doliolids), siphonophores and medusae (jellyfish) are also present. The distribution and seasonality of other members of the SEA 7 zooplankton community are described in Kennington & Johns (2006).

Harmful algal events and phytoplankton blooms

Table A3a.2 provides summary details of harmful algal events, phytoplankton blooms and toxic phytoplankton species reported from the SEA 7 area. Further details are provided in Kennington & Johns (2006).

Table A3a.2 - Harmful algal events and phytoplankton blooms in SEA 7

Harmful event/condition	Phytoplankton responsible	Reported occurrence in SEA 7 area
Toxic blooms	*Gymnodinium aureolum*	Bloomed extensively in 1996 along the Scottish west coast causing deaths of finfish, shellfish and other invertebrates. Abundant out to the shelf break in 1996.
Paralytic Shellfish Poisoning (PSP)	*Alexandrium tamarense*	Species present throughout the spring and summer months in waters extending from the Firth of Clyde to Loch Laxford.

Harmful event/condition	Phytoplankton responsible	Reported occurrence in SEA 7 area
Diarrhetic Shellfish Poisoning (DSP)	*Dinophysis* spp	Recorded from the Firth of Clyde, Loch Etive, Loch Creran, Loch Striven, the Minch and from the Malin Shelf. Identified in waters off the shelf break.
Amnesic Shellfish Poisoning (ASP)	*Pseudo-nitzschia*	Abundant from the Clyde to Loch Laxford and out to the shelf edge.

Resting stages in sediments and ballast water

Dinoflagellates such as the potentially toxic *Alexandrium* spp. produce cysts which rapidly sink out of the water column and can remain dormant in the sediments for several years. Once reintroduced into the water column and given the right combination of environmental conditions these cysts can act as an inoculum for future populations. The cysts can be transported a considerable way by water currents, especially during the winter months due to storm re-suspension events (Marret & Scourse 2002). Diatoms also produce resting stages known as auxospores which can result from environmental stress.

Sediments and water in ballast tanks are important vectors for the spread and introduction of planktonic species. Introduction of such species can lead to the problem of genetic mixing of different stocks and the introduction of new species to an environment (Carlton 1985). The transport of these organisms can also occur on a smaller scale in domestic traffic, which can rapidly move nuisance species and increase the distributional ranges of species (Lavoie *et al*. 1999). The introduction of new marine species from ballast waters is thought to be responsible for about 20% of all new species introduced to the marine environment in Britain (Eno *et al*. 1997).

A3a.1.2 Benthos

Much of the following information particularly that relating to the deep water region comes from the underpinning technical report *An Introduction to the Benthic Ecology of the Rockall - Hatton Area (SEA 7)* (Davies *et al.* 2006). Major research initiatives in the region include surveys commissioned by the Atlantic Frontier Environmental Network (AFEN), the Land Ocean Interaction Study - Shelf Edge Study (LOIS-SES), the Benthic Boundary Layer Experiment (BENBO), as well as a number of SEA surveys. The Scottish Association for Marine Science (SAMS) has been studying the benthic environment of the area for over 25 years.

Shelf and coastal region

Coast

The benthic communities present in the coastal region of SEA 7 are complex and varied and are described by Hiscock (1998). The complex coastline of the mainland and islands supports a wide range of habitats from those characteristic of extremely exposed conditions to extremely sheltered conditions. There is considerable local variation with for example the Loch Duich, Alsh and Long complex holding deep mud and rock communities in extreme shelter from wave action and tidal streams but with narrows having typical tidal stream-swept communities. In many of the sheltered locations on the west coast, deep water extends close inshore and many deep-water species occur in rocky habitats near to the coast. Distinctive communities are also present in areas of very strong tidal streams such as the Gulf of Corryvreckan, the Sound of Mull and the Sound of Jura (Hiscock 1998).

The Minch

The Minch seabed has been surveyed mainly through fisheries investigations and a programme of studies using acoustic survey and ground-truthing by video and grab sampling was initiated by the SOAEFD Marine Laboratory in 1995. Four broad groupings (or biotopes) were identified which could be related to sediment types. Gravel substratum was dominated by the featherstar *Antedon bifida* (Community A). Also present, but in lower numbers, were the cloaked hermit crab *Pagurus prideaux* with its commensal anemone *Adamsia carciniopados*, the cushion star *Porania pulvillus* and the squat lobster *Munida rugosa*. Soft mud was dominated by burrowing decapods such as *Calocaris macandreae* and *Nephrops norvegicus,* with the seapen *Virgularia mirabilis*, the echiuran *Maxmuelleria lankasteri* and the polychaete *Sabella pavonina* also commonly observed (Community B). Mixed sediments supported a variable fauna of which the cnidarian *Abietinaria abietina* was the most commonly observed (Community C). Boulders and bedrock were dominated by echinoderms (e.g. *Ophiothrix fragilis*, *Ophiocomina nigra*, *Asterias rubens* and *Echinus esculentus*) (Community D) (Pinn *et al*. 1998).

Recent acoustic mapping to determine the presence of cold water corals provided further details of seabed biotopes in The Minch (Roberts *et al.* 2005). The survey concentrated on an area to the east of the island of Mingulay where prominent mounds (up to 5m high and 15m in diameter) were found along seabed ridges (water depths varying between 72-215m). Seabed video showed the mounds to be characterised by extensive areas of live coral interspersed with dead reef framework and coral rubble. Other suspension-feeding megafauna were abundant, in particular the stalkless crinoids *A. bifida* and *Leptometra celtica*, various erect sponges (*Axinella* sp., *Phakellia* sp.), and many rocks showed dense cover of zoanthids (*Parazoanthus anguicomus*). The large cerianthid anemone *Pachycerianthus multiplicatus* was often seen in sediment-filled areas in the rubble surrounding the reef mounds. In deeper areas, heavily bioturbated muddy sediments were found with *Nephrops* present as well as the smaller mud-burrowing shrimp *C. macandreae* (Roberts *et al*. 2005).

Reef mounds were not seen in the other survey areas at Stanton Banks, west of Skye or the Sound of Rum from where *Lophelia pertusa* has been recorded in the past. At all these sites, crinoids were abundant on hard substrata and areas dominated by sponges and zoanthids were also seen. Topographic highs associated with bedrock at Stanton Banks were colonised by coralline algae, serpulid worms, ophiuroids and sponges, whereas the gullies were filled with sand and occasional areas of cobble/gravel. The Stanton Banks have been put forward recently as a draft Special Area of Conservation for bedrock reefs. In all the survey areas, small dome-shaped colonial organisms were seen in video surveys (although of poor resolution) with the authors indicating that these may be recently recruited coral colonies (Roberts *et al.* 2005).

The concentration of reef mounds in the Mingulay area may relate to a deep-water trough extending to the south. Input of oceanic water via this deep-water trough possibly combined with the increased primary productivity associated with the Barra Head mixing zone (Savidge & Lennon 1987) and the presence of hard substrata for coral recruitment may be significant factors that have favoured reef mound development (Roberts *et al*. 2005).

Hebrides shelf

There is very little information available on the benthic communities of the Hebrides Shelf but the benthic fauna present will likely vary according to the nature of the seabed sediments. Pebbles, cobbles, boulders and bedrock which are extensive to the west of the Outer Hebrides are likely to be colonised by a wide range of encrusting or sessile animals, chiefly sponges, hydroids, bryozoans, anemones and motile species such as sea urchins, starfish and crustaceans. The outer shelf is covered largely by mixed sediments of sand and coarse sand with rocks and boulders present. Seabed surveys of the Clair Field (Hartley Anderson 2000) to the north of the SEA 7 area indicated that mixed sediments supported a sparse epifauna of bryozoans and serpulid polychaetes.

There have been two recent surveys that have covered both the intertidal and subtidal habitats around St Kilda. The first was a survey conducted by SNH in 1997 that involved a complete mapping of the intertidal biotopes for all the islands and the main stacs, together with broadscale mapping of the seabed in the areas adjacent to the islands using a RoxAnn acoustic ground discrimination system with ground truthing provided by scuba diver observations, underwater video and grab samples. A second survey was carried out in 2000 jointly by SNH and the Fisheries Research Services laboratory, Aberdeen that mapped the extensive areas of seabed between the islands and a substantial area to the north-west of Soay. This survey employed a range of acoustic survey techniques such as RoxAnn, multibeam swathe bathymetry and side-scan sonar together with towed video and ROV and extensive grab sampling in the areas of soft sedimentary seabed (St. Kilda World Heritage Site Management Plan 2003-2008 (2003).

Deep water region

Hebrides slope

The Hebrides slope has been intensively sampled at depths between *ca*. 400m and 2,900m (Gage 1986, Gage *et al.* 2000). Seabed photographs show a clear transition of sediment type with depth, with shallower stations dominated by coarser sediments and deeper stations having much finer sediments. However, rock, cobbles and pebbles may provide additional habitat for species in areas of finer sediments (Jones *et al.* 1998). Marked current ripples occur at 1,100m (Jones *et al.* 1998, Roberts *et al.* 2000), potentially indicating a stronger current regime and increased occurrence of hydrodynamic disturbance (Howe & Humphery 1995).

Observations made by the SEA 7 survey on the Hebrides slope (*ca*. 650-2,200m) largely supported existing datasets (Gage 1986, Gage *et al.* 2000), with some areas showing evidence of hydrodynamic activity at shallower stations with a relatively low megafaunal density and diversity. The most frequently seen species were the echinoid *Echinus acutus* and the ophiuroid *Ophiomusium lymani.* The dominant species present on the fine sediments of deeper stations of *ca*. 1,300m, were the octocoral *Acanella arbuscula*, pennatulids such as *Kophobelemnon stelliferum* and hexactinellid sponges such as *Hyalonema* sp. (Jones *et al.* 1998, Roberts *et al.* 2000). Although the majority of the community on the Hebrides slope followed the expected distributional patterns for the north-east Atlantic, some species were found at unusual depths, for example, *A. arbuscula* is usually found at depths greater than 1,500m (e.g. Hughes & Gage 2004), rather than 1,300m from here. These differences are most likely explained by the local hydrodynamic regime and species association with the sediment types found throughout the area (Jones *et al*. 1998).

The macrofaunal community on the Hebrides Slope is composed principally of polychaetes (accounted for *ca*. 53% of individual specimens and *ca*. 43% of all species collected), crustaceans (*ca*. 20% of individuals and *ca*. 34% of species) and molluscs (*ca*. 10% of individuals and *ca*. 12% of species) (Jones *et al.* 1998). Total macrofaunal biomass decreased linearly with increasing depth, falling within the established pattern for the continental margin worldwide (Rowe 1983). However, the abundance of the population did deviate somewhat from the expected depth related trend, with polychaete abundance increasing by *ca*. 50% between 1,100-1,300m, potentially as a result of local hydrodynamic conditions and disturbance (Jones *et al.* 1998).

Rockall and Hatton Basins

At 1,920m depth, the Rockall Trough contains a community dominated by the octocoral *A. arbuscula* and the ophiuroid *O. lymani* (Hughes & Gage 2004). Sessile suspension feeders were most abundant accounting for 77% of the total megafaunal standing stock biomass. Further west, Hughes & Gage (2004) sampled the Hatton-Rockall Basin at 1,100m. At this shallower site, the hexactinellid sponges (*P. carpenteri*) and ceriantharian anemones (Cnidaria: species unspecified) were the most abundant, with mobile crustaceans such as *Munida tenuimana* relatively common. Sessile suspension feeders accounted for 92% of the total megafaunal biomass at this depth.

At all sites within the Rockall Trough and Hatton-Rockall Basin, polychaetes were the most abundant macrofaunal group, accounting for 55-58% of the total number of individuals and for 57-79% of the biomass (Hughes & Gage 2004). In the Hatton Basin, small errant polychaetes (e.g. Hesionidae, Glyceridae, Amphinomidae, Nephtyidae) numerically dominated the fauna (69% of total individuals), but some of the following families *e.g.* Capitellidae, Chaetopteridae, Lumbrineridae, Polynoidae, Ampharetidae contained much larger individuals that dominated the overall biomass. On the Feni Ridge in the Rockall Trough, surface deposit and interface (species which can alternate between suspension and deposit feeding) feeders (e.g. Ampharetidae, Onuphidae, Cirratulidae) dominated the fauna (77% of total individuals). These community differences were most likely as a result of local hydrodynamic regime and food supply (Gage *et al.* 2000).

Banks and seamounts

The Rockall Bank was the most intensively sampled area by the SEA 7 survey. Samples showed the bank to consist of different sedimentary regions, with the south east mainly composed of fine muddy sand, with the echinoid *E. acutus* the most common mobile megafauna. The eastern flank of the bank has extensive areas of exposed bedrock with evidence of strong sediment scour (Narayanaswamy *et al.* 2006). To the west and north-west of the bank, several areas of live coral reef framework were recorded, composed of *L. pertusa* and *M. oculata* as reported from submersible observations from the 1970s (Wilson 1979).

The Hatton and George Bligh Banks have been less studied than the Rockall Bank and Trough. However, both these areas have extensive live and dead coral framework comprised of *L. pertusa* and *M. oculata*, with a diverse associated community, including the cnidarian *Phelliactis* sp., the antipatharian coral *Stichopathes* sp. and many hydroids/bryozoans and mobile epifauna such as crustaceans and ophiuroids (Narayanaswamy *et al.* 2006).

The Anton Dohrn Seamount showed evidence of strong hydrodynamic activity on the flanks and plateau. There were no discoveries of large sessile epifauna such as gorgonians, corals or massive sponges. Instead, the sessile community was mainly composed of brachiopods and barnacles, whereas the mobile megafauna were mainly composed of echinoderms such as *Calveriosoma* cf. *fenestratum* and *Cidaris cidaris* (Narayanaswamy *et al.* 2006).

Important species

In the deep sea, certain species can modify the complexity of the habitat by forming biogenic structures such as reefs, tests or their own body form or if mobile, by manipulating the sediment to form burrows, tracks and feeding depressions (so called 'Lebensspuren'). These structures may persist for long periods in low energy abyssal environments (Jumars & Eckman 1983) and may serve a range of different functions, such as refuges from predators, mating and nursery grounds and may offer enhanced feeding prospects (e.g. Beaulieu 2001).

Xenophyophores

Xenophyophores are large protozoans found exclusively in the deep sea (Hughes & Gooday 2004). They agglutinate sediments to form elaborate tests which are often large (>25cm), either on or within sediments or on rock surfaces. Dense fields of xenophyophores (possibly *Syringammina fragilissima*) were found on muddy sediments at 1,108m on the Hebrides Slope, achieving densities of up to $10m^{-2}$ (Figure A3a.3).

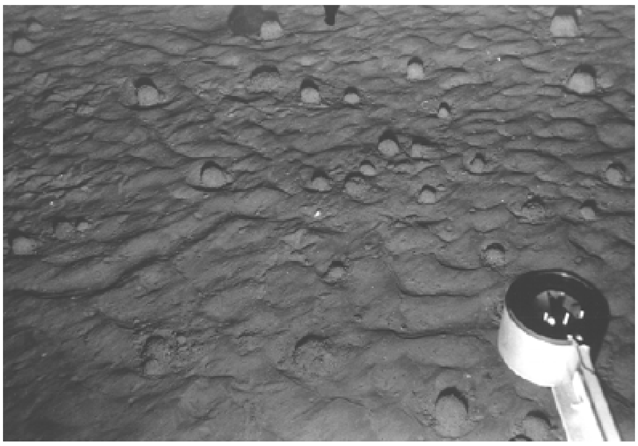


Figure A3a.3 - Xenophyophores on the Hebrides Slope

Notes: Photographed at 1,108m (Enterprise Oil block 154/1).
Sources: Jones et al. 1998, Gage 2001.

The presence of xenophyophores appears to significantly increase the abundance of macrofauna and meiofauna in the immediate area (e.g. Hughes & Gooday 2004). *S. fragilissima* may perform many different roles, such as providing hard substrate for epifaunal species, elevating suspension feeders above the seafloor and increasing food available to deposit feeders resulting from the deposition of fine particles. The tests of xenophyophores may also passively trap larvae, leading to concentrated prey populations which may benefit predators, as well as forming a habitat for mating, reproduction and nursery functions (Hughes & Gooday 2004).

Sponge beds

Sponge beds may have many of the same effects on the benthic community as xenophyophores. The north east Atlantic deep sea contains abundant aggregations of the hexactinellid sponge *Pheronema carpenteri* at depths of *ca*. 1,000-1,300m (e.g. Hughes & Gage 2004). The sponge aggregations appear to be directly related to increased abundance and richness of the macrofauna, particularly where there are large deposits of sponge spicules in the immediate area (e.g. Bett & Rice 1992). Dense spicule mats may have several effects on the benthic community, such as providing hard substrate, suitable for colonisation by species such as actinarians, hydroids and bryozoans (Bett & Rice 1992). Spicule mats and sponge bodies may also serve as refuge for prey species, as well as serving to trap particulate matter and phytodetritus.

Cold water corals

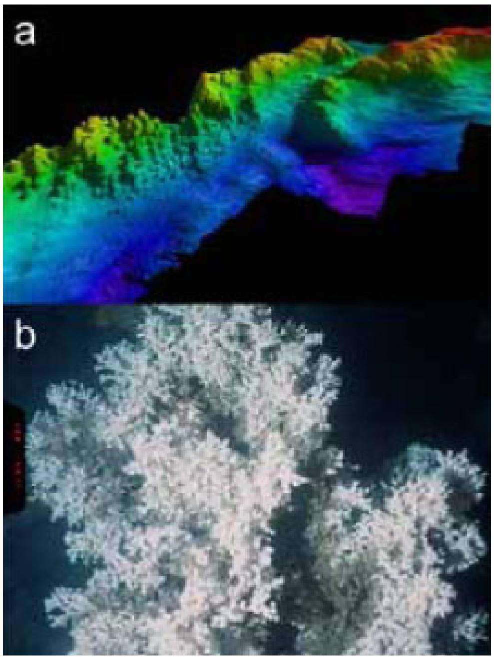


Figure A3a.4 – L. pertusa colonies recorded in the SEA 7 area.

Notes: (a) Multibeam echosounder survey showing characteristic mounds formed by L. pertusa in the Sea of the Hebrides, (b) Seabed photograph of one of these L. pertusa mounds.
Source: Roberts et al. 2005.

L. pertusa reefs frequently occur on the exposed hard substrate of banks, seamounts and shelves usually between depths of 200-400m (Rogers 1999), but may occur in shallower and much deeper water. In the SEA 7 area *L. pertusa* colonies are distributed sparsely to the west of Shetland, but are more abundant on the south and west flanks of the Rockall Bank (Wilson 1979), Wyville Thomson Ridge, Lousy Bank and Hatton Bank (Roberts *et al.* 2003) and in the Sea of the Hebrides between the Outer Hebrides and Scottish mainland (see Figure A3a.4).

During the SEA 7 survey *L. pertusa* was also found in the northern part of the Rockall Bank as well as George Bligh Bank (Narayanaswamy *et al.* 2006). In recent surveys of the northern Rockall Trough, colonies of *L. pertusa* were discovered capping mounds, known as the Darwin Mounds at depths of *ca*. 900-1,000m. These mounds are up to 75m in diameter and 5m high, and host an associated community of sessile suspension feeders that occur in close association with the coral (Masson *et al.* 2003), such as the xenophyophore *S. fragilissima* at densities of up to $7m^{-2}$ (Bett 2001). The mounds were designated recently as a possible Special Area of Conservation.

Lophelia and other cold-water corals such as *Madrepora oculata* and *Solenosmillia variabilis* create three-dimensional habitats in waters where the seafloor may be relatively featureless (Rogers 1999). In turn, these corals provide habitat for a wide variety of different species, including fish (Costello *et al.* 2005) and invertebrates (Jensen & Frederiksen 1992).

Diverse invertebrate fauna have been recorded on living reefs, the dead coral framework and the adjacent coral rubble areas. Jensen and Frederiksen (1992) collected 25 blocks of *Lophelia* and found 4,626 individuals belonging to 256 species, a further 42 species were identified amongst coral rubble. The Darwin Mounds support a macrofaunal community that appears to be taxonomically distinct from the majority of other sites within the north-east Atlantic. For example, several species such as *Porella laevis*, *Stegopoma plicatile* and *Eunice norvegica* occurred >75% of the time with *Lophelia* and were absent from neighbouring sites such as the Wyville Thomson Ridge and Faeroes Plateau (Henry & Roberts 2004).

Hall-Spencer *et al.* (2002) observed widespread damage to coral reefs caused by the trawls of commercial fishing vessels on the shelf edges of Ireland and Norway. The passage of the trawl may increase mortality of the coral by crushing, burying or wounding corals, increasing susceptibility to infection and epifaunal recruitment which may eventually smother corals (Fosså *et al*. 2002). The destruction of the coral reduces the three-dimensional structure to rubble, decreasing the complexity of the habitat with potential impacts on the associated community composition (Koslow *et al.* 2001, Fosså *et al.* 2002). The intensity of trawling in the SEA 7 area is unclear, but from studies conducted on the Hebrides slope off Scotland, trawling marks were clearly visible in 2-12% (Roberts *et al.* 2000) and 5-47% of seabed photographs (Lamont & Gage 1998). In 2004 the EC took action to protect the Darwin Mounds and prohibited all fishing with gear that makes contact with the seabed in a defined area around the mounds.

Roberts *et al.* (2005) noted that the dominant fishery in the Mingulay reef area was a trawl fishery for *Nephrops* utilising relatively lightweight gear over areas of sorf muds. This suggested that fishermen were likely to avoid reef areas to limit damage to their nets. However, the authors indicated that the patchy distribution of the reef areas would make them vulnerable to damage, if mixed trawling using heavier gear were to develop in the area (Roberts *et al*. 2005).

Trends in benthic communities

Depth

In general benthic communities in the SEA 7 area follow the same general trends in standing stock that occur throughout the north-east Atlantic in response to increasing depth (Lampitt *et al.* 1986). The BENBO study sites show an exponential decrease in standing stock biomass with depth (Hughes & Gage 2004). Faunal abundance also decreases with depth, especially between 1,100m and 1,920m. Samples collected from 1,100m, have much higher densities of individuals and taxa than at deeper sites (Hughes & Gage 2004). These differences may be the result of increased along-slope current activity at the shallower depth, as the biomass of suspension feeders is sometimes closely associated with near-bed flow speed (Flach *et al.* 1998), or critical slopes where sediment can become resuspended by currents or internal waves (Rice *et al.* 1990, White 2003).

Disturbance

The complex and irregular topography of the banks and seamounts in the SEA 7 area can alter and amplify the hydrodynamic regime, creating areas with sediment scour and smoothed, current-lineated bed features (e.g. Lonsdale & Hollister 1979). Disturbance from storm driven currents may also occur periodically, such as those recorded next to the Hebrides Terrance Seamount when current speeds exceeded 0.5-0.6ms^{-1} (MacDougall & Edelsten 1987).

In the SEA 7 area, areas with relatively consistent levels of hydrodynamic disturbance on the upper slope have a comparatively less abundant polychaete community that is more diverse and with much lower community dominance (Gage 1997). Consistent disturbance, in the form of moderate flow speeds appears to increase the diversity of the community, potentially by improving conditions for deposit feeders (MacDougall & Edelsten 1987, Gage 1997) and suspension feeders (Genin *et al.* 1986). Some sites within the SEA 7 area are often devoid of relatively fragile species such as xenophyophores and hexactinellid sponges potentially due to a strong hydrodynamic regime. Instead the community may be characterised by infaunal species or larger epifauna such as brittle stars, which are usually indicative of disturbed areas (e.g. Jones *et al.* 1998).

Other forms of disturbance on benthic communities in SEA 7 may include demersal trawling (as described above) and clam dredging.

Seasonality

In the north-east Atlantic the majority of phytodetrital deposits usually reach the seafloor during the spring and early summer and disappears during the course of the summer (Tyler 1988), delivering an estimated 2-4% of spring-bloom surface production to the seafloor (Gooday 2002). Benthic community responses to this pulse of phytodetrital input have been observed.

Within the north east Atlantic one of the most dramatic temporal changes was observed at the BENGAL site in the Porcupine Abysssal Plain. Using time-lapse photography from 1991-1994 and 1997-2000, Bett *et al*. (2001) recorded significant changes in megafaunal composition. From 1991-1994 the abundance of epibenthic megafauna such as ophiuroids, principally *Ophicoten hastatum* and the holothurian species *Amperima rosea* were low. The total megafaunal density was dominated by larger bodied holothurians. In contrast, photographs from 1997-2000 recorded a decrease in the abundance of phytodetritus and increases in the total megafauna. In particular, the abundance of ophiuroids increased 10-fold and *A. rosea* by 1,500-fold. This has become widely known as the "*Amperima event*".

Within the SEA 7 area, the BENBO sites were sampled in May 1998 and July 1998, before and after the main seasonal phytodetrital input (Hughes & Gage 2004). The sites at 1,100m and 3,580m did not show a significant response in community composition or standing stock between the two months, however, the site at 1,920m had the largest phytodetrital input of all depths (Black 2001) which resulted in a 2.7-fold increase in metazoan meiofaunal abundance (Hughes & Gage 2004).

Reproductive activity and spawning of many deep-sea organisms often occurs continually throughout the year. However, some species do exhibit pronounced seasonality in reproduction (Tyler 1988). In the Rockall Trough, a significantly higher proportion of some female isopod species brood during the winter (25%) compared with the summer (7%) and the timing of vitellogenesis appears to coincide with the deposition of phytodetritus during the summer (Harrison 1988).

A3a.1.3 Cephalopods

The University of Aberdeen's School of Biological Sciences was commissioned to provide an overview of cephalopod ecology and distribution in the SEA 7 area (Hastie *et al.* 2006). This report focused mainly on the main species of fishery importance, the loliginid squid *Loligo forbesi.* Brief accounts of other commonly occurring cephalopod species of potential importance were also provided.

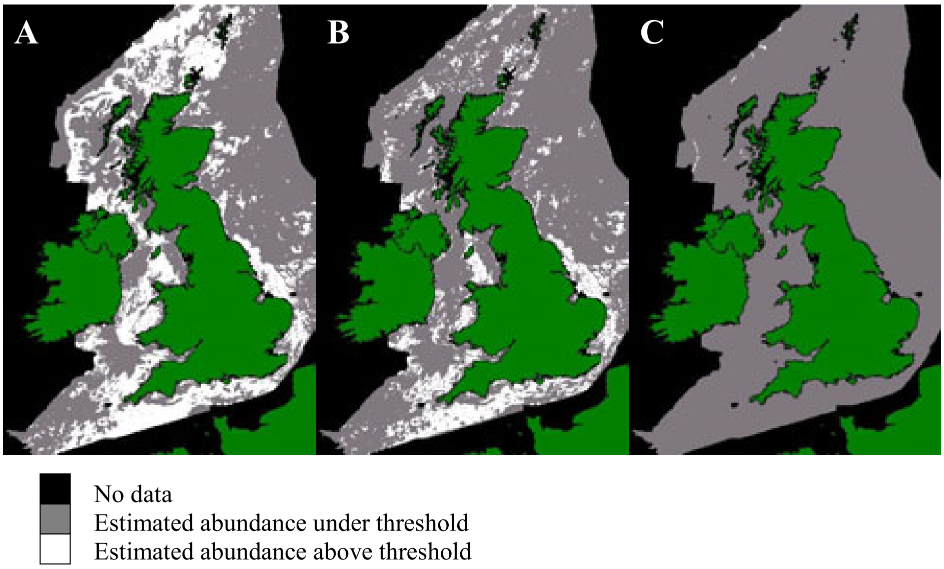
Cephalopods in the SEA 7 area

Abundance and distribution

The veined squid, *L. forbesi* is a neritic species occurring in coastal waters and continental shelf seas in the eastern Atlantic. In Scottish waters it spawns mainly from December to February although breeding animals are also recorded in May. Two main pulses of recruitment are found in April and November, with small numbers of recruits present throughout most of the year (e.g. Pierce *et al.* 1994a). Holme (1974) indicated the existence of distinct winter and summer breeding populations of *L. forbesi* in UK waters. However, it seems that since the 1970s, the summer breeding population has declined in Scottish waters and the winter population now dominates and breeds later than was previously the case (Pierce *et al*. 2005).

Genetic evidence exists for separate offshore (Rockall Bank) and shelf stocks in Scottish waters. Mature squid are recorded throughout Scottish waters in winter and eggs of *L. forbesi* have been recorded in trawls off Shetland and are regularly found on creel lines along the Scottish coast. Stowasser *et al*. (2005) compared the distributions of mature adult *L. forbesi* during spawning with suitable physical habitat conditions for spawning. Based on these, extensive areas of seabed within the SEA 7 area, and elsewhere in UK waters, were identified as potentially suitable spawning habitat (Figure A3a.5). However, at present, it is unclear how many of these areas are actually used by squid.

Figure A3a.5 – Potential spawning areas of L. forbesi in UK waters



Notes: Based on aggregations of mature adults in suitable physical habitats during spawning season (November-December). Abundance thresholds: A: 5 squid.hr^{-1} fishing, B: 30 squid.hr^{-1} fishing, C: 60 squid.hr^{-1} fishing.
Source: Stowasser et al. 2005.

The main Scottish fishery for *L. forbesi* occurs in coastal waters and usually exhibits a marked seasonal peak around October and November, corresponding to the occurrence of pre-breeding squid (e.g. Young *et al*. 2006). Analysis of fishery data collected between 1980 and 1990 indicated that *L. forbesi* was widely distributed on the continental shelf and also occurred on offshore banks – notably Rockall (Pierce *et al.* 1994b). Approximately 453 tonnes of loliginid squid was landed in Scotland from catches in the SEA 7 Area in 2003, around 20% of the Scottish total that year. The majority of squid landed are caught in ICES Division VIa (west of Scotland) with the proportion of squid caught in ICES Division VIb (mainly Rockall Bank) ranging from 2–23% over recent years. Demersal trawl surveys along the west coast of Scotland during November (1990-1994) showed that highest catches of *L. forbesi* occurred north of Ireland near the Stanton Bank area. Good catches occurred north and west of the Hebrides and in Donegal Bay, whereas catches south and west of Ireland were relatively poor (Pierce *et al.* 1998). Recent analysis of long-term trends in abundance points to the possible influence of oceanographic conditions on squid abundance and suggests that the relative importance of summer and winter breeding populations may show marked shifts on a decadal time-scale (e.g. Pierce *et al*. 2005).

Other species

Small numbers of the European squid, *Loligo vulgaris,* which has a more southerly distribution, are occasionally found in catches from the SEA 7 area (Pierce *et al.* 1994b). Whilst there is no current market for the small European common squid, *Alloteuthis subulata*, it is often the most common cephalopod encountered during surveys of shallow, coastal waters (e.g. Collins *et al*. 1995) and is the most commonly recorded cephalopod species in stomach contents of demersal fish in UK waters (Daly *et al.* 2001).

The presence of the European flying squid *Todarodes sagittatus* in coastal waters to the west of Scotland is seasonal (Lordan *et al.* 2001) and thought to be a consequence of extensive geographic migrations from coastal feeding grounds in northern waters to hypothetical deep-water spawning grounds in the mid-Atlantic (Borges & Wallace 1993). Occurrence and catches of *T. sagittatus* in the SEA 7 area may be related to influxes of Atlantic water and the fluctuating strength of its current system (Wiborg & Gjøsæter 1981). The lesser flying squid *Todaropsis eblanae* can at times be widespread and abundant in the north east Atlantic and these episodes may be linked to hydrographical anomalies (Hastie *et al*. 1994).

The southern shortfin squid, *Illex coindetii* is recorded occasionally in waters west of Scotland. Significant numbers of the common cuttlefish *Sepia officinalis* are occasionally taken in the SEA 7 area, notably in shallow waters off the west coast of Scotland (Anon 2005). The curled octopus, *Eledone cirrhosa* appears to be very common in shallow coastal waters west of Scotland (Boyle 1983).

Oceanic cephalopods found in deeper water, on the shelf edge and beyond are generally less well known, and none are currently marketed. Very large stocks of the potentially marketable Arctic squid *Gonatus fabricii* are found in the deep, cold waters of the north east Atlantic and Arctic (Kristensen 1983), and significant numbers of this species may sometimes occur in British waters. A number of other deep water cephalopod species are often caught in benthic trawls at 800–1,200m depth in the SEA 7 area (Daly *et al.* 1998).

Trophic interactions

At all life stages after hatching, cephalopods are active voracious carnivores feeding by day or by night on a wide variety of live prey including fish, crustaceans, cephalopods and polychaetes (e.g. Nixon 1987). Cephalopods, primarily squid species also constitute a primary food source for many marine predators: fish, seabirds and marine mammals (e.g. Clarke 1996, Croxal & Prince 1996). In marine mammals, they have such a high importance that over 80% of odontocete (toothed whales) and seal species regularly include cephalopods in their diet. Cephalopods comprise the main food in 28 odontocete species and may be an important factor determining the distribution of some marine mammal species within the SEA 7 area.

Sensitivity to environmental contamination and disturbance

Molluscs are known to naturally accumulate metals to high concentrations, particularly in the digestive gland. Heavy metal accumulation rates in cephalopod species appear to be rapid and various studies on cephalopods report high levels of cadmium (e.g. Bustamante *et al*. 1998, Koyama *et al*. 2000) and, to a lesser extent, mercury (e.g. Frodello *et al*. 2000). During a recent study funded by the DTI, Stowasser *et al*. (2005) found cadmium and mercury levels in squid to be highly variable between- and within-species. Spatial and temporal variations of the concentrations of these metals in the tissues of *L. forbesi* were also observed, with the highest levels recorded in the SEA 7 area (west of Scotland) during March although these may be confounded by seasonal migrations (Stowasser *et al*. 2005). Since cephalopods represent an essential link in marine trophic chains, the concentration of heavy metals in their tissues plays an important role in the bioaccumulation of these pollutants in their predators (Koyama *et al*. 2000).

A3a.1.4 Fish and shellfish

The following section provides a brief summary of fish and shellfish resources in the SEA 7 area. Much of the information comes from the underpinning technical reports describing fish and fisheries (Gordon 2006) and shellfish resources and fisheries (Chapman 2006). These reports describe the biology, distribution, fisheries and status of a wide variety of species and should be referred to for further information, for example on the locations of spawning and nursery grounds.

Fish communities

Demersal species

Shelf and coastal waters are very productive and support a diverse fish fauna. Coastal sea lochs and the Minches support fish assemblages composed primarily of whiting, sprat, Norway pout, hake and haddock. In shelf waters greater than 100m deep, haddock, poor cod, Norway pout, whiting and grey gurnard dominate. Commercially important species such as cod, haddock, whiting, sole, and plaice are present over much of the shelf with hake, anglerfish and megrim often also associated with the shelf edge. Shelf edge communities are dominated by silvery pout, blue-mouth redfish and hollowsnout rattail, with other deep-water species in smaller numbers (Fishery Agencies 2005).

The distributions of many of these species are dynamic with feeding, spawning or migratory movements between coastal waters, the shelf and upper parts of the continental slope. Hake for example belongs to a very extended and diverse community of commercial species including megrim, anglerfish, *Nephrops*, sole, seabass, ling, blue ling, greater forkbeard, tusk, whiting, blue whiting, conger, pout, cephalopods, rays etc. (Lucio *et al.* 2003 cited by ICES 2005a).

The shelf slope (500-1,800m) of the Rockall Trough supports a quite different species assemblage to the shelf and includes roundnose grenadier, black scabbard fish, blue ling, and orange roughy as well as deep-sea sharks and macrouridae (rabbit fish, etc.). These fish are characterised as being long-lived, slow-growing, and having a low fecundity, making them very vulnerable to overfishing (ICES 2005a).

The number of demersal fish species present in the Rockall Trough at any given depth is relatively high (*ca.* 40–50) on the upper and mid-slopes with total abundance and biomass of all species (caught using bottom trawl) maximal at depths between 1,000-1,500m. Thereafter, fish abundance and biomass decline rapidly with depth (Gordon 2001). A number of deep water species including ling and tusk inhabit a wide depth range from relatively shallow shelf waters into slope waters beyond 400m (ICES 2005a).

Clarke *et al.* (2005) found discards from trawling on the Rockall Trough were high, and composed of up to 30 different species including small individuals of commercial species such as roundnose grenadier, blue ling and greater forkbeard as well as a large range of non-commercial species, such as blue antimora, Murray's longsnout grenadier and Baird's smoothhead. In contrast, longline discards were mainly composed of non-commercial shark species such as blackmouth dogfish, greater lanternshark, birdbeak dogfish and longnose velvet dogfish.

It was generally assumed that the deep-water fish populations of the Hatton Bank and its surrounding waters would have strong affinities with those of the Rockall Trough. However, knowledge gained from the developing fisheries indicates a more complex situation. Fisheries for roundnose grenadier, black scabbardfish etc. exist over a large part of the bank but in some areas fisheries for Greenland halibut also occur. Greenland halibut are associated with the colder waters of Nordic Seas and are probably associated with the coldwater overflow across the Faroe/Iceland Ridge being channelled past the bank (Gordon 2006).

Pelagic species

A major component of the ecosystem is the spring migration into the area (shelf and upper slope) of a large abundance of migratory small pelagic fish, principally blue whiting and mackerel, but also horse mackerel. All three species spawn and feed extensively in the area, prior to migrating north out of the region in the summer (ICES 2005a). Herring are a key pelagic species and juvenile herring occur in shallower areas principally around the Minches and Barra, with older fish found near the shelf edge along with extensive mackerel and horse mackerel shoals (Fishery Agencies 2005). The area also includes considerable stocks of argentines and large numbers of small mesopelagic myctophids (lanternfishes) along the shelf break (ICES 2005a).

The seasonal distributions of pelagic species such as mackerel, horse mackerel and herring are associated generally with the distribution and properties of the relatively warm surface waters in the north east Atlantic (ICES 2005a).

Threatened and protected species

OSPAR have identified an Initial List of Threatened and/or Declining Species and Habitats (OSPAR 2005) which will inform the identification of Marine Protected Areas in the OSPAR maritime area. A number of fish species which may be present in the SEA 7 area have been included on the OSPAR List including basking shark, common skate, spotted ray, cod, orange roughy, salmon, sea lamprey and allis shad. Details of the biology, distribution and status of these species can be found in OSPAR (2005) and Gordon (2006).

Southall *et al.* (2005) have collated information on the distribution of basking sharks on the European shelf based on tagging, surveys and public sightings. These studies show that they are widely distributed on the west of Scotland shelf, especially in the Minch and around the Inner Hebrides. To explain the absence of sightings in the winter months it was often proposed that they hibernated in deep-water. However, recent work with archival tags has shown that they make extensive horizontal and vertical migrations to locate feeding hotspots, often associated with frontal systems. No prolonged open-ocean movements were observed (Sims *et al.* 2003).

The basking shark fishery was one of the earliest directed fisheries for pelagic sharks in the north east Atlantic (Heessen 2003). Norway has always been the main country to exploit basking shark in a wide ranging fishery from the Barents Sea to the Kattegat, in the wider North Sea and to the west of Scotland and Ireland. There were also smaller Irish and Scottish fisheries. Most of the Scottish catch was from the west coast (Gordon 2006).

In general, the primary reason for inclusion of these species on the OSPAR List is related to their vulnerability to directed or by-catch fishing as a result of their biology or historical exposure to overfishing.

Migratory species

Salmon and sea trout

Salmon and sea trout share similar anadromous lifecycles involving migrations between natal rivers and oceanic feeding grounds. For both species, there have been general declines in the numbers of fish returning to Scottish rivers, particularly on the west coast. The reasons for these declines are complex but may include pollution, predation, by-catch, parasites and climate change. There are also concerns about salmon farm escapees interbreeding with wild salmon and causing fitness reduction and potential extinction of wild stocks (McGinnity *et al.* 2003)

Salmon in freshwaters are protected under Annex II of the Habitats Directive although marine and estuarine sites are excluded from selection. There are two west coast river systems designated as Special Areas of Conservation for their high quality salmon populations; the Langavat SAC in the Western Isles and the Little Gruinard River SAC in Wester Ross (JNCC website – http://www.jncc.gov.uk).

Extensive research on the freshwater phase of the salmon life cycle has revealed much about the factors affecting juvenile production, but much less is known about the salmon's life at sea.

On the west coast of Scotland, post-smolts are recorded in rivers and estuaries during early spring, after which there are few recordings until they turn up in research catches in June on the shelf west of the Hebrides and northwards to the Faroe Shetland Channel. Their migration patterns across the Scottish shelf prior to being entrained within the shelf edge current are at present unknown. Post-smolts from other parts of the UK and other southern European countries are also likely to migrate through the SEA 7 area on passage to the northern feeding grounds (ICES 2005b).

Recapture data from tagged adult salmon strongly suggest that the oceanic homing migration, opposite to the smolt migration, is independent of currents with homing fish often moving along the shortest distance from tagging site to the coast (Hansen *et al.* 1993). Returns of salmon to western rivers are confined largely to the summer months.

In contrast, sea trout appear to remain within nearshore waters rather than undergoing extensive migrations leading to concerns about their greater risk of exposure to sea lice infections from salmon farms in these areas as well as declines in stocks of their main prey species, sandeels (FRS website – http://www.frs-scotland.gov.uk).

Other migratory species

Information presented by Scottish Natural Heritage's national assessment of Scotland's fresh waters (SNH 2001) indicates that eels are present within most west coast river systems. Whilst there is little tradition of exploiting eels in Scotland, they are subject to intensive exploitation in other parts of Europe and there has been a general decline in their numbers throughout Europe.

Both the river lamprey and sea lamprey migrate from the sea up rivers to spawn. Both species are listed on Annex II of the Habitats Directive although no sites have been designated for them on the west coast of Scotland. Very few river or sea lampreys were recorded in west coast rivers by the SNH (2001) national assessment. Lampreys require that spawning rivers be easily accessible and given that many rivers on the west coast are spate rivers prone to flooding, this may limit their numbers.

Allis and twaite shads are members of the herring family which feed in coastal and estuarine waters before migrating up rivers to spawn. Whilst both species are present in south west Scotland, coastal waters and rivers of SEA 7 do not appear to form an important part of their range. Both species are listed on Annex II of the Habitats Directive.

Commercial shellfish species

Nephrops is the most valuable shellfish species exploited by the Scottish fishing industry. The species is found on a range of soft sediments consisting of varying mixtures of mud and sand particles. The main areas of exploitation are in the North Minch, South Minch and the Sound of Jura. They are also found in deeper water (600m or more), on the continental shelf and slope west of the Outer Hebrides.

Deep water red crabs (primarily *Chaceon affinis*) occur from around 300 to 1,000m on Hatton, Rosemary and Rockall Banks, on the Wyville Thomson Ridge and west of St Kilda. They have been found on rocky and stony sediments but are also known to occur on fine mud sediments. Red crabs are landed as a main target species and also as a by-catch from bottom set gill-net fisheries for angler fish, sharks and other deep-water fish.

The European lobster is common around the coasts, occurring on rocky shores, reefs and boulder fields from low water down to 60m. Lobsters are exploited by small inshore vessels using baited creels, which may also catch edible crab, velvet swimming crab and shore crab. Other commercially exploited species include giant and queen scallops, common mussels, cockles, razorshells and gastropod molluscs (Chapman 2006).

A3a.1.5 Marine reptiles

Information on the distribution and abundance of turtles within UK and Irish waters is limited. However, sightings records are recorded annually (e.g. Penrose & Gander 2007) and whilst these are likely to underestimate the numbers of turtles visiting UK and Irish waters, they provide valuable information. The 'TURTLE' database contains over 982 records of turtles in UK and Irish waters (http://www.strandings.com/Wales.html).

Distribution and abundance

Five species of marine turtle have been recorded in UK and Irish waters (e.g. Penhallurick 1990, Pierpoint & Penrose 1999). Only one species however, the leatherback turtle *(Dermochelys coriacea)* is reported annually and is considered a regular and normal member of our marine fauna (Godley *et al.* 1998). Loggerhead turtles *(Caretta caretta)* and Kemp's ridley turtles *(Lepidochelys kempii)* occur less frequently, with most specimens thought to have been carried north from their usual habitats by adverse currents (Carr 1987, Penhallurick 1990, Mallinson 1991). Records of two other vagrant species, the hawksbill turtle *(Eretmochelys imbricate)* and the green turtle *(Chelonia mydas)* are very rare (e.g. O'Riordan *et al.* 1984, Branson 1997).

Leatherback turtles feed primarily on jellyfish and their diet in temperate and boreal waters is known to include cnidarians and tunicates (den Hartog & van Nierop 1984). In UK and Irish waters they are often reported in the vicinity of jellyfish swarms, and there are several observations of leatherbacks feeding on jellyfish at the surface (e.g. Penhallurick 1990; C Cronin, JNCC cited by Pierpoint 2000). Hays *et al.* (2004) indicate that periodic residence in specific areas of the open sea is probably linked to locally enhanced prey availability, as leatherbacks target frontal features and mesoscale eddies.

Leatherback sightings from around the UK and Ireland have been reported in every month. However, most sightings are made between July and October, with a peak in August. Overall, strandings peak later, in September and October (Pierpoint 2000, Penrose 2003).

There appears to be some regional variation in the months in which most reports occur: the first reports each year of live leatherbacks usually come from southern Ireland and south west England, whereas the relatively few leatherbacks reported from North Sea coasts appear later in the year, mostly during the winter and early spring. The data imply that leatherbacks move into British and Irish waters from the south and west, and pass northwards up western coasts and the Irish Sea (Pierpoint 2000).

The previous SEA 6 Environmental Report (DTI 2005) highlighted the potential importance of the Irish Sea for leatherback turtles with 42% of all turtles recorded in the UK and Ireland (25 out of a total of 59 turtles) from the Irish Sea in 2004 (Penrose 2005). Whether this reflects the true situation or reporter bias resulting from greater opportunities to observe turtles from the more heavily utilised or populated coastal and marine areas of the Irish Sea is unknown, although the latter is likely to be a factor. The distribution and behaviour of leatherbacks and their jellyfish prey within the Irish Sea is currently being investigated by the Irish Sea Leatherback Turtle Project (http://www.turtle.ie/), described previously for SEA 6.

In comparison, fewer turtles are recorded from the SEA 7 area although this may in part reflect the rural, unpopulated nature of much of the west coast of Scotland. In 2005 and 2006, 7 turtles were recorded from the SEA 7 area, 3 in 2005 (out of a total of 90 from the UK and Ireland) and 4 in 2006 (out of a total of 66) (Table A3a.3).

Table A3a.3 – Marine turtles recorded in the SEA 7 area, 2005 and 2006

Species	At sea/Stranded	Alive/Dead	Date	Location
Leatherback	Stranded	Dead	Sep '05	Loch Indaal, Isle of Islay
Loggerhead	Stranded	Alive	Oct '05	Isle of Canna
Leatherback	Sea	Alive	Oct '05	Off Rodel, Harris
Loggerhead	Stranded	Dead	Feb '06	North Uist, Isle of Lewis
Leatherback	Sea	Alive	Mar '06	Campbeltown
Loggerhead	Sea	Alive	Jul '06	Oransay
Loggerhead	Stranded	Alive	Dec '06	Ardmucknish Bay, north Argyll

Source: Penrose & Gander 2006, 2007.

Of note is the relatively high proportion of loggerhead turtles recorded from the region. These are often juvenile animals (the loggerhead recorded off Skye was identified as a juvenile) which are thought to have been born in Eastern Florida and shortly afterwards become entrained in the Gulf Stream which takes them across the North Atlantic (Luschi *et al.* 2003). These oceanic movements have been simulated using a numerical model of North Atlantic general circulation which indicates that some of these loggerheads may drift into UK waters (the majority drifting south past the Azores and returning to the eastern USA in the North Atlantic gyre) with most probably succumbing to the low winter sea temperatures (Hays & Marsh 1997).

Pierpoint & Penrose (1999) indicate that loggerheads are most frequently reported as strandings with most animals stranded alive. Strandings occur most frequently during winter and spring, when animals are observed to have become lethargic in cold waters. Most loggerheads have been found on the west coast of Ireland, south west England and the west coast of Scotland (Pierpoint & Penrose 1999).

In 2005, the Marine Conservation Society (MCS) organised a Scottish Turtle Roadshow (funded by Scottish Natural Heritage as part of the national Action Plan for turtles) which visited a number of Scottish fishing towns between February and July. The aim of the roadshow was to increase awareness of turtles and encourage sea-users to report turtle sightings and strandings (MCS website – http://www.mcsuk.org).

A3a.1.6 Seabirds and coastal waterbirds

The SEA 7 area is of great importance to both seabirds and coastal waterbirds. Of particular relevance to the current section are the underpinning reports describing inshore seabirds in the SEA 6, 7 & 8 areas (Barton & Pollock 2005), and offshore seabirds in the SEA 7 area (Pollock & Barton 2006a). Other important references are highlighted.

Seabird species and distribution

Key areas for breeding seabirds

Twenty seven species of seabird totaling over one million pairs of birds breed in the SEA 7 area, with 9% of these birds breeding in Northern Ireland. Nearly 72% of this total is comprised of just four species (guillemot 24.0%, puffin 22.4%, fulmar 13.7% and Manx shearwater 11.7%) (Barton & Pollock 2005).

More than 1% of the British breeding population of 22 species occurs within the SEA 7 area (Table A3a.4).

Table A3a.4 – Important species of seabird breeding in the SEA 7 area (Britain)[1]

Species	Total[2]	% of British population	% of biogeographic population
Leach's petrel	48,012	74-100	1
Puffin	239,056	41.3	3.6-4.4
Manx shearwater	126,338	40.3-45.5	30.8-37.2
Storm petrel	11,347	33.9-53.9	1.7-3.8
Gannet	73,287	32.4	18.8
Shag	8,339	29.2	11.4-12.6
Fulmar	143,234	28.7	3.5-5.3
Razorbill	62,859	25.6	8
Great black-backed gull	4,449	25.6	4-4.5
Black guillemot	13,167	23.1	6.4-10.1
Common tern	2,160	21	0.6-1
Guillemot	289,689	14.7	6.7-6.9
Cormorant	910	13.3	1.7-1.8
Herring gull	18,163	12.7	2.3-2.6
Arctic tern	6,351	12.1	0.4-1.3
Little tern	231	11.9	1.1-1.4
Kittiwake	41,237	11.2	1.4-1.7
Arctic skua	221	10.4	0.6-1.5
Common gull	4,911	10.2	0.8-1.2
Great skua	553	5.7	3.5
Lesser black-backed gull	3,113	2.7	1.7
Black-headed gull	1,684	1.3	<1

Note:
1. *Data from Seabird 2000*
2. *Census unit = pairs*

Source: Mitchell et al. (2004), Barton & Pollock (2005).

Numbers of Manx shearwater are internationally important with up to 37% of the biogeographic population breeding in the region. Gannet and shag are also important in an international context and a further 16 species breed in internationally important numbers.

In a national context, Leach's petrel was the most significant with almost 100% of the breeding population occurring in the SEA 7 area. However, internationally, this is only *ca.* 1% of the biogeographic population. Puffin, Manx shearwater, storm petrel, gannet, shag, fulmar, razorbill, great black-backed gull, black guillemot and common tern were also very important species with over 20% of the British population breeding in the SEA 7 area.

More than 1% of the all-Ireland population of 11 species are found in the Northern Ireland section of the SEA 7 area (Table A3a.5). Razorbill, guillemot and kittiwake are the most important species, each with over 20% of the all-Ireland population. Numbers of breeding razorbills and guillemots are also internationally important.

Table A3a.5 – Important species of seabird breeding in the SEA 7 area (N. Ireland)[1]

Species	Total[2]	% of Ireland population	% of biogeographic population
Razorbill	22,771	29.6	2.9
Guillemot	95,741	27.1	2.2-2.3
Kittiwake	10,814	22	<1
Fulmar	4,198	10.5	<1
Puffin	1,582	7.4	<1
Cormorant	344	6.6	<1
Common gull	91	5.7	<1
Black guillemot	306	4.5	<1
Shag	155	4.2	<1
Lesser black-backed gull	134	2.8	<1
Black-headed gull	356	2.3	<1

Note:
1. *Data from Seabird 2000*
2. *Census unit = pairs*

Source: Mitchell et al. (2004), Barton & Pollock (2005).

Table A3a.6 lists the most important seabird colonies in the SEA 7 area i.e. colonies which hold 5% or more of the nationally important breeding population for one species or a combination of species. Sites and species are arranged in descending order of importance, with species that occur in internationally important numbers shown in bold.

Table A3a.6 – Summary of important seabird colonies in the SEA 7 area[1]

Area	Site	Species
Northern Ireland		
Antrim	Rathlin Island	**Razorbill**, **guillemot**, kittiwake, puffin, common gull, fulmar, black guillemot, lesser black-backed gull, black-headed gull, shag
Antrim	Sheep Island, Causeway Coast	Cormorant, razorbill, shag
Antrim	Causeway Coast	Fulmar, razorbill, kittiwake
Britain		
Western Isles	Boreray, St. Kilda	Gannet, Leach's petrel, puffin, fulmar
Western Isles	Dun, St. Kilda	Leach's petrel, puffin, fulmar
Lochaber	Rum NNR	Manx shearwater
NW Sutherland	Handa Island	**Razorbill**, **guillemot**, **great skua**, Arctic skua, kittiwake

Area	Site	Species
Western Isles	Shiant Islands	**Puffin**, razorbill, great black-backed gull, shag, guillemot
Western Isles	Hirta, St. Kilda	**Fulmar**, Leach's petrel, storm petrel, **Manx shearwater**, great skua, puffin
Argyll and Bute	Treshnish Isles	**Storm petrel**
West coast Ross and Cromarty	Priest Island	**Storm petrel**
Western Isles	Berneray	**Razorbill**, guillemot
Western Isles	Soay, St. Kilda	Puffin, Leach's petrel, fulmar, storm petrel
Western Isles	North Uist	Arctic skua, common tern, little tern, Arctic tern, common gull
Western Isles	North Rona	Great black-backed gull, Leach's petrel, storm petrel
Argyll and Bute	North Mull	Common tern
Western Isles	Mingulay	Razorbill, fulmar, guillemot
Western Isles	Sula Sgeir Island	**Gannet**, guillemot
Western Isles	Lewis and Harris	**Black guillemot**
Argyll and Bute	Isle of Colonsay	Guillemot, kittiwake, razorbill
Western Isles	Flannan Isles	Puffin, fulmar, guillemot

Note: 1. Based on data from Seabird 2000
Source: Mitchell et al. (2004), Barton & Pollock (2005).

Many of the seabird colonies present in the SEA 7 area have been designated as Special Protection Areas because of the nationally and internationally important numbers of seabirds they support. The total seabird breeding population on St Kilda for example is the largest concentration in the UK with 16 species of breeding seabirds. All relevant SPAs in the SEA 7 area are described in Appendix A3a.2 and the underpinning conservation report (AICSM 2006).

In contrast to 2004 and indeed most previous years, colonies in the north west of Scotland appear to have suffered from low food availability in 2005, with Arctic terns, kittiwakes and puffins experiencing very low breeding success (Mavor *et al.* 2006). For example, kittiwakes on Canna for the first time on record suffered breeding failure and the species had the least successful season on record on Handa. On St. Kilda, puffins were very unsuccessful, due to apparent low availability of suitable prey (e.g. sandeels or sprats) (Mavor *et al.* 2006). Summary details of breeding numbers and success of the main breeding seabirds in the SEA 7 area are presented in Table A3a.7below.

Seabirds at sea

Table A3a.7 below also provides summary details of the at sea distribution of important seabird species within the SEA 7 area. The European Seabirds At Sea (ESAS) database formed the basis for much of the information (Pollock & Barton 2006a).

Recent analysis indicates significant gaps in ESAS survey coverage for the SEA 7 area with only 7% of the total area surveyed (25% of the overall suggested target amount) (Pollock & Barton 2006b). Offshore waters in SEA 7 had the poorest quality data with many gaps, particularly in winter. However, based on surveys that have been conducted, seabird density and species diversity is generally low beyond the shelf edge. The most commonly recorded species are fulmar which are very abundant and not threatened. ESAS survey coverage in inshore waters of SEA 7 is quite patchy, particularly off the west coast of the Uists in winter. JNCC have conducted aerial surveys in these areas and around Islay to improve survey coverage. Wetland Bird Survey coverage at coastal sites in SEA 7 is fairly complete along much of the coast and around the majority of islands. There are some gaps however around parts of the Western Isles, Skye and the Small Isles (Pollock & Barton 2006b).

Table A3a.7 – General seabird breeding status, distribution and abundance in SEA 7

Species	Breeding status, distribution and abundance	
Fulmar	Peak densities in April, lowest November. Account for *ca.* 80% of seabirds offshore. Numbers at colonies appeared stable between 2004 and 2005, although downward trend since mid-1990s.	**Jan-May:** Widespread at low densities, concentrations along shelf edge, north west of Anton Dohrn seamount and over Hatton Bank. **Jun-Sep:** Widespread at low to moderate densities, with occasional high densities along shelf break and over Rockall Bank. **Oct-Dec:** Limited survey coverage. Highest densities N and W of the Western Isles, and over shelf edge around 57ºN.
Gannet	Tend to migrate south after breeding season. Recorded in all months of year. Peak densities in August, with lowest densities in November. In general, numbers at colonies increasing.	**Nov-Apr:** Highest densities along shelf edge. Few birds in deep waters. Widespread at low densities over shelf waters. **May-Oct:** More widespread in offshore waters with low densities as far west as Hatton Bank. Highest densities N and W of Western Isles close to colonies, low densities along shelf edge.
Kittiwake	Largely oceanic in nature, only coming to shore during the breeding season. Recorded in all months, with peak numbers in August, and lowest numbers in March. Long-term (1986-2004), increase in numbers in SW Scotland (although with a decline most recently), but decrease in NW.	**Jan-Apr:** Widespread in inshore waters. Further offshore, peak densities recorded along the shelf break. Densities lower over the Rockall Trough and Bank. **May-Sep:** Highest densities in inshore waters close to breeding colonies. Widespread at low densities over the Rockall Trough and Bank and the Hatton Bank. **Oct-Dec:** Limited survey coverage. High densities in shelf waters north of the Western Isles, in the Minch and occasionally further offshore. Low densities over shelf break.
Manx shearwater	Majority that breed in Britain winter off South America. Highest densities in August, with numbers decreasing rapidly into September and October. Large numbers regularly recorded passing Islay on passage. 2005 breeding success on Rum well below average. Fledgling rates high on Sanda.	**Mar-May:** Highest densities inshore close to the major breeding colony on Rum. Birds largely absent from offshore areas, although low densities along shelf break and over Rockall Trough. **Jun-Sep:** Widely scattered in low densities offshore, with occasional high density patches encountered (e.g. Rockall Bank). Birds encountered over Hatton Bank in June.
Puffin	Largely pelagic, only coming ashore to breed between March and August. After breeding, birds disperse widely. Recorded in all months, although majority between April and November. In 2005, breeding numbers stable on Lunga but declining on Handa. Poor breeding success on Dun, St. Kilda.	**Apr-Aug:** Highest densities recorded around the Western Isles and in the Minch. Widely scattered at low densities along the shelf break and eastern edge of the Rockall Trough, and as far west as Hatton Bank. **Sep-Nov:** Birds disperse offshore away from breeding colonies. Low to moderate densities in the northeast Rockall Trough. Low densities over the Rockall Bank in September. **Dec-Mar:** Few birds, with numbers increasing in March north of the Western Isles and in the Minch, although densities still low.

Species	Breeding status, distribution and abundance	
Guillemot	Widespread in the SEA 7 area in all months and found mostly in shelf waters. In general, numbers at colonies (e.g. Handa, Hirta, St. Kilda, North Rona, Tiree and Lunga) have decreased significantly. Breeding success low compared to 2004.	**May-Jul:** Highest densities recorded off NW Scotland. Moderate densities throughout Minch. **Aug-Sep:** Large flocks in inshore waters, as undergo a full body moult and birds are flightless for several weeks. Largest concentrations in Loch Broom, Sound of Sleat, Sound of Jura, the Gulf of Corryvrecken, in the Clyde and the Butt of Lewis. **Dec-Jan:** High densities recorded off Skye and north coast of N Ireland.
Razorbill	Recorded in all months of year. More widespread in winter than summer. Leave breeding colonies by mid-August with most birds not returning to land until February or March. Despite short-term declines, trend in breeding numbers generally upward.	**May-Sep:** Widespread at low to moderate densities throughout The Minch and west of the Western Isles. High densities recorded between Mull and Skye in August. Slightly more restricted range over the winter months. High densities recorded off Mull in February.
Black guillemot	Widely recorded in coastal areas. SEA 7 particularly important, with up to 10% of the biogeographic population and 34% of the British breeding population. Little information available but breeding numbers fairly stable.	Birds present in all months, with highest numbers recorded around the Uists, Skye and Tiree in August. Winter distribution throughout coastal waters.
Great black-backed gull	More marine than lesser black-backed gull. Recorded in all months, with peak in January and April, lowest numbers in July. In SW Scotland, numbers at colonies sampled in both 2004 and 2005 were similar, but a decrease of 19% recorded in NW Scotland.	**Nov-Apr:** Widespread at low to moderate densities as far west as 10ºW. Patches of moderate to high density along shelf break. **May-Oct:** Distribution pattern broadly similar to the winter distribution, although densities generally lower. Occasional birds recorded in offshore waters, although very few along shelf break.
European storm petrel	Pelagic species, only coming ashore to breed on offshore islands. Return from wintering grounds off Africa in April. Majority recorded June to September with peak in August. Difficulties in surveying. Tape play back surveys recorded decreases on Priest Island and Hirta, St. Kilda with Lunga showing no decline.	**May-Jun:** Widespread at low to moderate densities over shelf edge to N and W of Western Isles. Highest densities along shelf edge. **Jul-Sep:** Widespread at low to moderate densities over shelf waters, with low densities over the Rockall Bank and north of the Anton Dohrn Seamount. **Oct-Nov:** Majority have left the area. Birds primarily restricted to inshore areas such as the Minch and shelf waters.
Leach's storm petrel	Pelagic species, only coming ashore to breed on offshore islands. Return from wintering grounds in the tropics in April, with numbers increasing in May and June, and peaking in August. Three colonies (St. Kilda, Flannan Islands and North Rona) hold 99.9% of the Britain and Ireland breeding population.	**May-Aug:** Highest numbers recorded north west of the Outer Hebrides, beyond the shelf edge, in waters greater than 1,000m deep. A few birds recorded far offshore, and very few inshore. **Sep-Oct:** Numbers decreased considerably, with birds widely scattered throughout the area. Birds more frequently encountered in low numbers in shelf waters, and also over deeper water in the Rockall Trough and over the Rockall Bank.
Lesser black-backed gull	Partial migrant, with most birds moving south during the winter. Recorded in all months with lowest densities in November, and highest in April. General decline in breeding numbers in SW and NW Scotland.	**Nov-Mar:** Low densities in the Minch and inshore waters, with a few individuals scattered further offshore. **Apr-May:** Large influx of birds. Low densities in offshore areas such as the Hatton Bank, Rockall Bank and Rockall Trough, although moderate to high density patches over shelf break. **Jun-Sep:** Low densities throughout area.

Species	Breeding status, distribution and abundance	
Great skua	Recorded in all months except January. Peak in August. Increase in apparently occupied territories on Handa, Canna and Priest Island. Decline on Coll. Breeding success generally poor.	**Nov-Mar:** Low numbers observed to N and W of Western Isles. Majority inshore of the shelf break. **Apr-Oct:** Widespread in low numbers throughout offshore waters as well as shelf waters.
Arctic tern	Commonest tern breeding in Britain. After breeding, head south to Antarctic seas. Recorded April to October. General decline in breeding numbers of 11.6% between 2004 and 2005. However highly variable between colonies. In general, poor breeding success in 2005.	Low numbers of early returning birds in April, with greater numbers seen in May, when birds as far offshore as 23ºW. **Jun-Jul:** Concentrated around breeding colonies on west coast islands, occasional birds offshore. **Aug:** More widespread in offshore areas in low to moderate numbers. **Sep:** Considerable drop in numbers, majority of records from offshore areas. **Oct:** Low numbers in the Minch.
Common tern	Total British and Irish population estimated at 14,497 apparently occupied nests, with more than 20% within the SEA 7 area. General increase in breeding numbers particularly in NW Scotland. In general, poor breeding success in 2005.	Majority winter along the coast of west Africa, returning to Britain and Ireland to breed between April and October. **May-Jul**: Earliest birds recorded in the SEA 7 area in May, with highest densities recorded in June and July around the Western Isles. **Aug:** Birds only recorded occasionally.
Arctic skua	Small population breeding in N and W Scotland. Recorded April to November, with peak in August. Population on Handa continued its decline since 2001 to lowest level in 20 years. Numbers on Coll remained stable.	**May:** Widely scattered in low numbers. Many birds migrating north to Arctic breeding grounds. **Jun-Jul:** Bias towards inshore areas, particularly around Western Isles, low numbers offshore. **Aug:** Majority in inshore waters of the Minch. Low numbers over Rockall Bank and Trough. **Sep-Nov:** Few widely scattered birds.
Shag	Recorded at low densities throughout year. Highest densities December to February. In NW Scotland, numbers 35% lower than in 2004, with notable decreases on Canna and Eigg. Overall number in SW Scotland generally stable.	Large flocks of shags recorded between Coll & Tiree, Harris & North Uist, South Uist & Barra and off Rum, Mull and Eigg between September and February.

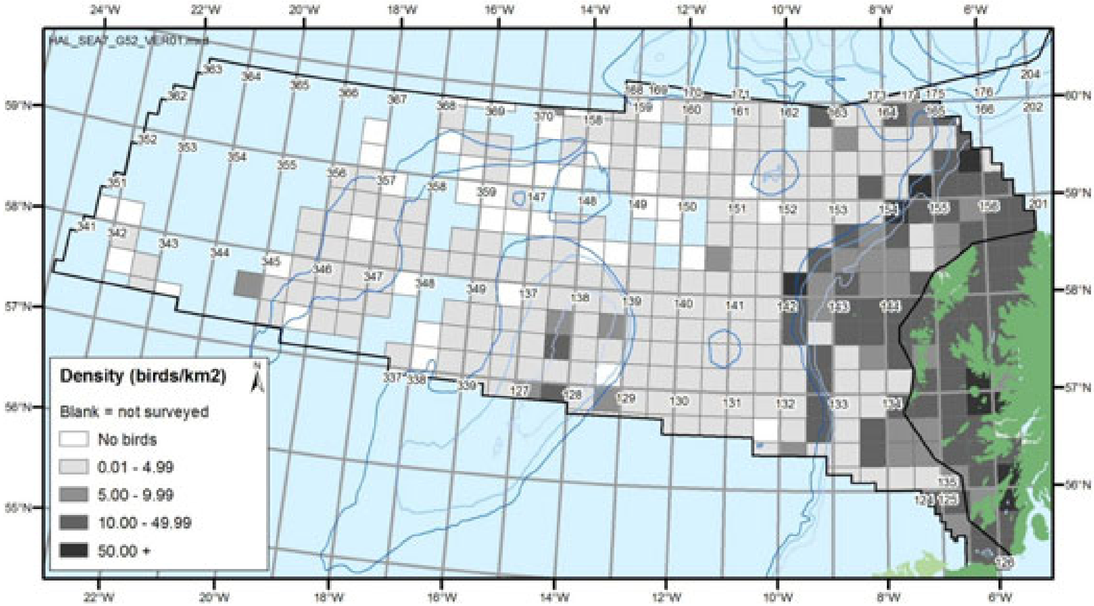
Source: Pollock & Barton (2006a), Mavor et al. (2006).

Other migrant seabird species which are present within offshore areas of SEA 7 in low numbers and at certain times of the year include sooty shearwater, great shearwater, little auk, pomarine skua, and long-tailed skua. The distributions of these birds are described in Pollock & Barton (2006a).

Important marine areas for seabirds

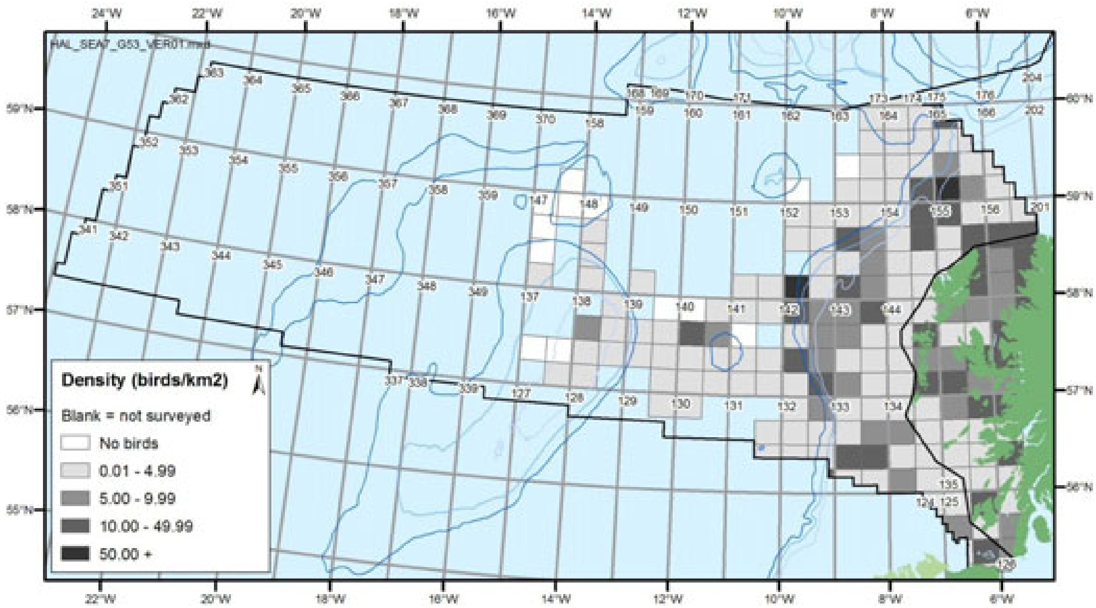
From ESAS data, seabirds generally occurred at moderate to high densities over much of the shelf in summer with low densities in offshore waters. Concentrations of birds were found along the shelf edge, north east Rockall Trough and over the Rockall Bank (Figure A3a.6) (Pollock & Barton 2006a).

Figure A3a.6 - Total seabird density in SEA 7 area in summer – April to September



During the winter months, lower densities of birds were found along the shelf break and across much of the shelf. Low densities were generally found over deep waters although coverage was limited at this time. Moderate to high densities were recorded close to the Anton Dohrn Seamount and to the north and east of the Outer Hebrides (Figure A3a.7) (Pollock & Barton 2006a).

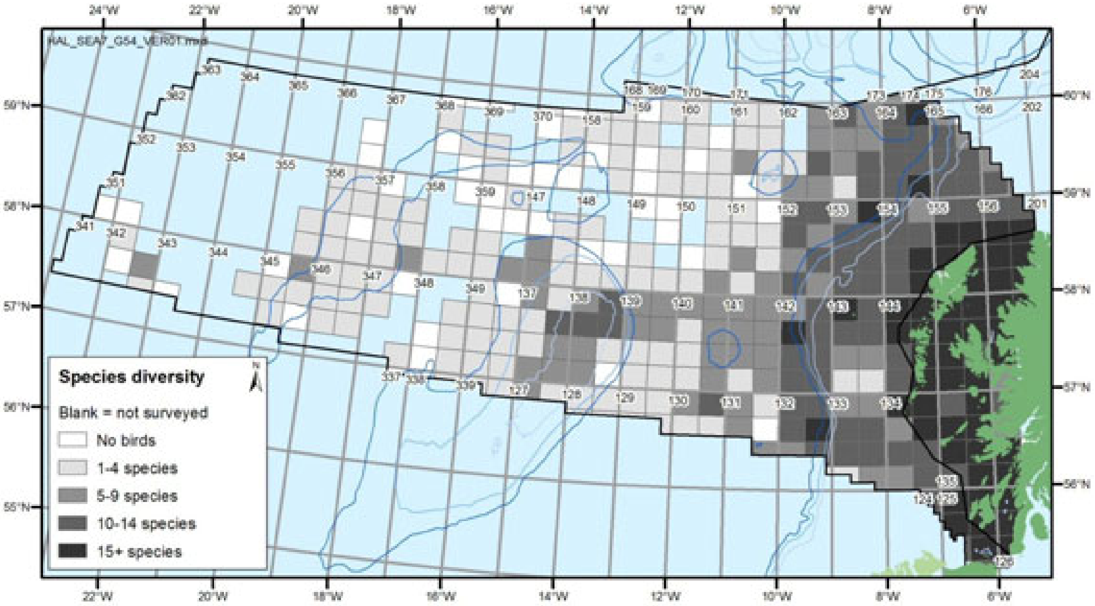
Figure A3a.7 - Total seabird density in SEA 7 area in winter – October to March



Seabird species diversity

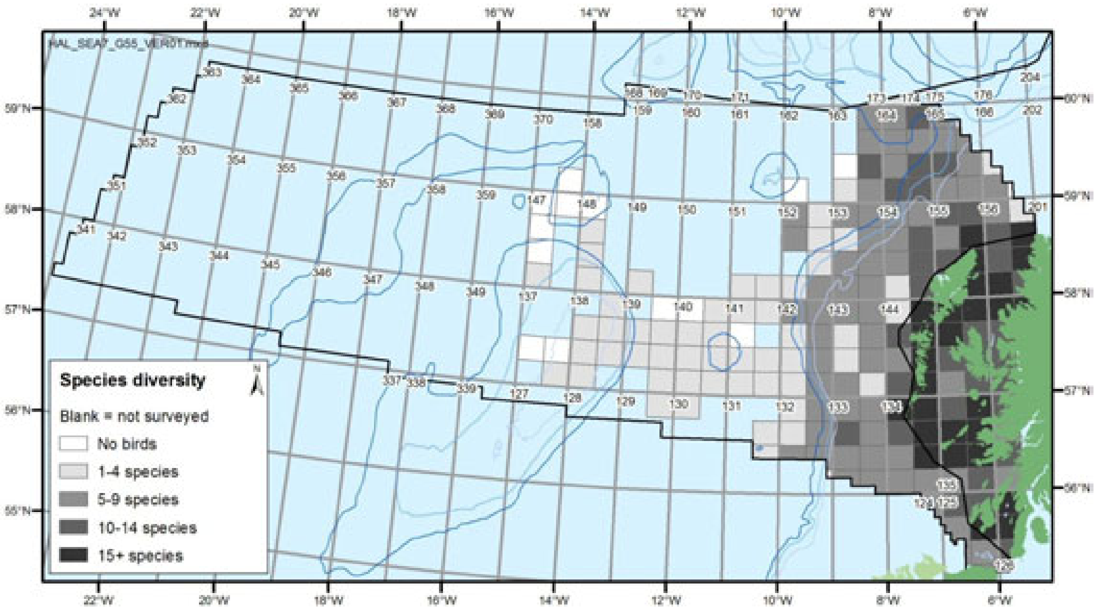
In summer, more than 15 species were recorded in inshore waters around the major breeding colonies and in some areas of the shelf break, while the Rockall Bank and Rockall Trough held between 5 and 14 species (Figure A3a.8). Less than 5 species were recorded in most other offshore areas. Species diversity was highest over the Rockall Bank in July and September, with fulmar, gannet and kittiwake being the most common species. Other species regularly recorded in these areas in summer included great shearwater, Manx shearwater, sooty shearwater, great skua and lesser black-backed gull (Pollock & Barton 2006a).

Figure A3a.8 - Species diversity in SEA 7 area in summer (April to September)



Although survey coverage was not as extensive in the winter period, lowest species diversity was again recorded in offshore waters. Inshore waters around The Minch supported the greatest diversity of species. Between 5 and 14 species were recorded in the north east Rockall Trough and along the shelf break (Figure A3a.9). Less than 5 species were recorded in most other parts of the Rockall Trough and Rockall Bank, with fulmar, gannet and kittiwake being the most common species (Pollock & Barton 2006a).

Figure A3a.9 - Species diversity in SEA 7 area in winter (October to March)



Potential for offshore SPAs in SEA 7

The EU Birds Directive (79/409/EEC) provides for protection, management and control of naturally occurring wild birds within the European Union through a range of mechanisms. One of the key provisions is the establishment of an internationally co-ordinated network of protected areas. Member States are required to identify and classify the most suitable areas in size and number for rare and vulnerable species listed on Annex I of the Directive. In addition, provision must also be made for regularly occurring migratory species, regarding their breeding, moulting and wintering areas as well as staging posts along their migration routes. Designated sites are known as Special Protection Areas (SPAs).

Three Annex I species, European storm petrel, Leach's storm petrel and Arctic tern are found in offshore waters of SEA 7. Almost all the Britain and Ireland breeding population of Leach's storm-petrels and up to half of the Britain and Ireland breeding population of European storm-petrels breed in SEA 7 waters. Important feeding areas for these two species need to be considered for SPA status.

Studies examining seaward extensions of existing breeding seabird colony SPAs recommended that the marine SPA boundary around colonies be increased by 2km for gannet, and 1km for common guillemot, razorbill and puffin. This extension should apply to all colonies where 1 or more of these species is included in the breeding seabird assemblage (McSorley *et al.* 2003). This would include seabird colonies in the SEA 7 area, such as St. Kilda, Flannan Isles, North Rona and Sula Sgeir. Such seaward extensions would not include feeding areas for European storm petrel and Leach's storm petrel, which feed further offshore.

The major difficulty with selecting potential offshore SPAs in the SEA 7 area is that offshore waters generally support low densities of seabirds, and that the existing ESAS data does not show any obvious hotspots. Seabirds are very mobile, moving from one food source to another, often a considerable distance away, and therefore are not tied to one area. Figures A3a.6 and A3a.7 above indicate that the shelf edge and the Rockall Bank were the areas where highest seabird densities were likely to be encountered, with generally low densities elsewhere in offshore areas. Other studies have also highlighted the importance of the shelf edge for seabird species (e.g. Pollock *et al.* 1997, Pollock *et al.* 2000).

Terrestrial SPA selection has focussed primarily on designating multi-species SPAs and it may be that offshore areas that hold higher densities of seabirds such as the Rockall Bank could be suitable areas to consider for designation. It must also be kept in mind that survey effort has been limited in offshore waters of the SEA 7 area, and several years of data would be needed to confirm the importance of particular areas for feeding or moulting seabirds.

It is anticipated that the marine SPA work addressing offshore SPAs for feeding and other aggregations of birds will commence soon, and is scheduled to take two years (Jim Reid, *pers comm.* cited by Pollock & Barton 2006a).

Waterbird species and distribution

Waterbirds include seaducks, divers and grebes, bitterns and herons, rails, crakes and coots, wildfowl (JNCC refer to this group as waterfowl) and waders.

The absence of large, productive estuarine systems on the west coast of Scotland north of the Solway Firth means that the SEA 7 region does not contain sites supporting internationally important assemblages of waterbirds (>20,000 birds). However, the area is still of international importance for many wintering waterbirds (especially some geese and waders), which generally do not occur in large, multi-species aggregations (JNCC website - http://www.jncc.gov.uk/).

Key areas for breeding waterbirds

Machair habitats throughout the Hebrides, including associated marshes, fens and rough wet pastures, support high densities of breeding waders. Internationally important numbers of migratory dunlin, oystercatcher, redshank and ringed plover breed on the machair of North and South Uist. The machair and grasslands of Tiree, pasture near Loch Indaal, Loch Gruinart and other farmland on Islay, and the low-lying coastal regions of Colonsay and Oronsay all support important breeding areas for waders (Craddock & Stroud 1997, May & Law 1997).

The machair also supports north west Scotland greylag geese which breed primarily on the Outer Hebrides (North and South Uist, with smaller numbers on Harris and Lewis), Coll and Tiree, and in parts of Caithness and Sutherland. WeBS counts in August 2004/05 recorded a total of 5,081 birds on the Uists. Peak counts on Tiree and North Uist were both record counts (Banks *et al.* 2006). Other sites identified by WeBS as of international importance for the geese included Benbecula, Loch Broom, Colonsay, Loch Urrahag and Branahuie Saltings (Banks *et al.* 2006). The majority of these birds are sedentary and overwinter close to the breeding areas.

Rocky shores and exposed western beaches provide ideal breeding habitats for oystercatcher, ringed plover and lapwing. Sandy bays and saltmarshes provide habitat for breeding shelduck with important areas on Benbecula, Kintyre and Islay. Breeding eider ducks are also widespread in the region and Islay supports important numbers of breeding common scoter. Habitats associated with the numerous inland freshwater lochs and surrounding moorlands present in the region are important for red-throated and black-throated divers, raptors and greenshank (Craddock & Stroud 1997, May & Law 1997). Mointeach Scadabhaigh on North Uist is of international importance for both red-throated and black-throated divers with the birds feeding in adjacent marine areas.

Key areas for wintering and migratory waterbirds

Seaducks, divers and grebes

The SEA 7 region is of national and international importance for a variety of seaducks, divers and grebes outside of the breeding season with many species overwintering in coastal and nearshore waters. The most important sites are highlighted in Table A3a.8 and Figure A3a.10 (i.e. sites which hold 5% or more of the nationally important population for 1 species or a combination of species). Sites and species are arranged in descending order of importance, with species that occur in internationally important numbers shown in bold.

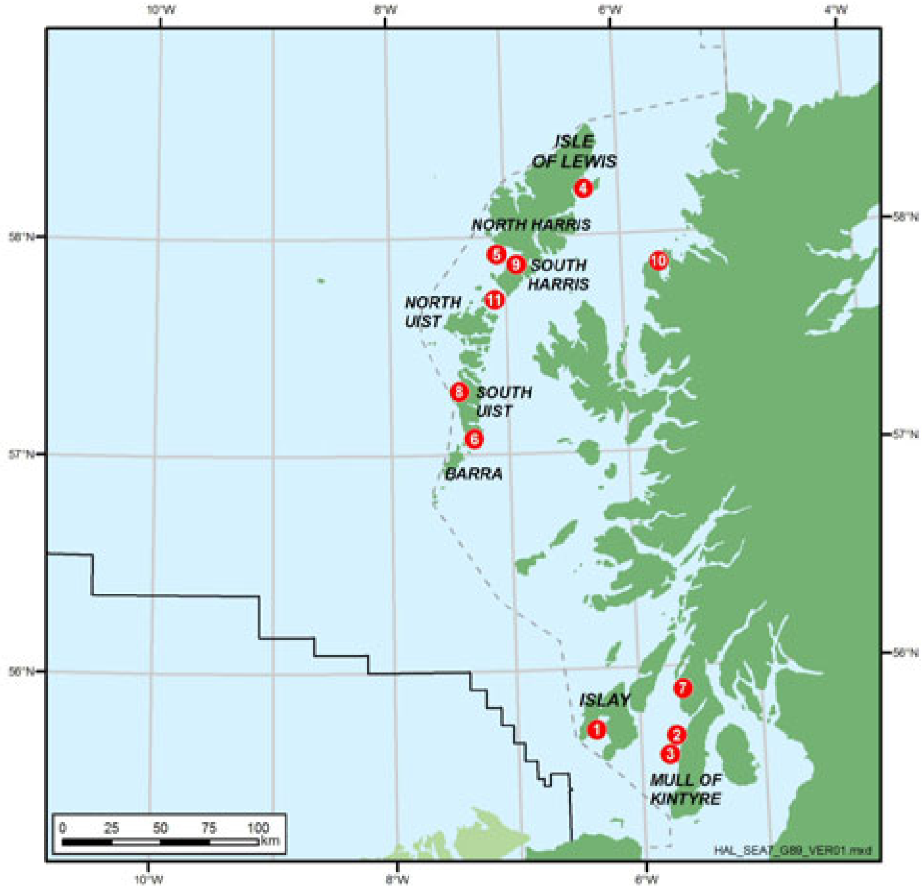
Table A3a.8 – Important sites for non-breeding seaducks, grebes and divers

Map ref	Sites	Species
1	Loch Indaal, Islay	Scaup, Slavonian grebe, **great northern diver**, red breasted merganser, red-throated diver
2	Sound of Gigha	Slavonian grebe, black-throated diver, red-breasted merganser, **great northern diver**
3	West Kintyre Peninsula	**Great northern diver**
4	Braighe, Lewis	Black-throated diver, long-tailed duck, red-breasted merganser

Map ref	Sites	Species
5	Sound of Taransay	**Slavonian grebe**, great northern diver
6	Eriskay	Black-throated diver
7	Loch Caolisport	Black-throated diver, **great northern diver**
8	Howmore, S Uist	**Great northern diver**, long-tailed duck
9	Traigh Luskentyre	Slavonian grebe, black-throated diver
10	Loch Ewe	Black-throated diver, slavonian grebe
11	Sound of Harris	Slavonian grebe, great northern diver, long-tailed duck

Source: Barton & Pollock (2005).

Figure A3a.10 - Important sites for non-breeding seaducks, grebes and divers



Key areas for great northern divers are Loch Indaal, Islay, the Sound of Gigha, west Kintyre peninsula, Loch Caolisport and Howmore, South Uist, while the Sound of Taransay holds internationally important numbers of Slavonian grebe (Barton & Pollock 2005).

During the recent JNCC aerial surveys (Dean *et al.* 2004), nationally important numbers of great northern divers was recorded off the west coast of the Outer Hebrides in February. Potentially significant numbers of common eiders (1,078) and red-breasted mergansers (26) were also recorded. The most important areas for these wintering birds were the Sounds of Harris, Monach and Barra, and the waters to the east of Berneray. Similarly, a February survey of the waters around Coll and Tiree recorded nationally important numbers of great northern divers (175) as well as potentially significant numbers of common eiders (496) (Dean *et al.* 2004).

WeBS 2004/05 reported nationally important numbers of eider in the Firth of Clyde (13,042) with other areas (e.g. Loch Long and Loch Goil, Loch Fyne and Holy Loch to Toward Point) also supporting nationally important numbers (1,000-1,400 birds) (Banks *et al*. 2006).

Geese and other migrants

The region is of importance for migrant waterfowl in spring and autumn, as it lies on the major migratory flyway of the east Atlantic, and many waterfowl, especially geese, either pass through as they move between southern wintering areas and Arctic breeding grounds or overwinter in the region. The importance of the region may increase during periods of severe cold weather further east in Scotland and continental Europe when there may be influxes of waterfowl into the region (Craddock & Law 1997a, b).

The islands off the west and north coasts of Scotland and Ireland (as well as several mainland sites) support the entire population of Greenland barnacle goose during the winter. The main concentration is on the island of Islay (44,186 birds occurring there in 2004/05 (Banks *et al.* 2006). As numbers on Islay have steadily increased, some other key sites, notably Coll and Tiree have become increasingly important, possibly as a result of an increase in intensively managed grasslands providing more favourable feeding habitat, as well as the establishment of Goose Management Schemes. Some smaller, uninhabited islands are now less used, possibly due to habitat changes possibly brought about by cessation of grazing (Wildfowl and Wetlands Trust website - http://www.wwt.org.uk/research/monitoring/greenland-barnacle.asp).

Greenland white-fronted geese migrate south during September and October to winter exclusively in Britain and Ireland. Wintering areas are characterised by remote peatlands and low intensity agricultural land. Two thirds of the Scottish population occur on Islay (8,350 birds, WeBS 2004/05), the remaining located at regularly used sites, mostly in western Scotland, with Tiree, Coll, Rhunahaorine and Machrihanish supporting the largest numbers (Wildfowl and Wetlands Trust website).

The international importance of the region as a wintering ground for both geese species is reflected in the large number of SPAs that have been designated for them. These include the Shiant Isles, North Uist Machair and Islands, Monach Islands, Coll, Treshnish Isles, Gruinart Flats, Rinns of Islay, Bridgend Flats and Laggan.

Over winter, the rocky and sandy shorelines of the North Uist Machair and Islands SPA support internationally important numbers of migratory waders such as purple sandpiper, ringed plover and turnstone. Similar habitat in the South Uist Machair and Lochs SPA supports ringed plover and sanderling. Sanderling prefer sandy shores and nationally important numbers of both birds on passage (August) and overwintering (December) were recorded at Ardivachar Point by WeBS 2005/06 (Banks *et al*. 2006). Sanderling numbers at this site peaked during the autumn migration (550 birds), with smaller numbers wintering (315-400). Large numbers of bar-tailed godwit and knot are also associated with sandy shores throughout the region.

Islay, Colonsay, Coll and Tiree are important as staging areas for certain species in autumn, especially for whooper swan, golden plover, lapwing, dunlin and snipe (Craddock & Law 1997a). The Rinns of Islay SPA supports internationally important numbers of whooper swan on passage and nationally important numbers (194 birds) were recorded from Loch à Phuill on Tiree during a November 2004/05 WeBS survey (Banks *et al*. 2006). In December 2004/05, important numbers of mute swan (394) were recorded at Loch Bee on South Uist which they use as a moulting site.

In autumn and spring Islay holds large flocks of migrating bar-tailed godwit and whimbrel also occur on passage. Curlew are abundant in winter with redshank and greenshank occurring in small numbers on Islay and Mull. Greenshank were also recorded in small but nationally important numbers during the WeBS 2003/04 survey at Loch nan Capull, South Uist (8 birds) (Collier *et al.* 2005) and Broadford Bay, Skye (7 birds) during the WeBS 2004/05 survey (Banks *et al*. 2006). Grey plover are regular on passage on Islay and Tiree (Craddock & Law 1997a).

Other birds

The region represents a stronghold for breeding corncrake which are found in internationally important numbers at a number of sites including North Uist Machair and Islands, South Uist Machair and Islands, Coll, and the Rinns of Islay. The Rinns of Islay also supports internationally important numbers of breeding and overwintering chough which utilise cliff habitat. Other important sites for chough include Colonsay and Oronsay, and The Oa on Islay.

Several raptor species breed in the region in internationally important numbers including golden eagles on Rum and Mull, and hen harriers on Islay. The successfully re-established white-tailed eagle also breeds on the west coast and Western Isles. The Outer Hebrides and St. Kilda also support two sub-species of wren.

Vulnerability to surface pollution

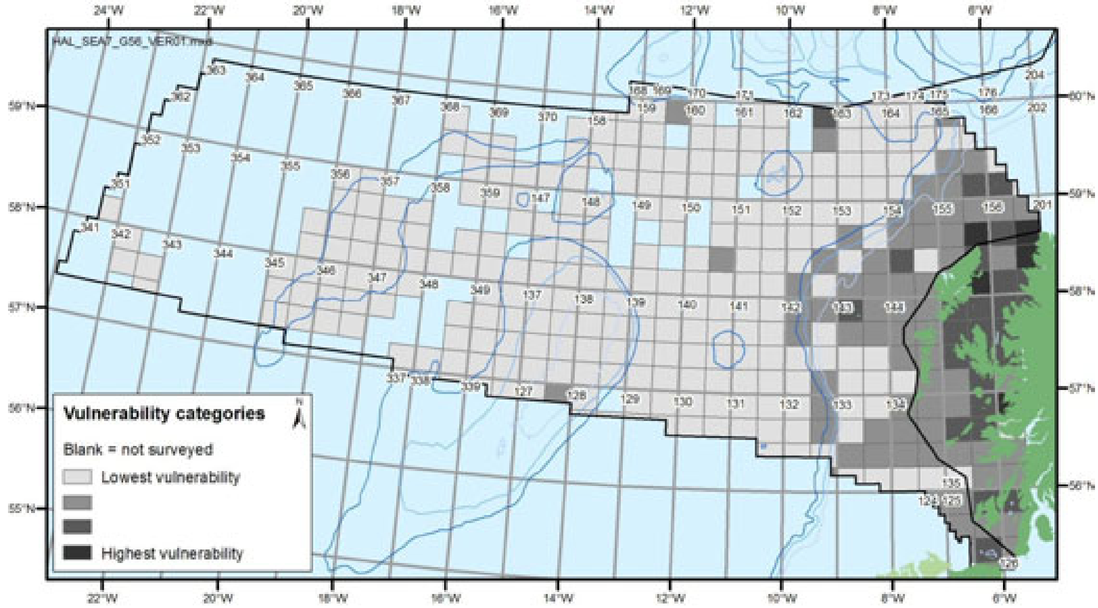
Information on the vulnerability to surface pollution for all species was compiled using data from ship-based and aerial survey data from the ESAS database (Pollock & Barton 2006a). Seabird vulnerability in offshore areas of SEA 7 was generally low throughout the year (Figure A3a.11). However shelf and coastal waters around important seabird colonies are very vulnerable to surface pollution and disturbance.

The vulnerability of seabird species to surface pollution at sea is dependant on a number of factors and varies considerably throughout the year. The Offshore Vulnerability Index (OVI) developed by JNCC and used to assess the vulnerability of bird species to surface pollution considers four factors:

- the amount of time spent on the water
- total biogeographical population
- reliance on the marine environment
- potential rate of population recovery (Williams *et al.* 1995)

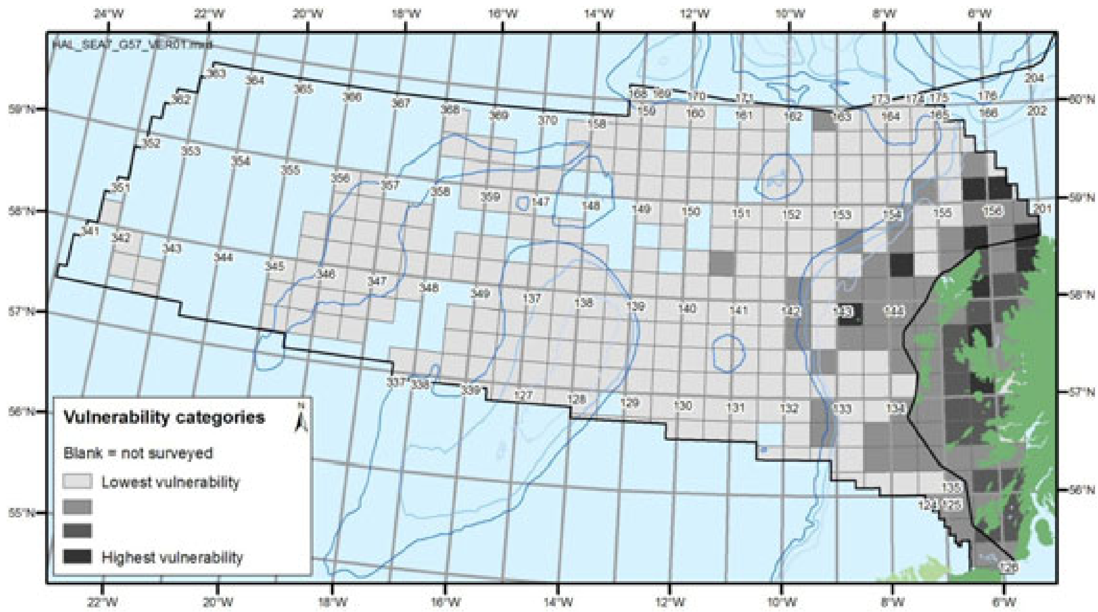
Of the species commonly present in the SEA 7 area, Manx shearwater, gannet, auk species and seaducks, in particular common scoter and divers are the most vulnerable to oil pollution due to a combination of heavy reliance on the marine environment, low breeding output with a long period of immaturity before breeding, the regional presence of a large percentage of the biogeographic population and that some species congregate in large concentrations on the sea surface and are flightless due to annual moults. In contrast, the aerial habits of the fulmar and gulls, together with large populations and widespread distribution, reduce vulnerability of these species.

Figure A3a.11 - Average seabird vulnerability in SEA 7 area – all year



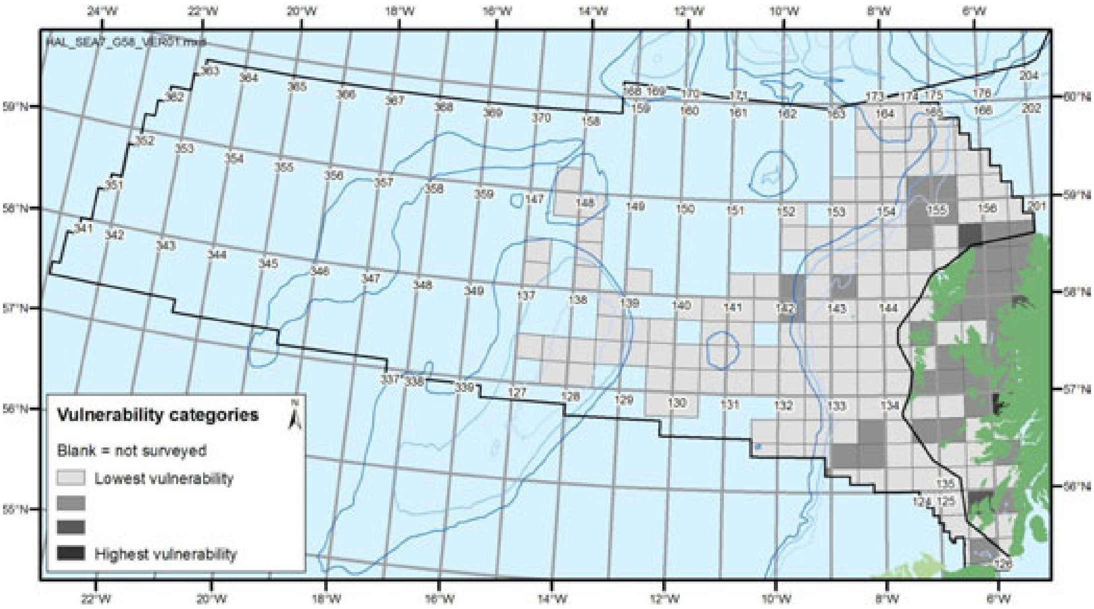
During the summer months, vulnerability was low in offshore waters, with some moderate areas of vulnerability along the shelf edge (Figure A3a.12). Waters around the offshore colonies of St. Kilda, North Rona and Sula Sgeir and in some inshore areas were highly vulnerable at this time.

Figure A3a.12 - Average seabird vulnerability in SEA 7 area in summer – April to September



Survey coverage was limited in the winter months, particularly between October and December, but seabird vulnerability remained low in the offshore areas that were covered. Seabird vulnerability in inshore waters was generally moderate with localised areas of higher vulnerability (Figure A3a.13).

Figure A3a.13 - Average seabird vulnerability in SEA 7 area in winter – October to March



A3a.1.7 Marine mammals

The SEA 7 area is an important area for marine mammals. Information on their abundance and distribution comes from various sources including large scale surveys (e.g. NASS, SCANS II), small-scale coastal survey work and aerial surveys of seal breeding colonies and satellite tracking studies (as described in Hammond *et al.* 2006). AFEN-funded acoustic recordings have also been used to determine the general distribution and seasonal patterns of movement of some cetacean species by Cornell University, Aberdeen University and the JNCC using the US Navy's SOSUS (Sound SUrveillance System) hydrophone array and low frequency sonobuoys.

Cetaceans

Common species

Ten cetacean species are known to occur regularly within the SEA 7 area:

- Harbour porpoise are the commonest cetacean in the region, with sightings throughout much of the area throughout the year, but with highest concentrations in coastal areas during the summer months. Results from SCANS II indicate that harbour porpoise were relatively abundant in coastal areas and in shelf waters to the north of the Outer Hebrides. There are also porpoise sightings on Rockall Bank and in deepwater areas.
- Bottlenose dolphins are common around the Hebridean Islands, but they can also be found offshore along the shelf edge and Rockall Bank.
- Common dolphins are recorded in large groups especially in the summer months in the Sea of Hebrides and southern part of the Minch but are also common off the shelf as far north as 65°N during summer.
- Risso's dolphins are abundant around the Hebrides, especially around the northern end of Lewis, with sightings rates highest in summer.
- White-beaked dolphins and Atlantic white-sided dolphins are both frequently observed in the north and west of SEA 7 (white-beaked generally more northerly than white-sided dolphins).
- Long-finned pilot whales are mainly recorded along the continental shelf slope and in the west and north of SEA 7.
- Killer whales are recorded regularly though infrequently, mainly in the Hebrides, and to a lesser extent along the shelf edge.
- Sperm whales are regularly recorded in deep waters beyond the shelf break and it is likely that SEA 7 covers a migratory route for some portion of the north eastern Atlantic sperm whale population at times of the year.
- Minke whales are frequent visitors to coastal areas in the summer months, but there are also high sightings rates in offshore areas such as Rockall Bank.

Delphinid species such as white-sided dolphins, white-beaked dolphins, common dolphins, and long-finned pilot whales can be detected acoustically during passive acoustic surveys although it is very difficult to determine species from their vocalistions. In surveys carried out to the north and west of Scotland since December 2000, delphinid species were heard throughout the area though concentrated away from shore (Figure A3a.14). Opportunistic sightings during the surveys suggest that white-beaked dolphins are concentrated to the north of the Outer Hebrides, whereas white-sided and common dolphins are found throughout the area. Opportunistic sightings of long-finned pilot whales were recorded in the deep waters of the Faroe-Shetland Channel, and frequently in deep waters to the west of the shelf edge.

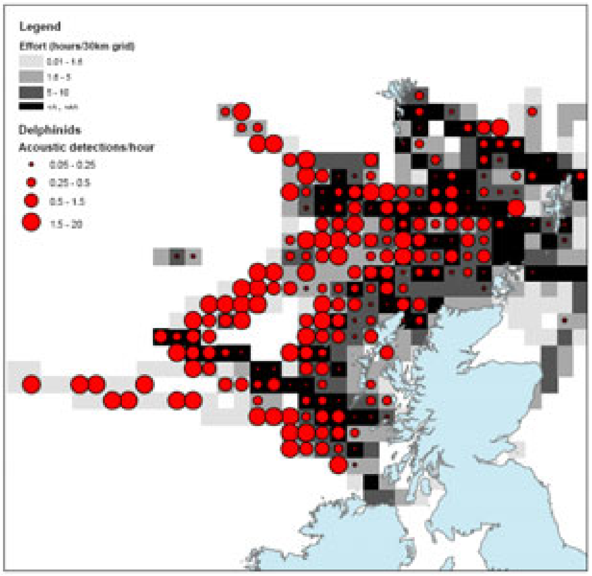


Figure A3a.14 - Delphinid acoustic detections, 2000-2005

Source: Hammond et al. (2006)

Other species

Several other species of cetaceans have been recorded including fin whales, striped dolphins, which occasionally appear among the Hebridean Islands, and three species of beaked whales - northern bottlenose whale, Cuvier's beaked whale and Sowerby's beaked whale. All but the striped dolphin are probably present in the deep water area throughout much of the year, but in low numbers. Several other species of baleen whale, namely blue whales, northern right whales, humpback whales and sei whales may also occur in the region although there is little information available as to their distribution and abundance.

AFEN-funded SOSUS monitoring of the region to the north and west of Britain and Ireland in 1996-1997 detected a number of deep water whale species (Clark & Charif 1998). Fin whale signals were the most frequently detected calls, occurring in every month of the year for which data are available. Highest whale counts and highest vocal activity scores occurred in October through January. Fin whale counts and vocal activity declined steadily from February to minimal levels in May through July, and then increased again during August and September.

Blue whales were detected in all latitudes, with peak detection rates off western Ireland in November and December, declining through late winter and early spring to minimal levels in March through June. Blue whale counts and vocal activity increased gradually from mid-July through September.

The seasonal patterns of calling activity appeared to be synchronous across all of the regions monitored for both fin and blue whales, and did not show any systematic seasonal migration.

Humpback whales were the least frequently detected species overall, occurring only north and west of Scotland, and only from November through April. Data weakly suggested a north to south progression in peak humpback vocal activity from early January to mid-February to mid-March. This progression, coupled with data on some individual humpbacks whose movements were tracked for periods of several hours, suggested a late-winter/early-spring southward migration of singing humpbacks into and through the SEA 7 area (UKOOA website - http://www.ukooa.co.uk/issues/Afen/v0000632.htm).

A visual and acoustic survey of offshore waters of the European margin including much of the SEA 7 area (CODA, Cetacean Offshore Distribution and Abundance) is due to start in July 2007. Target species include common dolphin, bottlenose dolphin and deep diving species.

Pinnipeds

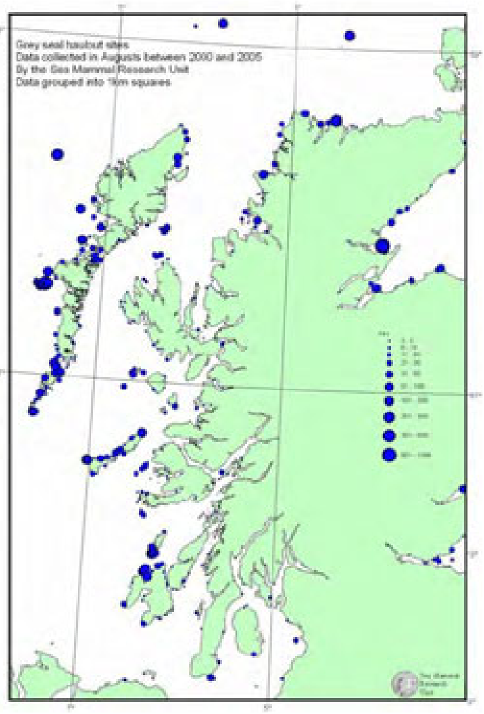
Grey seal

The British grey seal population has been increasing by around 6% annually since the 1960s and is estimated at around 120,000 individuals. The size of the breeding population in the Inner and Outer Hebrides has been estimated at 42,000 animals. During the pupping season in late summer-early autumn and the moulting season in spring grey seals spend more time ashore than at other times of the year. Haul out sites are highlighted in Figure A3a.15a.

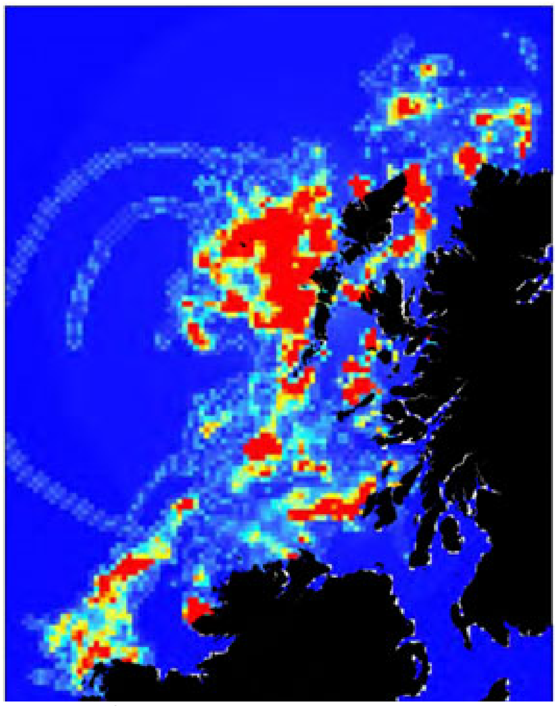
Figure A3a.15b describes the modelled at-sea usage for grey seals off the west coast of Scotland and Ireland. The shelf waters west of the Outer Hebrides are extensively used by grey seals, and there are “hot spots” on Stanton Bank to the south of Barra, waters to the west of Islay and Jura, and waters east of Lewis. Because of limited data on numbers of seals around offshore islands, estimates of usage around St Kilda, the Flannan Isles, North Rona and Sula Sgeir may not be very accurate. The SEA 7 shelf is clearly very important as foraging habitat for the large numbers of grey seals hauling out in the Inner and Outer Hebrides.

Figure A3a.15 – Grey seal haul out sites and spatial usage

a) Haul out sites



b) Spatial usage



Note: Figure A3a.14b based on telemetry data from ~75 individual grey seals, haulout counts and accessibility of points in space relative to the haulout sites. Red indicates high usage and blue low usage.

Harbour seal

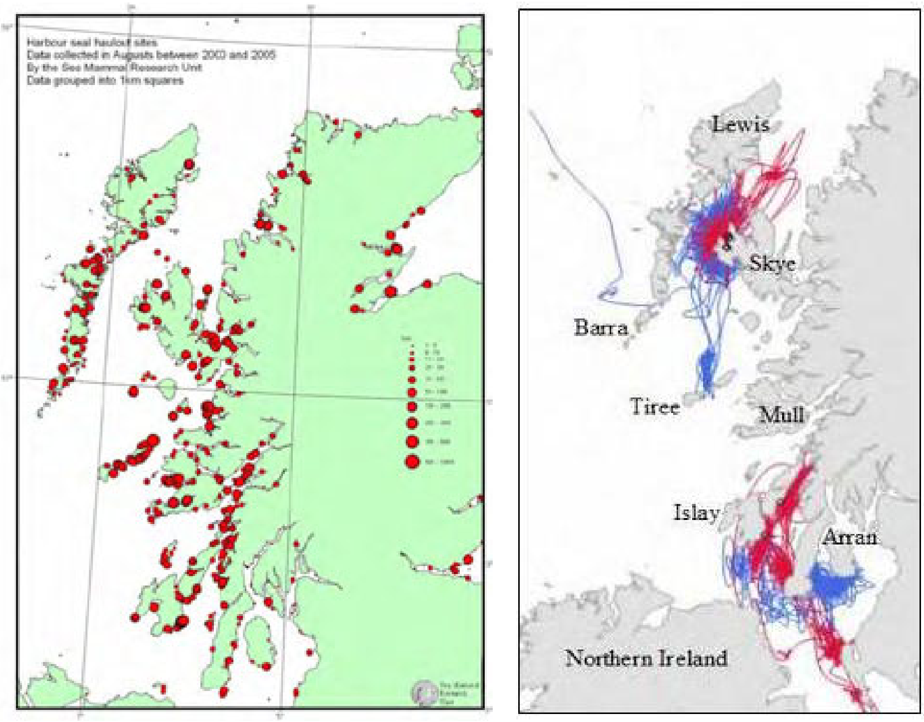
Harbour seals in the SEA 7 area are widely distributed along almost all island and mainland coasts. The number of animals in the area is likely to be more than 20,000, out of a total UK population of 50-60,000. Harbour seals spend more time ashore during summer when they are pupping and moulting. Haul out sites are highlighted in Figure A3a.16a. The movements of 24 harbour seals tagged in Jura, Islay and Skye were tracked by the SMRU between 2003 and 2005 (Figure A3a.16b).

The waters of the Minch and the Hebridean Sea are clearly important foraging areas for the large numbers of harbour seals in the SEA 7 area. Two geographical scales of movement were apparent from the tracking studies. Most trips were short to within 25km of the haul-out site, often (25-40% of the time) returning to the same site; thus a degree of site-fidelity and coastal foraging was apparent. However, some individuals made longer trips of over 100km, indicating that animals from haul-out sites were not completely isolated. Longer distance movements in south west Scotland showed some seasonality, occurring predominantly at the end of September and March. Almost half of the trips lasted between 12 and 24 hours although some trips lasted several days, with the longest recorded trip lasting more than 9 days.

Hooded seals usually forage in deep offshore oceanic waters along and off the continental shelf. They are regularly sighted in the SEA 7 area but there is no current estimate of the size of the population using the area.

Figure A3a.16 – Harbour seal haul out sites and spatial usage

a) Haul out sites *b) Individual seal tracks*



Note: Figure A3a.15, individual tracks of male (blue) and female (red) harbour seals. Satellite Relay Data Logger deployment locations are illustrated in black.

Relevant issues

Conservation

The international and national conservation frameworks protecting marine mammals have been described in previous SEAs and are summarised in Appendix A3a.3. At present within SEA 7, there are no marine Special Areas of Conservation designated under Annex II of the Habitats Directive for marine mammal species. However, there are 6 coastal SACs which are designated for their seal populations (see A3a.2.1 for details).

Bycatch

Compared with some other areas around the UK, the levels of fishing effort by gear types that are generally considered dangerous to marine mammals (pelagic trawls and gillnets) are low. The SMRU monitored gill and tangle net fisheries in the Hebrides in the late 1990s and concluded that only a few tens of porpoises are likely to become bycatch per year, mainly due to the low levels of fishing activity (Northridge & Hammond 1999). Pelagic trawls operate in much of this area, and a fairly high level of sampling of these fisheries (for herring, blue whiting, sprats, mackerel) has not yet recorded a single cetacean bycatch. There have been a few records of minke whales becoming ensnared in mooring lines, possibly those from lobster pot fisheries, but no study or estimates of this interaction have been made.

Vessel collision

Another potential source of mortality to cetaceans may be through collisions with vessels. Whales are occasionally reported to be struck and killed, especially by fast-moving ferries, in other parts of the world, and smaller cetaceans can also be impacted by propeller strikes from small vessels. In some areas, where ships are numerous and cetacean numbers are depleted, this can be a serious cause for concern. There are very few data with which to estimate the frequency of such events, and consequently this has not been identified as a significant source of additional mortality in the region.

A3a.2 Sites and species of nature conservation importance in SEA 7

The SEA 7 area contains a wide variety of coastal and marine habitats and species, many of which are of conservation importance. This section describes those conservation sites of international importance both in coastal and nearshore areas as well as those sites identified in offshore waters. Much of the information within this section comes from the underpinning technical report (AICSM 2006).

The coastal and nearshore areas of SEA 7 have been broken into four regions, each of which has some degree of common physiographic characteristics:

1. The Outer Hebrides and Atlantic Islands.
2. The long west coast of the Scottish mainland with its numerous sea lochs and islands between Cape Wrath and the Mull of Kintyre. This area also includes the Inner Hebrides with major larger islands such as Skye, Mull, Islay, Jura, Coll and Tiree. For cartographic purposes this coastal zone is divided into north and south sections by the Ardnamurchan Peninsula.
3. The north coast of Northern Ireland.

A3a.2.1 Sites of international importance

The Outer Hebrides and Atlantic Islands

The Atlantic coast of the Outer Hebrides is mainly very low and flat, being an extension of the wide shallow continental shelf to the west. This coast contains internationally important machair sites. Some higher areas are found in Harris and Lewis which also has eroding cliffs of glacial deposits. In contrast, the east (Minch) coast has West Highland characteristics: steep with sea lochs, mountains, cliffs and deep water nearshore. Except for the main ports of Lewis (Stornoway) and Harris (Tarbert) most populations concentrate on the west coast on the basis of traditional crofting agriculture.

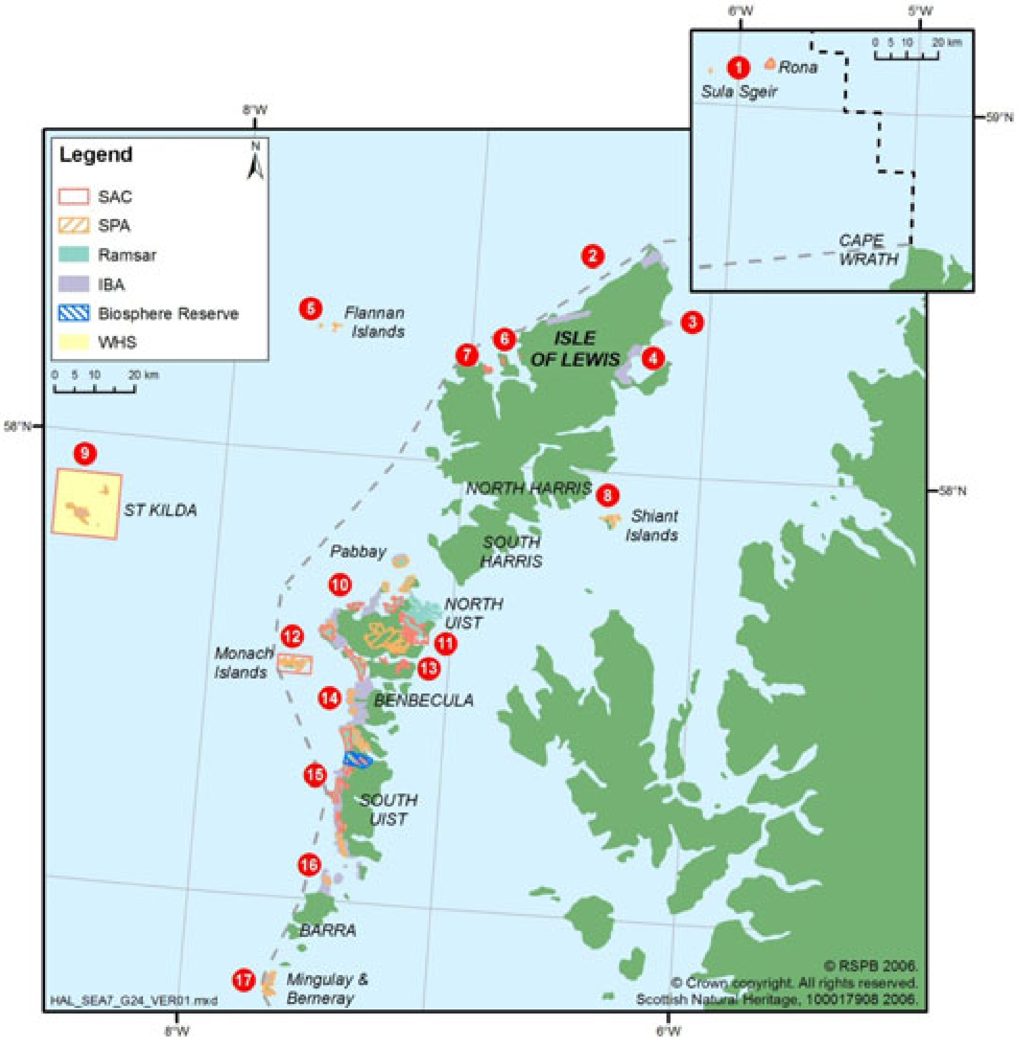
Table A3a.9 – Internationally important coastal conservation areas

Map Ref	Location	SAC	SPA	R	IBA	BR	WHS
1	North Rona and Sula Sgeir	✓	✓		✓		
2	West Coast Lewis				✓		
3	Tolsta Head Lewis				✓		
4	Stornoway to Back Lewis				✓		
5	Flannan Isles		✓		✓		
6	Loch Roag Lagoons	✓					
7	Tràigh na Berie	✓					
8	Shiant Isles		✓		✓		
9	St. Kilda	✓	✓		✓		✓
10	North Uist Machair and Islands	✓	✓	✓	✓		
11	Loch nam Madadh	✓	✓	✓			
12	Monach Islands	✓	✓		✓		
13	Obain Loch Euphoirt	✓					
14	West Coast of Benbecula		✓		✓		

Map Ref	Location	SAC	SPA	R	IBA	BR	WHS
15	South Uist Machair and Lochs	✓	✓	✓	✓	✓	
16	West Sound of Barra		✓		✓		
17	Mingulay and Berneray		✓		✓		

Abbreviations: SAC (Special Area of Conservation), SPA (Special Protection Area), R (Ramsar), IBA (Important Bird Area), BR (Biosphere Reserve) and WHS (World Heritage Site)

Figure A3a.17 – Internationally important coastal conservation areas



Key features of relevance to SEA 7

There are internationally important grey seal breeding colonies on North Rona and Sula Sgeir, and the Monach Islands. Many of the islands provide nesting localities for large numbers of seabirds. For example, the total population of seabirds on St. Kilda exceeds 600,000 pairs, making it one of the largest concentrations in the North Atlantic and the largest in the UK. Notable among the many breeding species are auks, petrels and shearwaters, gulls and large proportions of the national and international populations of gannet and puffin. These species feed not only in the waters close to the islands, but also further away in the North Atlantic. The reefs and submerged sea caves around St. Kilda support a diverse range of species and are of international importance.

North section of West Highlands and Inner Hebrides

The diversity of this area rests on the combination of numerous islands, some of which are large and well populated e.g. Skye, an even greater number of small rocky islands and the classic sea lochs and mountains of the mainland. Diversity is based on both geology and the history of glaciation which tended to be erosive and overdeepened sea lochs and inter-island straits. The mild oceanic climate and rich coastal waters provide a great variety of habitats and the small number of towns and villages has produced very little disturbance. Fishing, crofting and tourism are the main occupations.

Figure A3a.18 – Internationally important coastal conservation areas

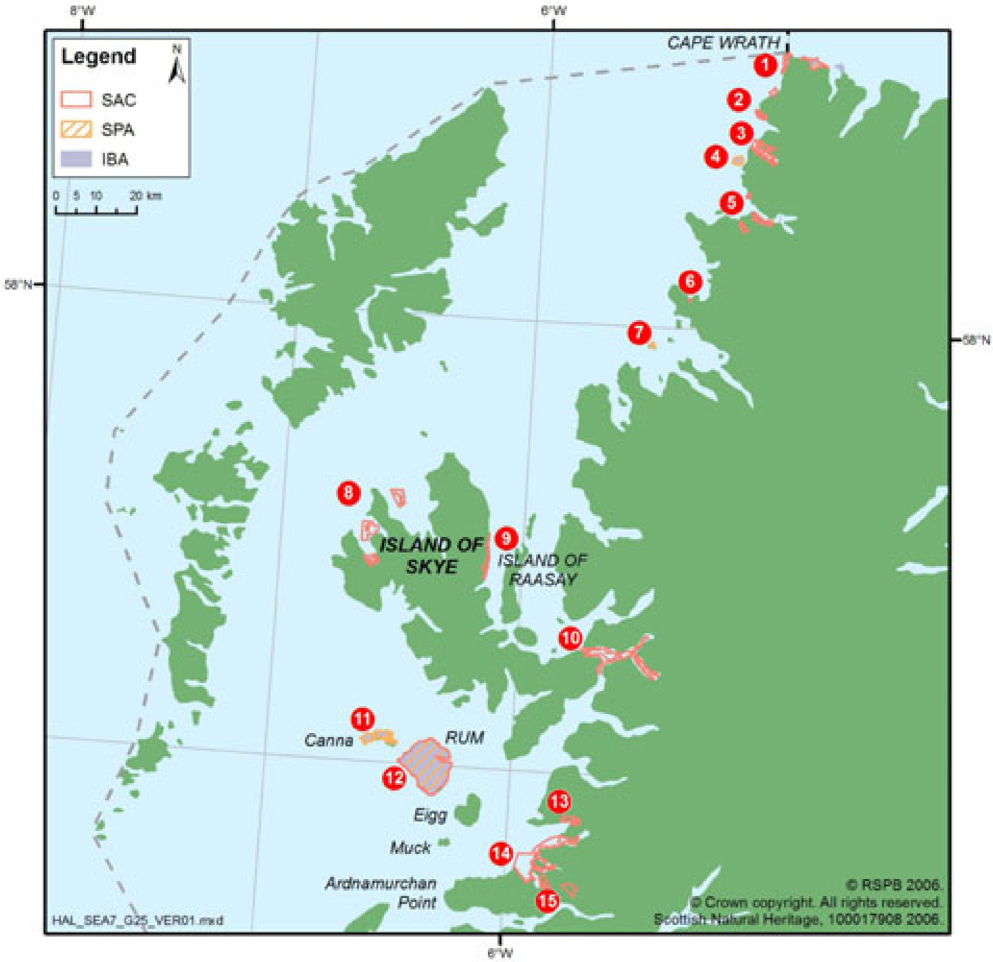


Table A3a.10 – Internationally important coastal conservation areas

Map Ref	Location	SAC	SPA	R	IBA	BR	WHS
1	Cape Wrath	✓	✓		✓		
2	Oldshoremore and Sandwood	✓					
3	Loch Laxford	✓					
4	Handa Island		✓		✓		
5	Ardvar and Loch a'Mhuilinn Woodlands	✓					
6	Achnahaird	✓					
7	Priest Island		✓		✓		

Map Ref	Location	SAC	SPA	R	IBA	BR	WHS
8	Ascrib, Islay and Dunvegan	✓					
9	Rigg - Bile	✓					
10	Lochs Duich, Long and Alsh Reefs	✓					
11	Canna and Sanday		✓		✓		
12	Rum	✓	✓		✓		
13	Glen Beasedale	✓					
14	Sound of Arisaig	✓					
15	Claisch Moss and Kentra Moss	✓					

Abbreviations: SAC (Special Area of Conservation), SPA (Special Protection Area), R (Ramsar), IBA (Important Bird Area), BR (Biosphere Reserve) and WHS (World Heritage Site)

Key features of relevance to SEA 7

The region supports a number of important seabird breeding colonies including Cape Wrath, Handa Island, Priest Island, Canna and Sanday. The island of Rum is home to the largest colony of Manx shearwater in the world and Priest Island supports one of the largest storm petrel colonies in the UK. The islands, skerries and isolated coasts of Ascrib, Islay and Dunvergen support breeding common seal. A wide range of marine habitats and communities are found in the sea lochs of Loch Laxford, Duich, Long and Alsh, from those associated with very sheltered conditions to tide swept reefs. The sublittoral sandbanks of the Sound of Arisaig support some of the most extensive maerl beds in the UK.

South section of West Highlands and Inner Hebrides

This area is broadly similar to the northern section but has wider and deeper sea lochs including the Firth of Lorne. The long peninsula of Kintyre with its distinctive west coast raised shoreline structures is also unique. Coll and Tiree are open, low machair islands. Mull is mountainous but contains a south west peninsula with beaches and machair. Colonsay is a unique combination of low hills and bayhead beaches. Islay is exposed in the west and is relatively heavily populated but contains a wide variety of coastal types. Jura is almost uninhabited and characterised by high mountains and the finest raised shingle beaches in Britain. In general, the area is more densely populated than further north being nearer the Firth of Clyde and the Glasgow conurbation.

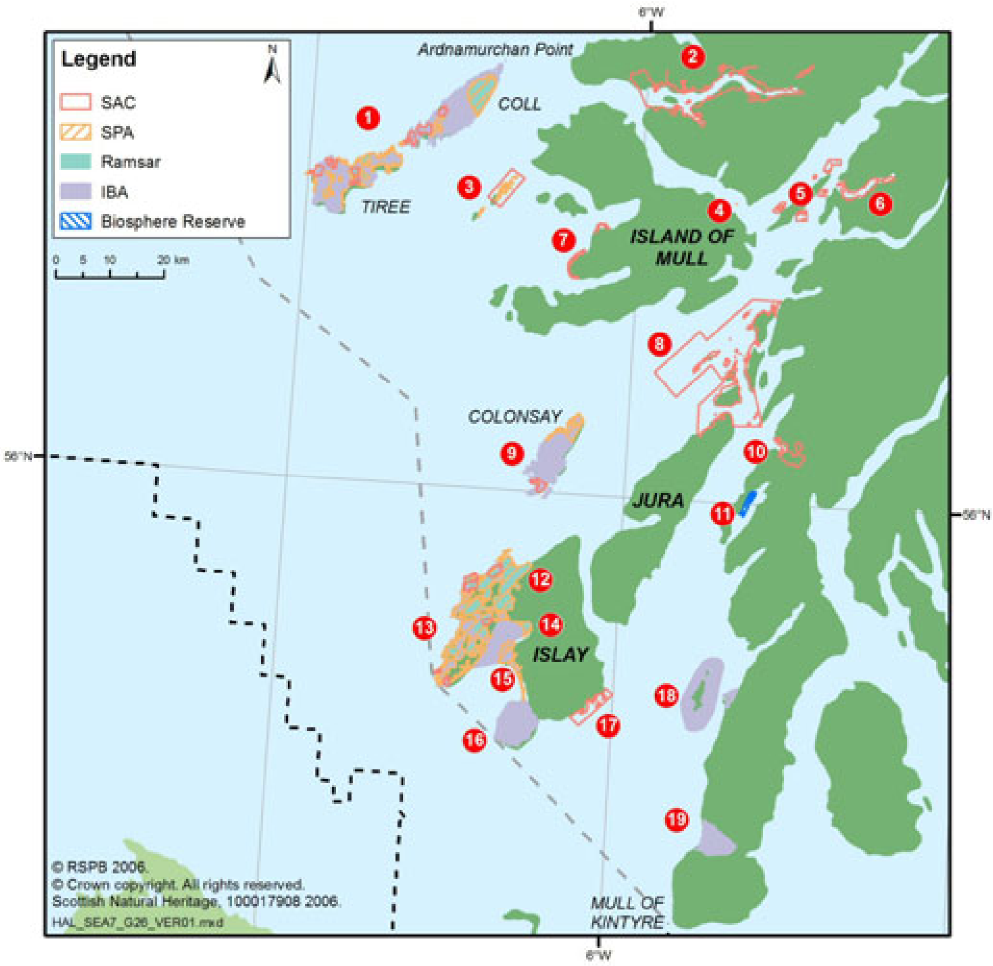
Table A3a.11 – Internationally important coastal conservation areas

Map Ref	Location	SAC	SPA	R	IBA	BR	WHS
1	Coll and Tiree	✓	✓	✓	✓		
2	Sunart	✓					
3	Treshnish Isles	✓	✓		✓		
4	Glas Eileanan		✓				
5	Eileanan agus Sgeirean Lios Mor	✓					
6	Loch Creran	✓					
7	Ardmeanach	✓	✓				
8	Firth of Lorn	✓					
9	Colonsay and Oronsay	✓	✓		✓		
10	Moine Mhor	✓					

Map Ref	Location	SAC	SPA	R	IBA	BR	WHS
11	Taynish					✓	
12	Gruinart		✓	✓	✓		
13	Rinns of Islay	✓	✓	✓	✓		
14	Bridgend Flats		✓	✓	✓		
15	Laggan		✓		✓		
16	The Oa				✓		
17	South East Islay Skerries	✓					
18	Gigha Island and Islets				✓		
19	Kintyre				✓		

Abbreviations: SAC (Special Area of Conservation), SPA (Special Protection Area), R (Ramsar), IBA (Important Bird Area), BR (Biosphere Reserve) and WHS (World Heritage Site)

Figure A3a.19 – Internationally important coastal conservation areas



Key features of relevance to SEA 7

The Treshnish Isles support breeding colonies of grey seals as well as seabirds (e.g. storm petrels) and are also of importance as traditional wintering grounds for Greenland barnacle goose. A number of other sites within the region support important goose wintering roosts including Gruinart, Rinns of Islay, Bridgend Flats, Laggan and The Oa. The offshore islands and skerries of Lismore support common seal breeding colonies, as do the skerries of south east Islay. Important marine habitats and species are found in Loch Creran, which is the only known site in the UK to contain living *Serpula vermicularis* reefs. The Firth of Lorn encompasses a complex group of islands, sounds and inlets characterised by some of the strongest tidal streams in the UK. The varied physical environment is reflected in the variety of reef types and associated communities and species, which are amongst the most diverse in both the UK and Europe.

Northern Ireland

This short coastline faces north and is partly sheltered by Rathlin Island. There is considerable variety of small scale coastal types, including cliffs, beaches and rock platforms. There is great geological variety but most sections are based on the basaltic formations including the Giant's Causeway which links directly to the tertiary volcanic province of the Inner Hebrides. Unlike the other areas this is a rich agricultural area with a relatively dense coastal population.

Figure A3a.20 – Internationally important coastal conservation areas

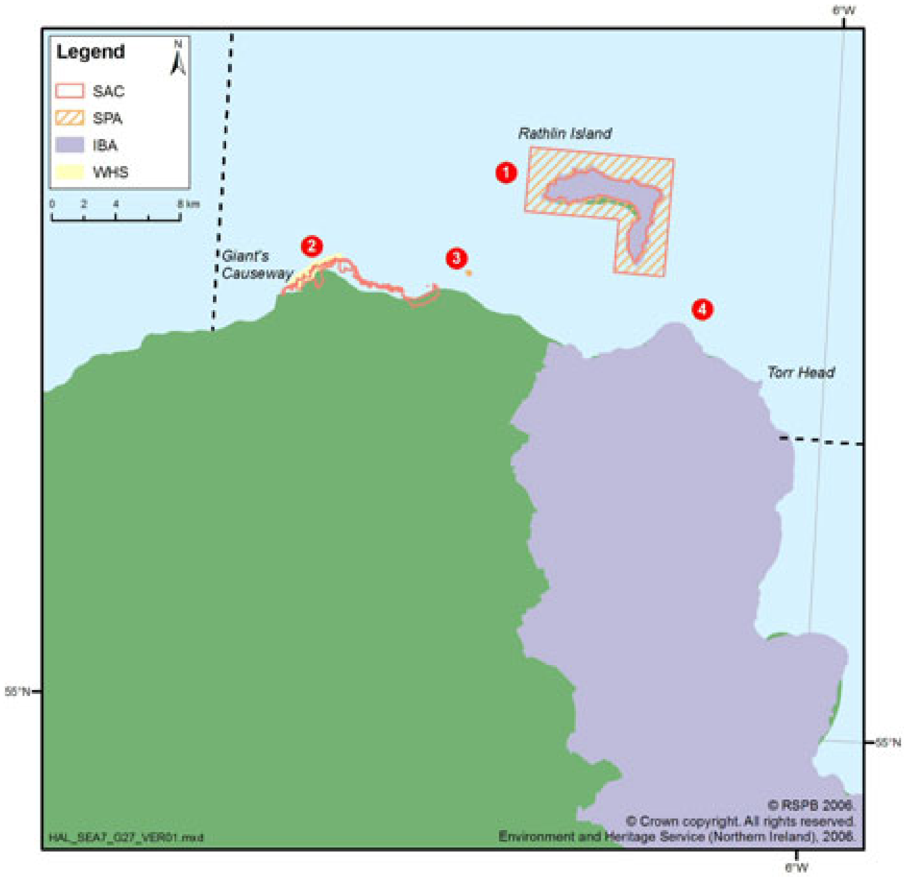


Table A3a.12 – Internationally important coastal conservation areas

Map Ref	Location	SAC	SPA	R	IBA	BR	WHS
1	Rathlin Island	✓	✓		✓		
2	North Antrim Coast	✓					✓
3	Sheep Island		✓		✓		
4	Antrim Plateau				✓		

Abbreviations: SAC (Special Area of Conservation), SPA (Special Protection Area), R (Ramsar), IBA (Important Bird Area), BR (Biosphere Reserve) and WHS (World Heritage Site)

Key features of relevance to SEA 7

The steep sea cliffs of Rathlin Island are important for seabirds, as well as peregrine. The island is surrounded by a variety of rocky habitats and is one of the best examples of reefs in Northern Ireland. The small, exposed Sheep Island has steep cliffs and rocky shores, and is important for breeding seabirds, in particular cormorant. The North Antrim Coast represents an extensive area of hard cliffs which includes the Giant's Causeway and Causeway Coast World Heritage Site.

A3a.2.2 Offshore sites of international importance

Offshore conservation (beyond 12 nautical miles)

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora and the *Council Directive of 2 April 1979 on the conservation of wild birds (79/409/EEC)* require member states to afford protection for certain species and habitats through the designation of Special Areas of Conservation (SAC) and Special Protection Areas (SPA) and protection of certain species respectively.

The Conservation (Natural Habitats, &c.) Regulations 1994 provided for the designation of sites in the UK on land and within territorial waters (12nmiles).

The *Offshore Petroleum Activities (Conservation of Habitats) Regulations, 2001* (as amended 2007) implemented the above directives in relation to oil and gas plans or projects carried out in whole or in part on the UKCS outside territorial waters – although there was then no mechanism for the designation of sites outside 12nmiles. Where it is considered that an activity completed under a project consent may have a significant effect on a SAC or SPA, the DTI must conduct an Appropriate Assessment (AA) prior to granting the consent.

The government has introduced draft regulations *the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2006* which provide the mechanism for the UK designation of offshore (outside 12 nautical miles) SACs and SPAs and the protection of certain species. The types of habitat and the species protected are listed in the Annexes to the Directives. The existing *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended 2007) remain in force, although the draft regulations make some amendments to them.

Marine SPAs

Many species of bird extensively use waters surrounding their breeding colonies or wintering grounds for a variety of purposes. Additionally, some species may utilise offshore areas. Therefore, it is important that the existing network of terrestrial/coastal SPAs is developed to afford protection to these marine habitats (Reid & Webb 2005). Work is currently underway to identify marine SPAs, and three possible types have been recognised (Vincent 2000):

- *marine extensions* to existing breeding seabird colony SPAs;
- *inshore areas* used by aggregations of non-breeding waterbirds outside the breeding season;
- *offshore areas* used by seabirds in feeding or any other type of aggregations.

Marine extensions

The JNCC surveyed seabirds in the waters immediately adjacent (up to approximately 5km from mean low water (MLW)) to six seabird colonies hosting nationally and internationally important numbers of seabird species (McSorley *et al*. 2003). This allowed formulation of possible generic proposals for identifying marine extensions of existing breeding seabird SPAs. Based on the results of this study and others, a series of recommended marine extensions to existing SPAs have been endorsed by the JNCC (summarised in Reid & Webb 2005):

- colony SPAs for which Atlantic puffin, common guillemot, or razorbill are interest features be extended offshore by 1km from MLW;
- colony SPAs for which northern gannet or northern fulmar are interest features be extended offshore by 2km from MLW;
- colony SPAs for which Manx shearwater is an interest feature be extended offshore by at least 4km from MLW, or more where the available evidence warrants it;
- marine extensions are not appropriate for SPAs for which the following species are interest features: great cormorant, skuas, gulls, black-throated diver, great crested grebe, Slavonian grebe, common scoter, red-necked phalarope.

In addition to the above, work is planned or ongoing to investigate the possibility of extensions for two species of storm petrel, European shag, red-throated diver and five species of tern (Reid 2006).

Inshore areas

Several species of migratory seaduck, divers and grebes utilise coastal waters, forming aggregations outside of the breeding season. As summarised by Reid (2006), the development of inshore marine SPAs is being addressed in two ‘Tranches’. The Outer Hebrides is a Tranche 2 area, and some population analysis work has already been completed.

Offshore areas

At present little progress in identifying possible offshore SPAs has been made (Reid 2006). Some funding for the work has been confirmed, with several analyses of the European Seabirds at Sea (ESAS) data proposed. The aim will be to spatially model the ESAS data to allow application of further tools to enable determination of seabird aggregations (Reid 2006). Therefore, at present, although there are no offshore areas designated as SPAs within SEA 7 or currently identified as potential SPAs, areas within SEA 7 may be identified and possibly designated in the future.

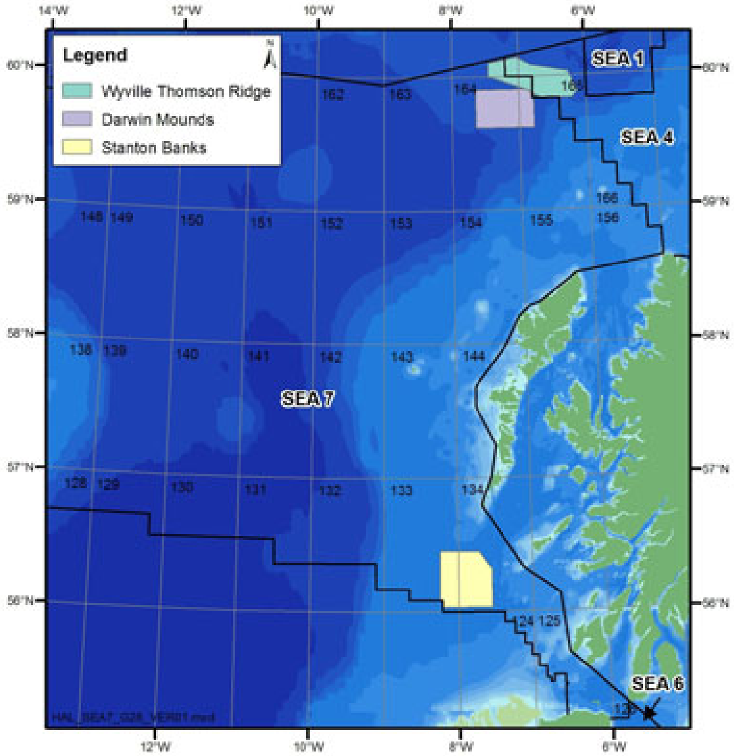
Offshore SACs

Since 2002, identification of SACs in UK offshore waters has been undertaken by JNCC in consultation with the country conservation agencies. Habitats for which SACs may be selected in UK offshore waters are:

- Sandbanks which are slightly covered by sea water all the time
- Reefs
- Submarine structures made by leaking gases
- Submerged or partially submerged sea caves

At present there is one possible (pSAC[1]) and 7 draft (dSAC[2]) offshore sites identified. Of these, the Darwin Mounds pSAC occurs wholly within SEA 7, as does the Stanton Banks dSAC, while the boundary of the Wyville Thomson Ridge dSAC, partially extends into the SEA 7 area (Figure A3a.21).

Figure A3a.21 – Draft and Possible SACs in the SEA 7 area



Source: Johnston et al. 2004, Johnston & Turnbull 2004.

Key features of offshore sites

The Darwin Mounds are considered an exceptional example of cold coral reefs in UK waters, with the "tail" feature thought to be unique. The site has also provided the first record of cold coral *Lophelia* growing on a sand substrate. The corals provide a habitat for various species of larger sessile or hemi-sessile invertebrates (i.e. sponges and brisingiids) and support significant populations of xenophyophores.

Stanton Banks are an example of bedrock mounds in offshore waters. Communities present are typical of moderately exposed/exposed circalittoral bedrock reef habitat. Granite ridges are characterised by numerous barnacles and brittlestars and extensive encrusting coralline red algae with brittlestars and sponges on the flanks.

The Wyville Thomson Ridge is representative of iceberg ploughmarks - a regional variant of stony reefs and is periodically subject to hydrodynamic conditions associated with the Faroe-Shetland Channel. Faunal communities are composed of species representative of hard marine substrata in deep water, e.g. sponges, brachiopods, octocorals, carpet forming

[1] Possible SACs (pSACs) are sites that have been formally advised to UK Government but have not, as yet, been submitted to the European Commission.
[2] Draft SACs (dSACs) are areas that have been formally advised to UK Government as suitable for selection as SACs, but have not been formally approved by government as sited for public consultation.

featherstars and sedentary, filter-feeding holothurians, and also less specialist fauna, e.g. crabs, squat lobster/other *Munida* spp. and sea urchin.

Other conservation intiatives

OSPAR Marine Protected Areas

A network of Marine Protected Areas (MPAs) is currently in the process of being identified by OSPAR. To inform the identification of MPAs, OSPAR has produced an *Initial List of Threatened and/or Declining Species and Habitats* in the OSPAR maritime area (see Table A3a.13 below). This list is not finalised and additional species and habitats may be added.

Table A3a.13 – Threatened and/or declining species and habitats in the SEA 7 area

Species[1]	Habitats[2]
Invertebrates	Carbonate mounds
Arctica islandica (ocean quahog)	Intertidal mudflats
Nucella lapillus (dog whelk)	Intertidal *Mytilus edulis* beds on mixed and sandy sediments
Fish	*Lophelia pertusa* reefs
Alosa alosa (allis shad)	Maerl beds
Cetorhinus maximus (basking shark)	*Modiolus modiolus* horse mussel beds
Dipturus batis (common skate)	*Ostrea edulis* beds
Raja montagui (spotted ray)	Seamounts
Gadus morhua (cod)	Seapens and burrowing megafauna communities
Hippocampus guttulatus (long-snouted seahorse)	*Zostera* beds
Hippocampus hippocampus (short-snouted seahorse)	*Zostera* beds - sub-type *Zostera marina* beds
Hoplostethus atlanticus (orange roughy)	*Zostera* beds - sub-type *Zostera noltii* beds
Petromyzon marinus (sea lamprey)	
Salmo salar (salmon)	
Thunnus thynnus (bluefin tuna)	
Birds	
Sterna dougallii (roseate tern)	
Reptiles	
Caretta caretta (loggerhead turtle)	
Dermochelys coriacea (leatherback turtle)	
Mammals	
Balaenoptera musculus (blue whale)	
Eubalaena glacialis (northern right whale)	
Phocoena phocoena (harbour porpoise)	

Notes:

1. *Determination of species in the SEA 7 area informed by the case reports for individual species (OSPAR 2006a).*
2. *Determination of habitats in the SEA 7 area informed by distribution maps provided on the OSPAR website (http://www.ospar.org/eng/html/welcome.html).*

Fifty six sites, all of them Natura 2000 sites were reported to OSPAR by the UK in January 2006. The exact landward boundaries of the sites are still being resolved. Although, it is not expected that any additional OSPAR MPAs will be reported before 2008, the UK is identifying additions to the marine component of the Natura 2000 network and will keep under review whether any of these sites merit reporting towards the OSPAR MPA network (OSPAR 2006b).

Marine Bill

The Marine Bill white paper *A Sea Change*, was published on 15 March 2007. The white paper covers five key issues: planning in the marine area; licensing activities in the marine area; marine nature conservation; modernising marine fisheries management, and a new marine management organisation (DEFRA website).

The responses to the white paper will inform the content of the Marine Bill that is introduced to the UK Parliament.

A3a.2.3 Species of international importance

In addition to specific conservation sites within the SEA 7 area, a number of individual marine species have been afforded protection. At a European level, a number of marine species including all cetacean species and otters, a number of fish species and a range of marine invertebrates are listed on Annex IV (Animal and Plant Species of Community Interest in Need of Strict Protection) of the Habitats Directive. Under this Annex, the deliberate capture, killing or disturbance of such species is banned, as is their keeping, sale or exchange. Harbour porpoise, bottlenose dolphin, grey and harbour seal are listed in Annex II, under which member countries are required to consider the establishment of SACs.

Several marine species are also protected in UK waters under Schedule 5 of *The Wildlife and Countryside Act, 1981.* These include all cetacean species, otters, all turtle species, a range of fish including sturgeon, allis shad, twaite shad and basking shark, and a number of marine invertebrates. The management and monitoring of protected species, as well as many additional marine species, is co-ordinated through the implementation of individual and grouped species action plans under the UK Biodiversity Action Plan.

A3a.2.4 Sites of national importance and non-statutory sites

In the Scottish component of SEA 7, sites of national importance include National Nature Reserves (NNR), Sites of Special Scientific Interest (SSSI) and National Scenic Areas (NSA). Geological Conservation Review sites (GCR) are also included as, although not statutory, they often form the basis of the NNR and SSSI sites and are of national importance. In Northern Ireland, sites of national importance include nature reserves, Areas of Special Scientific Interest (ASSI), Earth Science Conservation Review sites (ESCR) and Areas of Outstanding Natural Beauty (AONB). All nationally important sites are described and mapped in the underpinning technical report (AICSM 2006).

There are also a large number of non-statutory sites of nature conservation or landscape importance in SEA 7. These include Local Nature Reserves (LNR), Marine Consultation Areas (MCA), Ministry of Defence sites, Preferred Conservation Zones (PCZ) and a number of Regional Landscape Designations (RLD). There are also a host of sites managed by non-governmental organisations including the John Muir Trust, RSPB, Scottish Wildlife Trust and National Trust.

Appendix 3b - Geology and sediments

Underlying geology

The present day morphology of the eastern Atlantic margin results largely from rifting activities during the Mesozoic which resulted in the formation of the North Atlantic Ocean (De Haas *et al*. 2000). The major rifting episodes were of Permo-Triassic, Middle and Late Jurassic, and Early to Late Cretaceous age. Rifting between Rockall and Norwegian basins during the Cretaceous first created the unity of the region which following Atlantic opening, finally became the Atlantic Margin (Naylor *et al*. 2002).

Post-rifting Mesozoic to Quaternary sedimentary covering finally resulted in the present day morphology of the area. By the Early Miocene, the Greenland-Scotland Ridge (including the WyvilleThomson Ridge) was submerged and deep-water exchange between the Arctic and North Atlantic oceans was established (Boldreel & Andersen 1995).

Since the Pliocene (approximately 5Ma), regional uplift of the Scottish mainland and glaciations have transferred large amounts of sediment to the deeper offshore basins and resulted in thicker sediment accumulations (800m or more on fans) on the east margin of the Rockall Trough.

Hydrocarbon prospectivity

The SEA 7 area has been under-explored for hydrocarbons and has no producing oil or gas fields. Areas beyond the 200nm limit are still under negotiation for rights to licence so that only the Hebrides Shelf, Rockall Basin and the east areas of Rockall Bank have short-term prospects for licences issued by the DTI.

Difficulties in understanding the region's prospectivity are posed by the lack of detailed knowledge on source rocks and the impacts of thick sequences of Palaeogene volcanic rocks on exploration.

Very few wells have been drilled and current hydrocarbon exploration licences are restricted to a small area in the north east Rockall Basin. A single gas discovery (named 'Benbecula') was made by well 154/1-1, drilled in 2000, but this has yet to be fully appraised. Much of the evidence that hydrocarbons may exist in the SEA 7 area is circumstantial although this may change as exploration progresses. Table A3b.1 provides details of prospective regions.

Table A3b.1 – Prospective regions in the SEA 7 area

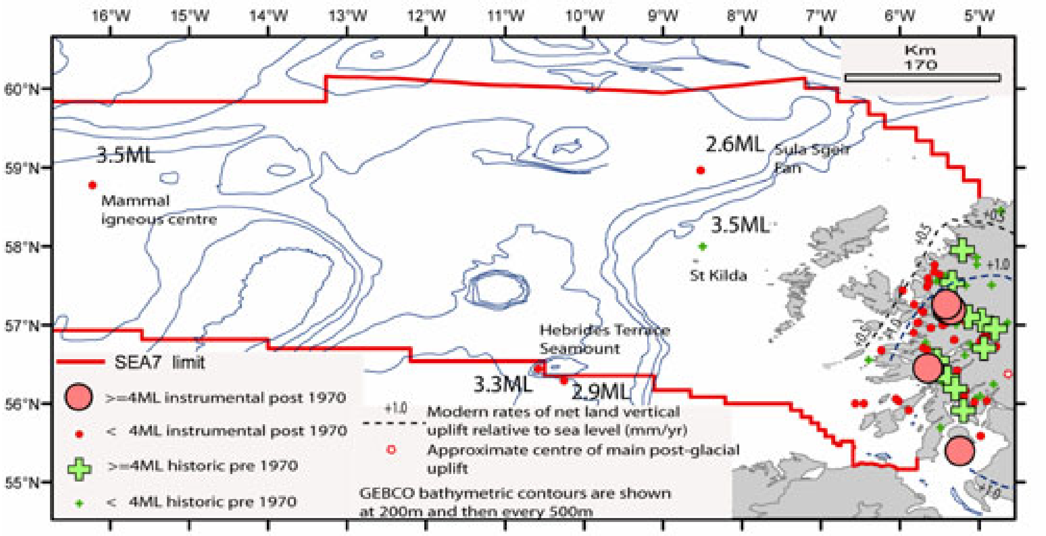
Region	Prospectivity	Exploration activity
Malin Sea, North Channel	Carboniferous rocks deeply buried beneath Permo-Triassic rocks.	One former licence area was awarded in the North Channel but abandoned without drilling.
The Minch, Sea of Hebrides	Potential reservoir targets include Permo-Triassic sandstones. Presence of source rocks problematic because they are unproven (Carboniferous) or are thought to lack potential for maturity (Jurassic).	Three wells drilled but no licences retained.
Rockall Basin & Bank	Most prospective area within SEA 7. Hydrocarbon plays in the southern Rockall Basin are under the upper-to-lower modern slope fronts. Prone to geohazards from submarine landslides.	Irish Dooish gas condensate discovery and the Benbecula gas discoveries prove a working petroleum system in the south Rockall Basin.

Region	Prospectivity	Exploration activity
Hatton Basin	Potential source rocks include Carboniferous, Jurassic and Cretaceous but their presence below the volcanic layer of the Hatton Basin is speculative.	Single occurrence of a natural oil slick in the northern part of the Hatton Basin reported by Hitchen (2004).

Earthquakes

Most earthquakes are recorded on the western margin of the British Isles facing the direction of crustal spreading on the Mid-Atlantic Ridge and where the rates of post-glacial mainland and coastal uplift have outstripped the rates of modern sea-level rise (Figure A3b.1).

Figure A3b.1 – Earthquakes in the SEA 7 area



Source: Holmes et al. (2006).

Earthquakes with Richter local magnitudes of 4.0ML (Richter local magnitude) or more are taken into account during structural design for developments tied to the seabed. Five earthquakes of this magnitude have been recorded in the nearshore since 1970 with none recorded on the outer Hebrides Shelf or in the areas further to the west.

In nearshore areas, earthquakes with Richter local magnitudes <4ML have averaged 2-3 events per year since 1970. The ground accelerations from these pose a risk of triggering small-scale seabed bedrock and unconsolidated sediment instability in the Scottish fjords.

None of the earthquake events that have been recorded in the Rockall Basin, Hatton Basin and associated slopes have been of sufficient magnitude to endanger man-made structures. There is no data to unequivocally link the initiation of the very large submarine landslides in the region to ground accelerations from earthquakes.

Seabed processes, substrates and features

The morphology and distribution of surficial sediments in the region has resulted largely from the interplay of glacial processes (e.g. iceberg rafting, debris flows), and palaeo- and modern-day physical processes including bottom currents and gravity-driven slope processes. The relative importance of these processes has varied both temporally and spatially.

Glacial processes

Widespread expansion of ice sheets across the Scottish shelf in the mid- to late Pleistocene interval resulted in widespread erosion of the shelves as the ice sheets extended to the shelf edge. At their maximum extent, the ice sheets delivered sediment directly to the continental slopes resulting in considerable shelf margin progradation (Stoker 1995). The flux of glaciogenic sediments was highest along the Rockall margin close to the Hebrides Terrace Seamount. Slope processes in this region were dominated by glaciomarine sedimentation with the deposition of debris flows and megaturbidite sequences (O'Reilly *et al.* 2001). Fields of seabed and buried submarine moraines on the middle to outer shelf mark the limits of the former ice sheets. Other glacigenic features include drumlins, enclosed deeps and iceberg scour as well as the fjordic coastline of the mainland. Stoker *et al.* (2006) described the submerged fjordic landscape of the Summer Isles in north west Scotland which included over-deepened rock basins, bedrock grooves, moraines, pockmarks, and slide scars.

Modern seabed processes and features

Shelf region

Since the beginning of the modern interglacial, glacigenic sediments have been reworked and winnowed by submarine processes to produce the bulk of the modern seabed sediments. The most significant modern new sedimentary input into continental shelf sediments is from marine biogenic carbonate.

In areas winnowed by strong submarine near-bed currents, the relict coarse biogenic and non-biogenic sediments form a seabed armour that more or less protects against further seabed erosion and provides a relatively stable substrate for living benthic fauna. The proportion of biogenic carbonate in seabed sediments on the Hebrides Shelf is usually highest in the coarser seabed sediments (e.g. sandy gravels, gravelly sand and gravels).

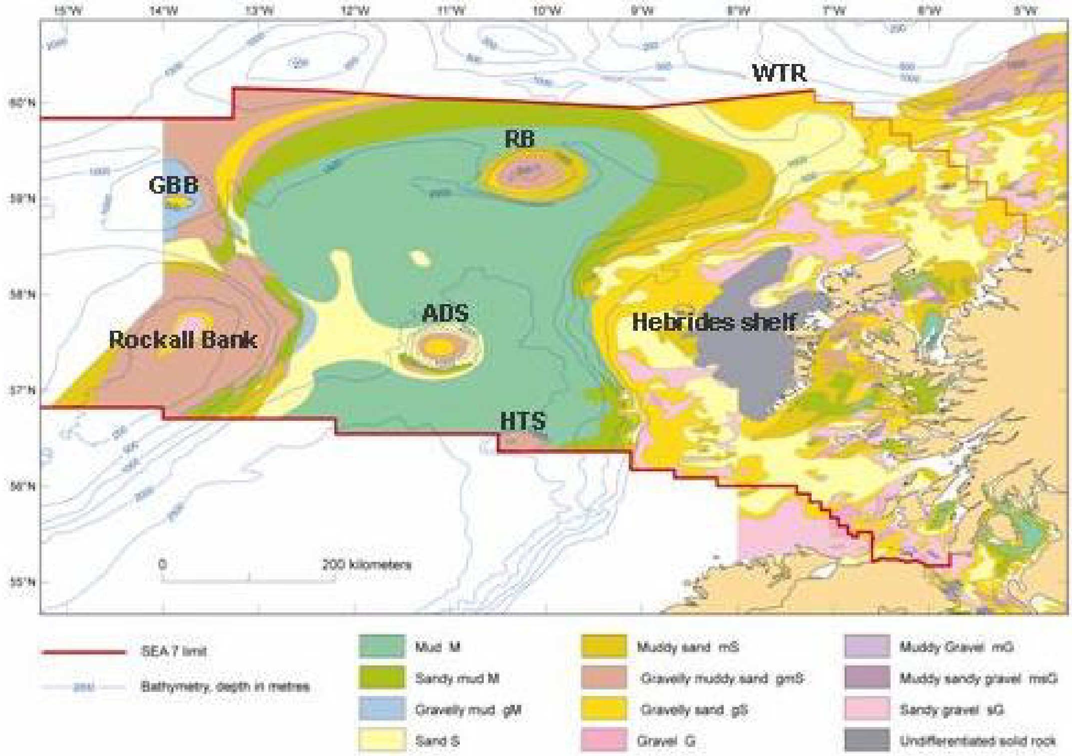
In tidal-dominated areas on the inner Hebrides Shelf, the distribution patterns of seabed gravels, sandy gravel, gravelly sands and percentage carbonate are locally positively correlated with stress put on the seabed by the acceleration of peak mean spring tidal streams in constricted passages around headlands and between islands, not primarily with water depth (Figure A3b.2). Large areas of seabed bedrock, cobbles and boulders occur in very highly stressed seabed environments with relatively shallow water and long wave fetches west of the Flannan Isles, Sula Sgeir and west of the Outer Hebrides. Exceptional sediment transport and depositional patterns can occur during storms and times of the lowest and highest astronomical tides.

Long-term sediment bedload transport on the outer shelf and upper slope is mainly driven by the north-directed European Slope Current. Stress from this current can mobilise large volumes of sediment along–slope. Maximum sustained velocities in the current range from 0.14 to 0.5ms^{-1} and vary with seasons, weather changes within seasons and location (SAMS 2006). There is also a strong rectilinear residual current that runs towards the south along the shelf edge of the eastern Rockall Bank. Hydrographic and bedform data point to the pollution potential from discharged fine-grained sediment particles carried along-slope and along-shelf to the wider seabed by the residual currents.

Deep water region

The DTI funded a survey in 2005 to map selected areas of the major offshore banks and shoals west of the northern United Kingdom with a view to investigating their geomorphology and sedimentary processes. Details of the survey's findings are described in Jacobs (2006) and summarised below.

Figure A3b.2 – Seabed sediments in the SEA 7 area



Notes: ADS - Anton Dohrn Seamount; GBB - George Bligh Bank; HTS - Hebrides Terrace Seamount; RB - Rosemary Bank; WTR – Wyville Thomson Ridge.
Source: Adapted from Holmes et al. (2006).

In the north east Rockall Trough, modern submarine landslides occur on the Barra and Donegal Fans. These features map to relatively steep slope angles and are separated by the Hebrides Terrace Seamount, a former igneous centre. The seamount is an elliptical feature approximately 40km by 27km. It rises from the foot of the continental slope between 1,650-2,000m, rising to a minimum depth of around 1,000m. South of 57º15'N the Hebrides continental slope falls away at 5-10º and the slope is extensively gullied. North of the gullied region, the slope is smooth though there is also a distinct notch paralleling the slope, similar to that seen on the East Rockall margin, at 1,000-1,100m water depth.

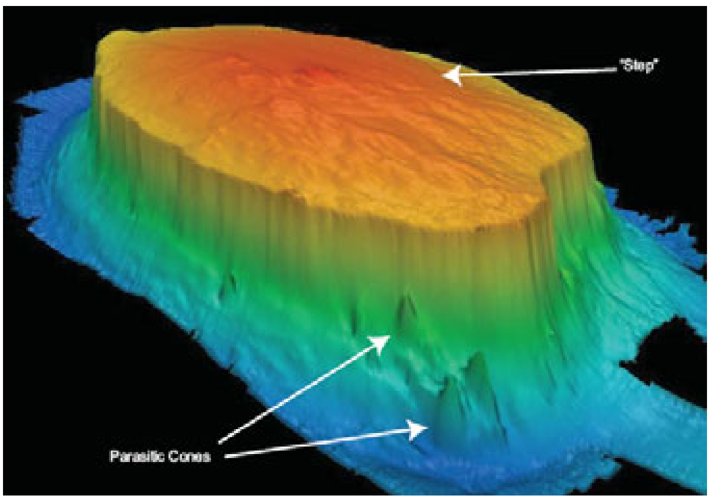
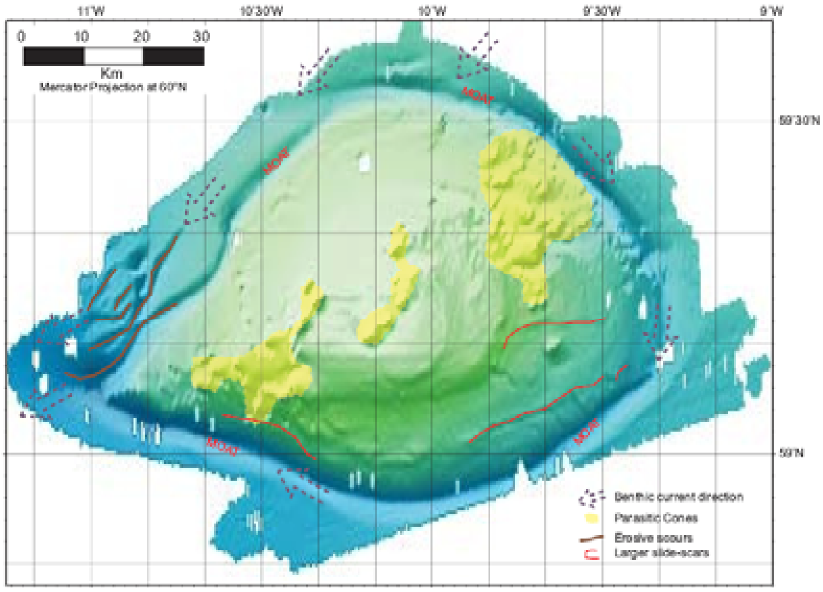


Figure A3b.3 - 3D perspective of Anton Dohrn Seamount

Source: Jacobs (2006).

The Anton Dohrn Seamount is a steep-sided domed seamount standing alone in the centre of the Rockall Trough (Figure A3b.3). It has a diameter of around 45km and a vertical relief of between 1,500 and 1,600m. Sheer walls are over 1,200m in height, and the summit dome shoals to ~550m at its centre. Figure A3b.3 highlights a series of parasitic cones to the north west and “steps” on the southern part of the summit. There is evidence of opposing current flow on the summit (northward to the west and southward to the east) which is a high energy environment with coarse sands, gravel and broken shell common. The summit displays evidence of intensive trawling activity.

Figure A3b.4 – Schematic overview of Rosemary Bank



Notes: Compiled from the EM120 RRS James Clark Ross and SV Kommandor Jack surveys.
Source: Jacobs (2006).

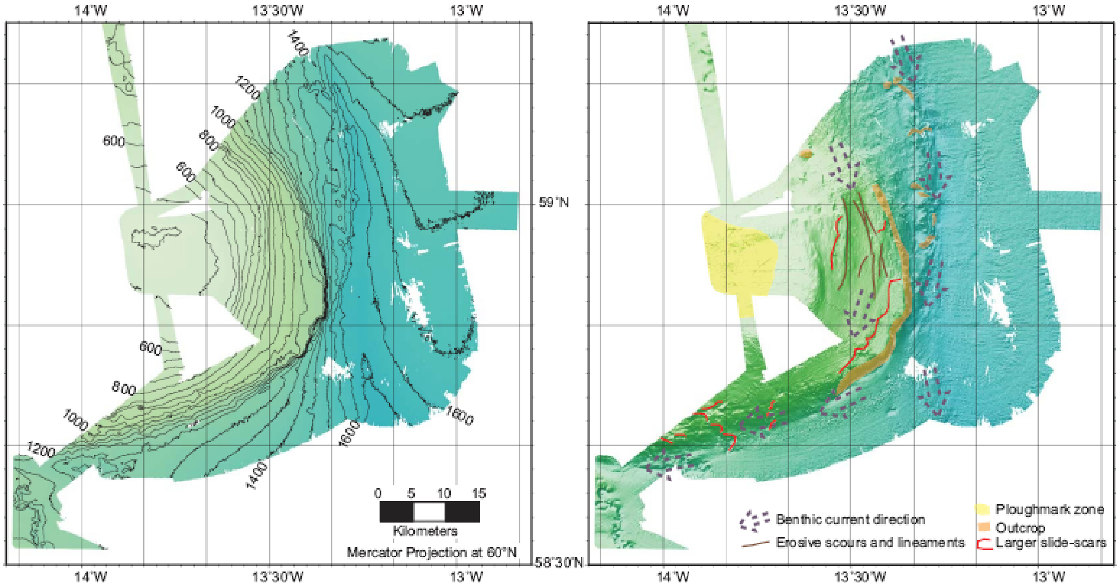
Rosemary Bank to the north is an ancient volcanic construction over 75km in diameter and 1,500m in height, ornamented with a series of grouped parasitic cones and a summit area covered by sediment (Figure A3b.4). The Bank exhibits a well developed moat below steep walls, and on the northern side of the moat are scours showing the effect of the strong benthic current regime (Howe *et al.* 2006).

The enhanced currents around seamounts provide ideal conditions for a range of benthic suspension feeders such as corals, sponges and hydroids, as well as concentrations of commercially important fish species (Gubbay 2002). The recent DTI survey revealed a diverse benthic community on the region’s seamounts that had not previously been recorded (Narayanaswamy *et al.* 2006, Davies *et al*. 2006). Seamounts have been included on the initial list of OSPAR threatened and/or declining habitats and species.

The Darwin Mounds which were recently put forward as the UK’s first offshore Special Area of Conservation under the EC Habitats Directive occur in the northern part of the NE Rockall Basin, in a small area south of the Wyville Thomson Ridge. They were discovered in 1998 during the AFEN and later 1999 DTI surveys and there are in excess of 225 mounds with each mound approximately 50-100m in diameter and up to 5m high. The mounds are found in water depths of 900-1,060m, north of a large area of pockmarks and appear to be closely related to these fluid escape features (Masson *et al.* 2003). The centre of the mound appears to be blocky rubble, with the cold-water coral *Lophelia pertusa* usually present (Bett 2001, Masson *et al.* 2003). The origin of these mounds is currently unclear, but hypotheses range from localised current regime to fluid or gas escape, either at present or sometime in the past (Masson *et al.* 2003).

To the south west, the George Bligh Bank has corals on its northern flank mounds and the summit has iceberg ploughmarks above 500m. The gravelly-sand mounds to the north of George Bligh Bank show indications of trawl damage to the colonising reef communities. On the eastern flank, small step-faults have been imaged by remote sensing and ground-truthing reveals coarse sands, gravels, boulders and outcrop. Around the southern margin of the Bank, erosive scars indicate high current flow into the Rockall-Hatton Basin (Figure A3b.5).

Figure A3b.5 - Schematic overview of George Bligh Bank



Note: Derived from the 2005 SV Kommandor Jack survey.
Source: Jacobs (2006).

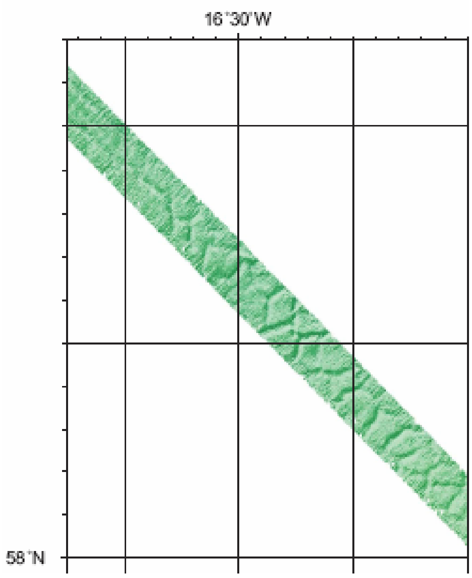


Figure A3b.6 - Polygonal faults in the Rockall-Hatton Basin.

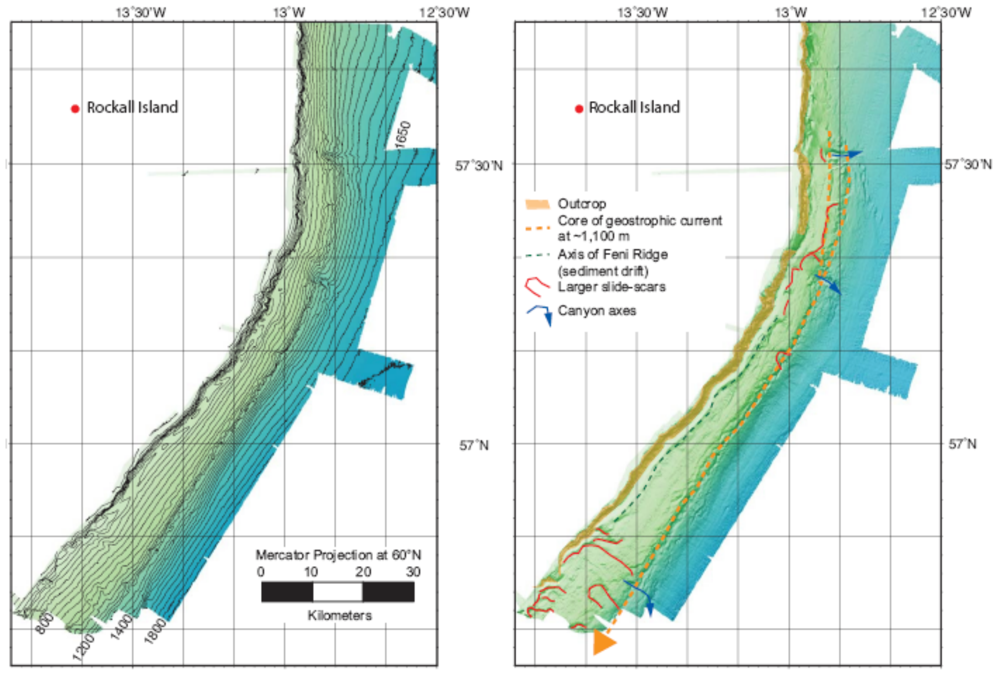
Source: Jacobs (2006).

A single transit across the Rockall-Hatton Basin as part of the DTI 2005 survey revealed a series of lineated seafloor depressions on the seabed of up to 5m in depth, surrounding individual seabed 'plates' which were typically around 3km across. These polygonal faults have been mapped extensively in various marine geological settings, but only with seismic profiling, as sub-bottom features. In other areas polygonal faults are know to be pathways for fluid escape, therefore these features may potentially be sites of unique faunal assemblages.

To the east of the Rockall-Hatton Basin, surficial sediments on the Rockall Bank are extremely variable and are usually coarse-grained sediments such as sands and gravels (often biogenic), with a continuum of sizes ranging up to boulders. Iceberg plough-marks are common on the flanks and rock outcrop and drop-stones form ideal substratum for encrusting faunas that include coral and sponges, though trawling and current activity may disturb colonisation.

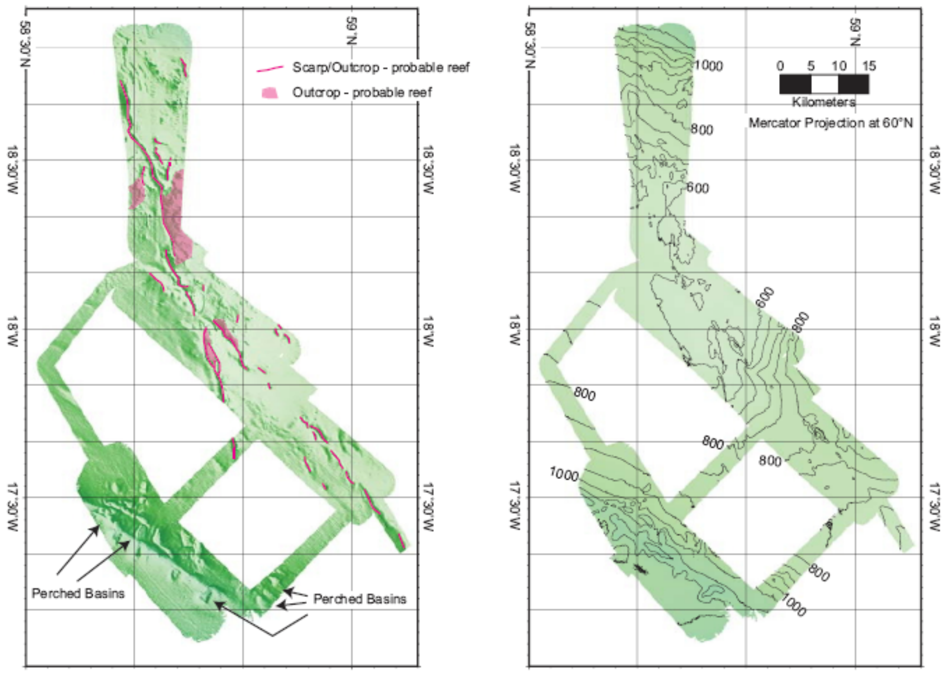
The eastern margin of Rockall Bank has a steep upper slope beneath a shelf break which is mostly at about 350m. This steep upper slope is an area of bedrock outcrop and also heavily incised into numerous small bights (Figure A3b.7). Should hydrocarbon activity take place in this area, detailed environmental, oceanographic, and geotechnical studies will be required. All along the mid-lower slope is evidence of landsliding, and although much of it is old and the deposits are now eroded, the instability along the margin should be noted and investigated in detail prior to any substantial structures being anchored. The growth of the Feni Ridge and the presence of a 'notch' at 1,100m indicate significant geostrophic current activity at depth along the east Rockall Bank margin. Furthermore, the surface of the Feni Ridge, especially near its crest shows evidence of instability and erosion.

Figure A3b.7 – Schematic overview of the eastern Rockall Bank



Source: Jacobs (2006).

Figure A3b.8 - Schematic overview of the central Hatton Bank region



Note: Derived from the 2005 SV Kommandor Jack surveys
Source: Jacobs (2006).

On the western side of the Rockall-Hatton Basin, elongate ridges and troughs are found over the central Hatton Bank and the mounds that extend to the west are host to diverse reef communities. The origin of the ridges and mounds are unclear, as is their relationship to each other and the deeper geological structural features of Hatton Bank. Strong current activity is a key component of where the central Hatton Bank reef communities are found (Figure A3b.8), with clean, often rippled sands at the top of the colonised scarp slopes and washed gravel lag deposits at their bases. The west Hatton Bank margin is likely to host interesting fauna displaying as it does steep irregular topography indicative of bedrock outcrop and volcanic constructions, and contour patterns suggestive of geostrophic current activity. The rest of the margin to the southwest is dominated by the complex topography of the volcanic ridge of the Endymion Spur.

Contamination

Contamination of the marine environment is associated principally with industrial development, with major sources comprising terrestrial emissions and discharges (transported to the marine environment via rivers and atmospheric transport); shipping; military activities, and offshore industries including oil and gas production (OSPAR 2000b). Direct (sewage and industrial) and riverine inputs to the SEA 7 coastal region are described in Table A3b.2.

Table A3b.2 – Direct and riverine inputs to the SEA 7 area in 2004

	Cadmium *(t)*	**Mercury** *(t)*	**Copper** *(t)*	**Lead** *(t)*	**Zinc** *(t)*	**g-HCH**[1] *(kg)*	**PCB**[2] *(kg)*
Sewage effluents	0.02-0.07	0-0.02	5.7-5.9	0.6-0.7	21.4-21.5	11.7-13.2	0
Industrial effluents	0-0.01	0	0.33-0.34	0.11-0.18	2.54	0.02-0,03	0
Riverine inputs	0.36-1.43	0.09-0.43	79.94-80.88	26.09-27.66	137.11-143.11	3.94-24.17	0-6.76
Total	**0.38-1.5**	**0.09-0.5**	**86-87**	**27-29**	**161-167**	**15.7-37**	**0-6.8**

Notes:
1. *Gamma-HCH (lindane)*
2. *PCBs (congeners: IUPAC Nos 28, 52, 101, 118, 153, 138, 180)*

Source: OSPAR (2006d).

In general, direct and riverine inputs to the SEA 7 area are lower than to other sea areas around the UK. From Table A3b.2 it is clear that riverine inputs dominate the input of contaminants to the SEA 7 coastal area with riverine inputs higher than usual in 2004 due to higher than average rainfall.

Hazardous substances – metals and organic pollutants

In general, the SEA 7 region is relatively pristine with little or no contamination of water and sediments. Metal concentrations in sediment samples taken from the Rockall Trough and to the north and west of Scotland (as part of AFEN and DTI surveys) give some indication of the concentrations that may be present in the SEA 7 area (Table A3b.3). Given that much of the SEA 7 area is very remote from industry/population centres and there are few offshore activities in the region, sediment metal concentrations are likely to be close to OSPAR Background Concentrations.

Table A3b.3 - Metal concentrations (mgkg^{-1} dry weight) from the Rockall Trough and north and west of Scotland

Metal	Rockall Trough[1]	North and west of Scotland[2]			OSPAR BC's[3]
		AFEN 1996	AFEN 1998	DTI 2002	
Mercury	0.025–0.353	-	-	-	0.05
Lead	3.43–16.2	2-39.3	3-14	3-20	25
Cadmium	0.027–2.57	-	-	-	0.2
Chromium	15.1–54.2	11-71	21-86	10-35	60
Copper	5.89–42.7	4-35.5	5-37	2-39	20
Nickel	8.83–38.9	9-45	11-41	5-34	30
Zinc	18.0–149	11-88	22-68	15-76	90
Barium	115–543	84-546	188-824	208-349	

Notes:

1. *Sediment samples collected during BGS gravity core survey of the Rockall Trough in 1998 for the Rockall Studies Group were analysed by the Marine Institute (Tyrrell 2001).*
2. *AFEN 1996 & 1998 surveys covered the Atlantic Frontier region. DTI 2002 survey covered the DTI SEA 4 area to the north and west of Shetland and Orkney.*
3. *OSPAR Background Concentrations represent the concentrations of those substances at "remote" sites, or in "pristine" conditions based on contemporary or historical data respectively, in the absence of significant mineralisation and/or oceanographic influences. All values with the exception of the OSPAR concentrations represent measured rather than normalised values. OSPAR values normalised to 5% aluminium.*

Sources: Tyrrell 2001, DTI 2003, OSPAR 2005-6.

Similarly, sea water metal concentrations for oceanic and shelf areas of SEA 7 are likely to be comparable to background reference concentrations, indicating that widespread contamination is not a general problem (OSPAR 2000b).

Contamination of sediments and sea water is likely to be restricted to areas close to industrial and population centres such as the Firth of Clyde. The influence of contamination in this area (and in the Irish Sea) does not appear to extend significantly northwards. Fine muddy sediments in sheltered sea lochs and deeps may act as potential sinks for metals although these are likely to be of natural rather than anthropogenic origin. Metal concentrations in samples of mussels and flatfish from the west coast of Scotland are considered normal and below background reference concentrations (MEMG 2005).

Relatively high concentrations of trace metals have been found in the livers of some deep water fish species from the Rockall Trough. For example, cadmium and zinc concentrations in the livers of black scabbard fish exceeded EU limits for human consumption (Mormede & Davies 2001a). Gordon *et al.* (1995) suggested that as continental slope fish tend to live longer and to feed at higher trophic levels than their shelf counterparts, the potential for the accumulation of trace metals may be greater. Cephalopods are also known to accumulate high levels of certain contaminants, notably cadmium and mercury (Bustamante *et al.* 1998).

Tributyltin (TBT) is a widespread contaminant of coastal waters and sediments as a result of its use as an antifouling agent on marine structures, nets and vessel hulls. It can be very persistent in the environment and demonstrates high toxicity to marine organisms, notably endocrine disruption in gastropod molluscs. In general, TBT concentrations in waters and sediments of SEA 7 are very low (or not detectable) with the scale of imposex effects on gastropods unlikely to adversely affect reproduction (MEMG 2005).

Some organic compounds, particularly those containing chlorine, combine persistence with a tendency to bioaccumulate and toxicity. In 1995/96 an extensive survey of polychlorinated biphenyls (PCBs) in the sediments of sea lochs and coastal areas to the west of Scotland found that the highest concentrations for the sum of twenty CB congeners (30–100μgkg^{-1} dry weight, unnormalised) occurred in the Firth of Clyde and its sea lochs, whereas offshore sediments generally had concentrations <3μgkg^{-1} dw (OSPAR 2000a). Higher levels of CBs and organochlorine pesticides were found in deep water monkfish than those caught over shelf areas around Scotland, although they were lower than those from industrialised areas such as the Firth of Clyde (Mormede & Davies 2001b).

Further offshore, the shelf and deep water areas are regarded as pristine and few measurements of hazardous substances have been made, except in response to particular incidents such as strandings of marine mammals. Some of those stranded on the Hebrides have been autopsied and samples of blubber and liver have been analysed as part of the UK Marine Mammals Stranding Project. Where the data are numerous enough to reveal a general picture they suggest a reduction in lead concentrations over the last 20 years and PCB concentrations in porpoises are generally lower than those found elsewhere e.g. in the Irish Sea (MEMG 2005).

Monitoring of hazardous substances throughout the OSPAR area indicates that the majority of hazardous substances have reduced over time (OSPAR 2006e). High (but in general reducing) concentrations of contaminants were generally found near known point-sources such as industry, harbours or river outflows although no such areas were identified within the SEA 7 region. However, further monitoring is necessary to develop a more comprehensive picture of the SEA 7 area (OSPAR 2006e).

Hydrocarbons

As a consequence of past riverine, atmospheric and vessel related discharges, hydrocarbon contamination of sediments is greatest in nearshore and estuarine environments. Contamination of sediments in the wider marine environment is mostly thought to result from atmospheric inputs originating on land, from shipping and from discharges from the offshore oil and gas industry.

The SEA 7 area lies within the European Waters Special Area established by the IMO (International Maritime Organisation) in 1999. This means there should be no discharge of oil or oil/water mixtures from any ship whilst it is in the area. This does not prevent occasional illegal discharges being made but within the region there have been very few oil slicks attributed to vessels. There is no oil production and few exploration wells have been drilled in the area (MEMG 2005). Given the dispersive environment and the low amount of exploration and appraisal drilling that has taken place, sediment and sea water hydrocarbon concentrations are expected to be within background ranges.

In general, the two main contributors of Polycyclic Aromatic Hydrocarbons (PAH) to the environment are fossil fuels, mainly crude oil, and the incomplete combustion of organic materials such as wood, coal and oil. As a consequence of their hydrophobic nature, PAH in marine environments associate rapidly with particulates, and therefore sediments represent the most important reservoir. Total 2-6 ring PAHs recorded in sediments in the AFEN 1996 and 1998 surveys were in the range 15-238ngg^{-1} (dry weight sediment), which are broadly typical of uncontaminated sediments. Concentrations from the DTI 2002 survey were comparable, in the range 5-519ngg^{-1} (DTI 2003a). OSPAR Background Concentrations for a number of PAHs in North Sea sediments range from 4-458ngg^{-1} (OSPAR 2005-6). PAH concentrations in sediment samples from sea lochs in north west Scotland, although clearly not of petrogenic origin, were considered to be rather high (MEMG 2005).

Radioactivity

Sellafield to the south of the SEA 7 area is the largest single source of artificial radionuclides to the UK marine environment. As a result of the northerly outflow of sea water through the North Channel, Sellafield-derived radionuclides are readily detectable in the Scottish Coastal Current (SCC). The highest concentrations of caesium-137 occurred in the North Channel/Clyde Sea area in the mid to late 1970s, but these had decreased by about two orders of magnitude by the mid-1990s. Several studies have shown a tongue of water, rich in caesium-137, extending to the west of the Outer Hebrides. Increased discharges of technetium-99, due to the commissioning of the Enhanced Actinide Removal Plant (EARP) in 1994, led to a five-fold increase in technetium-99 in the surface waters of the SCC within about eight months. It is expected that concentrations of plutonium in the SCC, which have been consistently higher than fallout levels, will continue to decrease (OSPAR 2000a).

The estimated radiation dose rates to organisms in the north eastern Irish Sea, and over the SEA 7 shelf, are unlikely to produce adverse effects at the population level (OSPAR 2000a).

Appendix 3c - Landscape/Seascape

Designated landscapes in SEA 7

National Scenic Areas

National Scenic Areas (NSAs) are Scotland's only national landscape designation. They are areas of land considered to be of national significance on the basis of their outstanding scenic interest which must be conserved as part of the country's natural heritage. They were introduced in 1980 by the Countryside Commission for Scotland to replace earlier categories of importance for scenic areas. A diverse array of features contribute towards these designations, including prominent landforms, coastline, sea and freshwater lochs, rivers, woodland and moorland.

Plans are also underway to establish the UK's first Coastal and Marine National Park (CMNP) in Scotland by 2008; with a number of possible sites lying within the boundaries of SEA 7 i.e. Argyll Coast and Islands, Lochaber and Skye, the Northwest Highland Coast and the Western Isles (SNH website - http://www.snh.org.uk).

Areas of Outstanding Natural Beauty

Within Northern Ireland large areas of landscape of distinctive character and special scenic value have been designated Areas of Outstanding Natural Beauty (AONB). This designation is designed to protect and enhance the qualities of each area and to promote their enjoyment by the public.

NSAs and AONBs of relevance to the SEA 7 area are described in Table A3c.1.

Table A3c.1 – Designated landscapes in the SEA 7 area

Designated landscape	Area (ha)	Description
Scotland		
South Lewis, Harris and North Uist NSA	10,9600	The coast of South Lewis is rocky and indented with wide sandy beaches between rocky headlands. Harris has the highest peaks in the Outer Hebrides, and a variety of coastal landscapes including deep sea lochs and sandy beaches between headlands with numerous stacks. The wide, sandy beaches of North Uist are separated from Harris by an island-studded sound.
South Uist Machair NSA	6,100	It is an extremely flat area of machair dune formations with diverse vegetation, interspersed with shallow lime-rich lochans. This area is also the most extensive cultivated machair system in Scotland, extending the whole length of the island and up to 2km inland.
St Kilda NSA	900	St Kilda NSA is the most remote part of the British Isles, located 66km west of the Outer Hebrides in the west of Scotland. It comprises the entire archipelago of islands and stacks, including Hirta, Soay, Boreray and Dun. These volcanic islands have been weathered into a dramatic landscape of towering black cliffs and stacks alongside steep grassed slopes. Below the sea surface lies an extensive network of submarine caves.
Assynt–Coigach NSA	90,200	Assynt–Coigach NSA is located in the north west of Scotland, north of Ullapool. Inland, there are spectacularly shaped steep hills, rising from moorland and lochs. The coastline presents a diverse landscape of inlets, sandy bays, rivers, lochs and native woodland.

Designated landscape	Area (ha)	Description
Northwest Sutherland NSA	20,500	Northwest Sutherland NSA includes the north west coast of Scotland. It is characterised by a bare, rugged and occasionally mountainous landscape, attributable to the Lewisian gneiss geology – one of the oldest known formations in the world. The Clo Mor cliffs near Cape Wrath in the north are the highest on the Scottish mainland.
Kintail NSA	15,500	Kintail NSA is located on the west coast of mainland Scotland. Three long mountain ranges terminate in this area, and it is home to one of Britain's highest waterfalls, the Falls of Glomach. The coastline is dominated by mountains dropping sharply into sea lochs.
Knoydart NSA	39,500	Knoydart NSA is a remote peninsula on the west coast of Scotland, only accessible by boat or a 26km walk across mountains and moorland. It includes four Munros and several lesser peaks, separated by broad glens, rivers and high lochs.
Morar, Moidart and Ardnamurchan NSA	13,500	This is essentially a coastal area on the west coast of Scotland, extending from the south shore of the Morar Peninsula to include the Sound of Arisaig, Loch Moidart, Kentra Bay and the northern shore of Ardnamurchan. There are numerous unspoilt sandy beaches with mountainous backdrops, the deepest lake in Britain at Loch Morar, and the most western point on mainland Britain at Ardnamurchan Point.
The Small Isles NSA	15,500	The Small Isles NSA is a small archipelago in the inner Hebrides, off the west coast of Scotland. The four main islands include Rùm, Eigg, Muck and Canna, while several other small islands and skerries are also present. Rùm is now an important study site for research into the ecology of red deer, while Canna is well known for its populations of puffins and Manx shearwaters.
Trotternish NSA	5,000	Trotternish NSA is located in the north east of the Isle of Skye, on the west coast of Scotland. This peninsula comprises steep mountains with rocky pinnacles inland, with peat moorland and crofting settlements at lower altitudes. The coastline possesses cliffs of varying height with occasional waterfalls dropping sheer into the sea. There are spectacular views across the island of Raasay to the mountainous Scottish mainland.
Wester Ross NSA	145,300	Wester Ross NSA is located in the northwest of Scotland. It is the largest of all the NSAs, and comprises a diverse range of landscapes including the Applecross Forest, Ben Damph Forest, Torridon Mountains and Loch Maree. It has some of the most remote and wild land in the UK. Along the coast, Gruinard Bay, Loch Ewe and Loch Gairloch present a mixture of beaches, islands, headlands, inlets, woodlands and crofting settlements.
Jura NSA	21,800	Jura is an island in the Inner Hebrides, adjacent and to the north east of Islay, on the west coast of Scotland. It is dominated by three steep-sided conical mountains (the Paps of Jura), which rise to 762m above sea level. Jura also has a large population of red deer.
Knapdale NSA	19,800	Knapdale NSA is situated on the west coast of Scotland. Its landscape is dominated by the dense Knapdale Forest, covering many hills and providing scenic views across the Western Isles.
Loch na Keal, Isle of Mull NSA	12,700	Loch na Keal NSA comprises the sea lochs of Loch na Keal and Loch Tuath, and the several small islands amongst them. A variety of landscapes exist, including island-studded seascape, various cliff forms, hills and woodland.

Designated landscape	Area (ha)	Description
Lynn of Lorn NSA	4,800	Lynn of Lorn NSA is on the west coast of Scotland, and includes the island of Lismore and its surrounding islets and skerries. It presents an island-studded waterway dominated by parallel limestone ridges both on land and partially submerged. These ridges support rich vegetation, varying from green, lush meadows to dense oaks and conifers.
Scarba, Lunga and the Garvellachs NSA	1,900	This NSA is located to the north of the island of Jura on the west coast if Scotland. It includes the islands of Scarba, Lunga, the four Garvellach islands and many smaller islands and skerries. Scarba rises sharply from the sea to a pyramid peak of 449m in height, while the Garvellachs are smaller and lower in elevation, but sharply angular with vertical cliffs to the north west. The landscape is visually enhanced by the strong tidal currents which cause water to race amongst the islands.
Northern Ireland		
Causeway Coast AONB	4,200	The AONB encompasses 18 miles of spectacular coastal scenery of dramatic cliffs and headlands broken by the wide sweep of fresh sandy beaches backed by dunes. Dark volcanic rocks and brilliant white chalk, eroded by the vigorous North Atlantic, form magnificent geological features including the renowned Giant's Causeway and Carrick-a-Rede. This natural beauty is made all the more impressive by the small harbours, fisheries and farms found along the coast. A rich and varied wildlife thrives on the offshore islands and rocks, amid the cliffs, sand dunes and hinterland.
Antrim Coast and Glens AONB	70,600	The coastline of County Antrim from Ballycastle to Larne and the world famous Glens of Antrim contain some of the most beautiful and varied scenery in Northern Ireland. The area is dominated by a high undulating plateau cut by deep glens which open north and eastwards to the sea. It is an area of contrasts: gentle bays are separated by blunt headlands; exposed moorland gives way to sheltered valleys; wide open expanses to enclosed farmland. Rathlin Island, lying offshore to the north, is rich in historical, geological and botanical interest.

Source: AICSM (2006).

Seascape

Scottish Natural Heritage commissioned the University of Newcastle to assess the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms (Scott *et al.* 2005). A development scenario of 100 turbines (each 150m tall) located 8km from shore in a 10x10 grid was used to assess the sensitivity of the various seascape units (Scott *et al.* 2005). Whilst this scenario is very different to any potential oil and gas developments in the area, the assessment provides useful information on the key characteristics and sensitivity of each seascape unit (Table A3c.2). Further details of seascape units including maps can be found in Scott *et al.* (2005).

Table A3c.2 – Key characteristics and sensitivity of seascape units in SEA 7

	Summary information
Cape Wrath-Loch Torridon	
Key characteristics	• Diverse and dramatic predominantly rocky coastline. • High cliffs, exposed rocky headlands, small inlets and bays, offshore islands. Larger inlets/sea lochs – Loch Broom, Little Loch Broom, Loch Ewe.

	Summary information
	• Sparse traditional settlements concentrating in sheltered inlets. • Hinterland comprises rough moorland and mountains many of which provide distinctive focal points. • Exposed, remote and highly natural area with strong wildland and scenic qualities. • Geology very apparent.
Sensitivity	High. Development would conflict with the key characteristics of this type which are complexity of landform and pattern, high naturalness and remoteness qualities.
Inner Sound/Sound of Raasay	
Key characteristics	• An area of two sounds divided by the Island of Raasay and bordered by the east coast of Skye and the west coast of the mainland. • Coastline mainly rocky rising steeply from the sea in some parts of Skye and Raasay. • Coastline fragmented and indented in places with islands forming focal points. • Long sea Lochs Kishorn, Torridon, Carron and Loch Alsh.
Sensitivity	High. This is also a highly natural area with qualities of remoteness in places – development would not relate in form or character and would detract from distinctive natural forms like those on Trotternish Peninsula.
North East Lewis	
Key characteristics	• Low rocky coastline, cliffs and fragmented coastline in places backed by moorland. • Sparsely settled. Small crofting settlements along coastline. Large settlement at Stornoway with some industrial development, airport and busy port. • Views of the Minch and beyond views of distant hills on mainland particularly distinctive Assynt. • Parts of this landscape feel remote except Stornoway area.
Sensitivity	Medium–High. Turbines would relate to the linear coastline and simpler hinterland to the north but conflict with qualities of remoteness and naturalness. Further south a windfarm would conflict with more complex landform although the port and industry at Stornoway provides an area of developed nature where turbines could relate. Elsewhere settlement is small scale and traditional and development would not relate to this character.
Butt of Lewis-Carloway	
Key characteristics	• Low rocky coastline rising to cliffs in places. • Backed by moorland behind coastal fringe of crofting settlements. • Linear coastline with open views of Atlantic, occasionally limited by undulating landform. • Exposed.
Sensitivity	Medium. Turbines could relate to the large scale, open seascapes and simple linear forms and patterns but the industrial nature and scale would conflict with the small scale settlement and crofting character and would cause a major focal point for a large stretch of sea where none other exists. It would also detract from the dominating experience of a wild and exposed coastline causing a substantial change of character.
The Little Minch	
Key characteristics	• Heavily indented and rocky fragmented coastline of eastern Harris and the Uists with distinctive 'Knock and Lochan' hinterland; contained sounds and narrows also present on this western coast eg Loch Seaforth and Sound of Harris. • Indented coastline of western Skye contains long, narrow sealochs. • Settlement small scale with traditional crofting. • Hinterland largely moorland with large areas of remote undeveloped land. • Views of Harris mountains and the mountainous ridge of the Trotternish peninsula on Skye focal points. • Important ferry routes from Uig (Skye) to Tarbert (Harris) and Lochmaddy (North Uist).

	Summary information
Sensitivity	High. Although this unit contains coastal and hinterland forms of different character and scale the overall complexity and naturalness of seascape form and pattern is distinctive and would be highly sensitive to the development scenario considered. The area is intervisible with important views back and forth from the Western Isles to Skye and a windfarm would create a focus of a very different character.
Carloway-Griminish Point	
Key characteristics	• Contained views occur in the south from within a more fragmented coastline and mountainous hinterland. • High mountainous areas in Harris, steeply rising from the sea in places. • Many uninhabited islands in the Sound of Harris provide focal points. • On Harris some visual containment is provided by mountainous hinterland and rocky headlands creating a series of small to medium scale seascapes. Views are directed seaward due to landform limiting views inland. • In the sounds islands create containment and frame areas of sea creating small to medium scale seascapes.
Sensitivity:	High. This unit is generally small scale with complex form and patterns creating dynamic views. Turbines may dominate horizon within confined seascapes and the linear form and regimented pattern would not relate to the highly natural and complex pattern and form of the area. The introduction of built development of such a scale would impact on the high degree of naturalness of the area and conflict with the scale and character of settlements. Turbines would also be a competitive focus to offshore islands and distant mountains which form a series of key views when travelling particularly over the Sound of Harris.
West Uists	
Key characteristics	• Large areas of machair, smaller scale to North in between headlands and spits but extensive linear stretches further south with flat crofting land and moorland behind. • Sparse, traditional crofting settlements with linear arrangement along roads. • Wide open views of land and sea giving expansive panoramas and large scale seascapes more contained to the North where extensive dune systems present. • Exposed feel and seascape dominates experience.
Sensitivity	Medium. Development could relate to the scale and general simplicity and linear nature of these seascapes but would detract from the perceptions of naturalness, remoteness and the strong sense of coastal edge that is present here.
Barra and the Sounds	
Key characteristics	• A sequence of small scale machair bays nestled in low lying rocky coastline. • Mountainous hinterland restricting views inland. • Sheaval mountain on Barra is a focal point throughout this area and has an apparent vertical scale due to steepness rising from the sea. • Small isolated crofting settlements close to the coast, apart from main town of Castlebay which has the ferry terminal – ferries to Oban and Lochboisdale. • Open sound of Barra with Eriskay, Fuday and other islands in sound creating changing interplays of land and water and framing distant sea. • Series of uninhabited and fairly dramatic islands to the extreme south. • Scenic, isolated with qualities of exposure and remoteness.
Sensitivity	High. Development would introduce a large scale element of industrial character in an area where such development is absent thereby causing a significant change of character. The scale may cause conflict with small scale seascapes and apparent scale of mountainous landscapes. Parts of this area are uninhabited and have a high sense of naturalness and remoteness which development would substantially alter.
West Coll, Tiree, Canna and Rum	
Key characteristics	• Areas of machair on Coll and Tiree with sequence of sandy beaches, low rolling profiles of hinterland and at slight elevations open seascapes.

	Summary information
	• Dramatic profile of the Cuillins of Rum offering key views within this area. • Small sparse settlements. • Well farmed character on Tiree, hinterland of Coll comprises moorland. • Very exposed, little shelter provided by landform. • Tiree popular for water sports. • Sense of islandness, created by isolation, panoramic views and time of journey.
Sensitivity	Medium–high. Turbines could relate to the predominantly large scale, flattish and open landforms of these seascapes. However, they would conflict with smaller scale seascapes and the limited views of the sea from smaller bays and inlets. They would also conflict with key views of Rum which has a more dramatic and vertical profile. Wind energy would relate to the feeling of windiness and exposure of these seascapes but may detract from their elemental nature. Turbines would conflict with the natural qualities of the area and the traditional small scale character of the settlements. Night lighting and interference with sunsets would also create significant impacts and change of character.
Sound of Sleat-Point of Ardnamurchan	
Key characteristics	• Greatly indented, predominantly rocky coastline with some extensive sandy bays. • Strongly enclosed by islands and mainland. • Settlement mainly on the coast. • Hinterland comprises moorland and hills. • Views of Rum, Skye particularly where sound of Arisaig opens up. • Coastlines fairly similar in character, so distinctive peaks create important landmarks in the large scale particularly Rum, Skye Cuillin and Knoydart.
Sensitivity	High. Seascape pattern of interlocking mountains, islands and sea is a key characteristic which would be disrupted by development. Turbines would introduce a large scale modification into a highly natural area with some extremely remote hinterland creating a significant change in character. Landmark views of high peaks and views of Small Isles, Skye and Morar would be compromised.
Sound of Mull/Firth of Lorn/Sound of Jura	
Key characteristics	• Narrow sounds, high containment. • Main settlement at Oban, with important ferry routes to the islands. • Main transport routes A85, A816. • Fragmented coastline and small islands including Slate Islands to south. • Slotted views out to open sea.
Sensitivity	High. It would be physically unfeasible to accommodate the development scenario within the narrow Sounds. Irrespective of the geographical limitations to development, the strong containment and scale of the small islands would be diminished by turbines.
West Mull/East Tiree and Coll	
Key characteristics	• Low lying rocky coastline. • Generally low lying undulating and stepped moorland in hinterland. • Sparse small scale settlement with traditional crofting. • Conical mountains in central Mull forming focal points. • Wide bay like area in central Mull with indented coastline, islands, tall cliffs and stepped waterfalls forming focal points within this seascape. • Areas of machair on Coll, Tiree and Iona with sequence of sandy beaches, low rolling profiles of hinterland and at slight elevation open seascapes.
Sensitivity	High. Although there are larger scale horizontal seascapes in this area development would conflict with the apparent vertical scale of steep mountains rising from the sea around Mull. The form of development would not relate well to the highly natural and predominantly indented and fragmented coastline particularly around Mull. Turbines would conflict in scale and character with the sparse traditional settlements and detract from the spiritual associations of Iona.

	Summary information
West Islay	
Key characteristics	• Flattish rolling profile with elevated scenery at Mull of Oa and North Islay. • Mostly very sparsely populated excepting main settlement at Bowmore and at ferry port of Port Ellen where there is an urban feel. Elsewhere settlements are very small scale. Many distilleries are focal features. • Dramatic and rugged coastal scenery on north and west Islay with scenic sandy bays. Strong feelings of remoteness and naturalness in many areas. • Large tidal sealoch at Loch Gruinart important for birdwatching especially geese at dusk. • Much of the coastline only accessible on foot excepting area around Loch Indaal which is skirted by a coastal road.
Sensitivity	Medium–High. Overall the seascapes are varied and development could relate to the generally larger scale, open seascapes and simpler hinterlands. However, there is a significant proportion of smaller scale, secluded, intricate and fragmented areas with limited sea views and more dramatic cliffs and coastline in places. Development may detract from the character of these elements. Development would conflict with the scale and character of the traditional fishing settlements. The natural qualities of this area would be compromised by this scale of development.
South Mull/Colonsay/West Jura/Sound of Islay	
Key characteristics	• Rocky coastline rising to cliffs in places, caves, raised beaches. • Paps of Jura and Mull mountains foci within this area. • Sparsely settled, very remote areas of strong wildland character; • Open views to sea from moorland plateau in hinterland; • World famous Corryvreckan whirlpools at the northern tip of Jura – in full roar this can be heard almost 10 miles away.
Sensitivity	High. This area is large scale and predominantly open and could accommodate the scale of development. However, development would cause a transformative change to the qualities of remoteness and naturalness in this area. Development is limited here, there are no major transport routes, most places are accessible only by boat or on foot. There are important natural features like the Corryvrecken whirlpool, raised beaches and caves on West Jura. Development would also compete with the focal points of the Paps which are key views throughout this area.
West Kintyre/South East Jura and South East Islay	
Key characteristics	• Contained seascape created by the proximity of coasts of Jura, Islay and Kintyre forming a broad sound. • Even linear coastline of Argyll no distinct headlands but occasional shallow sandy bays resulting in Gigha and Paps of Jura being key focus of views from mainland. • Sheltered feel more exposed towards open sea at Mull of Kintyre. • Sparse settlement, farming and fishing communities. No large scale development. Houses painted white, some grander houses; some distilleries on Islay. • Moorland, farmland, forestry and some designed landscapes. • Paps of Jura and headlands of Islay and Kintyre key focal points within this seascape, • Views to Ireland and Mull.
Sensitivity	High. Development would conflict with the medium scale seascapes towards the north of this area but could possibly be accommodated in the larger scale areas further south where the area opens up. The area is a contained seascape with key views to the Paps of Jura which dominate this seascape and the Kintyre headland. Turbines would disrupt the appreciation of these strong focal points. There is a lack of development in this area, although the onshore windfarms on Argyll can be spotted in good weather. The scale of development is significantly different to the generally small scale, traditional or historic settlements and houses in this area.

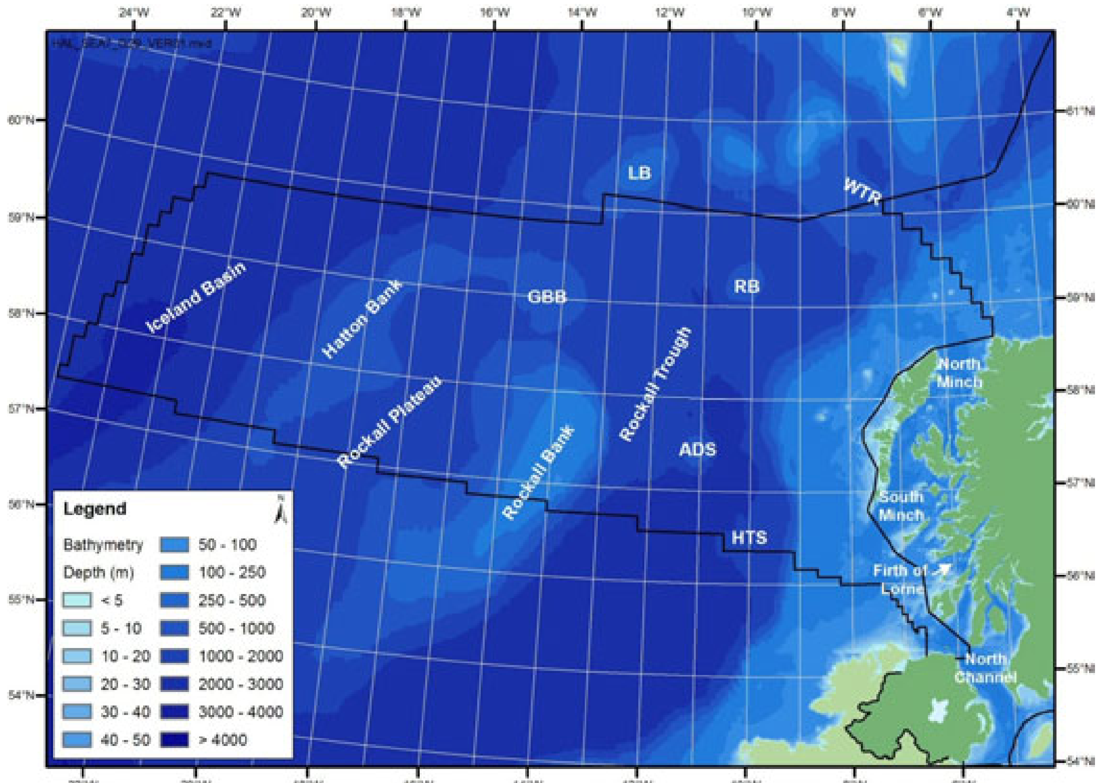
Source: Scott et al. (2005).

Appendix 3d - Water environment

SEA 7 is the largest and most extensive of the SEA regions and the range of marine environments is probably the most diverse of all the regions; from abyssal ocean depths and isolated seamounts, to narrow coastal sounds and fjords. The edge of the continental shelf forms a natural break within the region; separating the deep ocean, where large-scale, slowly-evolving flows dominate, from the shelf and coastal seas, where tidal and seasonal changes dominate the variability.

The oceanic region is composed of three parts, the Iceland Basin, the Rockall Plateau and the Rockall Trough (Figure A3d.1). Maximum depths (3,220m) are found within the Iceland Basin. Shelf and coastal areas have a complex bathymetry consisting of glacially over-deepened valleys (sea lochs), deep sounds between islands, and isolated deeps. There are few shallow water areas (<50m) on the shelf.

Figure A3d.1 – Bathymetry of the SEA7 area



Notes: ADS - Anton Dohrn Seamount; LB - Lousy Bank; GBB - George Bligh Bank; HTS - Hebrides Terrace Seamount; RB - Rosemary Bank; WTR – Wyville Thomson Ridge.

Water masses and circulation

Oceanic region

The SEA 7 area falls in between the two main circulation systems of the North Atlantic - the sub polar and sub tropical gyres. The main branch of the North Atlantic Current (NAC) sweeps eastwards from the western North Atlantic before turning in a more northerly direction and flowing to the west of the Hatton Bank. Smaller southerly branches of the NAC enter the Hatton-Rockall area from the north and circulate over the Rockall Bank and further to the south. A branch of the NAC travels north eastward across the Rockall Plateau and through the Rockall Trough towards the Faroe-Shetland Channel.

A poleward flowing shelf edge current (SEC) is present along the continental margin and occupies the upper part of the slope typically above 700m. Near the southern boundary of SEA 7, it makes an excursion across the slope and onto the shelf (Ellett *et al.* 1986, Souza *et al*. 2001) before continuing its path along the slope at the southern end of the Hebrides. The current exhibits some seasonality, with weaker flows in spring and stronger flows in autumn and mean current speeds are estimated to be between 0.05 and 0.2ms^{-1}, with higher speeds where the flow is 'squeezed' by depth contours. The maximum current in summer was at about 200m depth but in winter, flow was much more uniform throughout the water column (IACMST 2005).

Wintertime mixing of the near-surface layers in the region usually occurs to depths of 500–700m (Ellett & Martin 1973, Meincke 1986; Holliday *et al*. 2000), but there is evidence of deeper mixing, possibly to 1,000m (Ellett *et al*. 1986). This means that the region is a major area for ventilation of the North Atlantic and facilitates ocean-atmosphere heat exchange (Meincke 1986). This mixing forms relatively homogeneous upper layer waters, identified primarily as a saline Eastern North Atlantic Water (ENAW) entering the region from the south, and occasionally a fresher Western North Atlantic Water (WNAW) from the north west. ENAW forms in the Bay of Biscay (Pollard *et al.* 1996) and is transported northwards by the SEC through the region and beyond (Ellett & Martin 1973, New *et al.* 2001). Less saline WNAW is carried into the area by the main branch of the North Atlantic Current (NAC) but generally turns northwards to the west of Hatton Bank and does not usually enter the Rockall Trough (Schmitz & McCartney 1993, Pollard *et al.* 1996, Holliday *et al*. 2000).

Since the early 1990s there has been a general warming of surface waters in the Rockall Trough. This warming does not appear to be directly related to atmospheric conditions, as indicated by the NAO Index or to variations in local net atmospheric heat fluxes. Instead, variations in temperature appear to be caused by varying inputs of the water masses to the south of the region - Central North Atlantic Water, Mediterranean Outflow Water, Western North Atlantic Water and Sub Arctic Intermediate Water (Holliday 2003).

Beneath the generally northward flowing surface waters, drifters at a nominal 700m exhibit a more complicated flow pattern. Currents in the northern and western parts of the Iceland Basin are derived from the outflow from the Arctic and flow towards the south west along the Iceland Shelf edge and Reykjanes Ridge (Lavender *et al.* 2005). On the western flank of the Rockall Plateau there is a complementary north eastward flow of ~0.02ms^{-1}, which appears to cross the gap between Lousy and Hatton Banks and enter the northern part of SEA 7 in the Rockall Trough. Within the Rockall Trough, at 700m, there is a fairly strong anti-clockwise rotating current (~0.05ms^{-1}) at the southern end of the SEA 7 area. In the north, Norwegian Sea Deep Water (NSDW) is known to flow episodically southwards over the Wyville Thomson Ridge and into the Rockall Trough. Circulation models (New & Smythe-Wright 2001) and evidence from sediment bedforms within the Rockall Trough (Lonsdale & Hollister 1979) suggest an overall cyclonic flow of deeper water (>1,200m depth), with Labrador Sea Water and North Atlantic Deep Water entering the Rockall Trough from the south. The deep flows then diverge from the slope current and are topographically steered anticlockwise around the Trough, leaving the region immediately to the south of Rockall Bank. These south westward bottom flows are thought to occur primarily on the lower slopes of the Rockall Bank (New & Smythe-Wright 2001).

During spring and summer months the water column over much of the oceanic region undergoes thermal stratification with an upper mixed layer down to approximately 75-100m. The nature and extent of stratification varies both spatially and temporally. Generally, stratification breaks down with the onset of autumn cooling and associated more energetic conditions. This mixing process is reflected in winter temperatures which are fairly constant

(9-10°C) through the water column down to about 500-750m, and reach 5-6°C by 1,500m (SAMS 2006). Upwelling occurs along the shelf edge bringing nutrient rich water to the surface with associated enhanced productivity (IACMST 2005).

Other features

Variability in both upper and deep circulation due to eddies has been measured in the Rockall Trough with eddy activity greatest around the seamounts of the northern Rockall Trough (Dickson *et al.* 1986, Booth 1988). Current observations near the Anton Dohrn seamount revealed very variable directions with speeds generally of order 0.1-0.2ms^{-1} in the upper layers and, about 0.05ms^{-1} near the seabed (Ellett *et al.* 1986). Wind stress levels in the Rockall Trough tend to peak in winter, whilst eddy kinetic energy levels (in the 3 to 28 day band) appear to be at a maximum in spring (Dickson *et al.* 1986). Drifter observations in January 1984 (Booth 1988) demonstrated that the region around the Anton Dohrn seamount is rich in small eddies with periods of between 1 to 3 days. Other drifter observations (Burrows & Thorpe 1999) have shown much larger eddies, with periods of order 10 days and speeds up to 0.25ms^{-1}.

Internal waves are periodic oscillations of the water column through disturbances in the vertical density stratification. Essentially, tidal flow across the shelf edge causes the thermocline to depress and this depression propagates away from the shelf edge region as a wave. The north east Atlantic is a prolific area of internal wave generation (Baines 1986) and internal waves have been observed in SAR (Synthetic Aperture Radar) images (New 1988). These images show the generation points at the shelf edge and packets of internal waves propagating away from the source region periodically on every tide. Booth (1981) suggested that strong oscillatory currents found in the deep northern sector of the Rockall Trough were a result of internal tidal motions. Non linear internal waves (solitons) measured during the LOIS (Land Ocean Interaction Study) Shelf Edge Study (SES) between 56°N-58°N were associated with oscillations in the thermocline of up to 50m and occasional strong currents (up to 0.5ms^{-1}). In regions where internal waves reflect from the continental slope, periodic mixing of water adjacent to the seabed is often observed (White 1994). Such conditions may cause the generation of nepheloid layers (regions of suspended sediment) in the water adjacent to the slope (Thorpe & White 1988).

Cascades of shelf water down slope generally occur intermittently from late winter to spring, when at temperate latitudes water on the shelf can be colder (denser) than in the ocean. Ellett (1968, cited by SAMS 2006) found evidence of cascading on the western side of the Rockall Bank and estimated that the associated speed was about 0.02ms^{-1}. Although sufficient conditions for cascading have been observed within the SEA 7 region, there have been few confirmed reports.

Shelf region

The physical structure of the shelf seas is largely determined by a balancing act between the stratifying influences of solar radiation and fresh water run-off from the land, and the mixing influences of the strong tidally and wind driven flows, themselves shaped by the irregular bathymetry and coastline of the SEA 7 region. Tidal currents in some areas, particularly to the south west of Islay and the Mull of Kintyre, and between north Skye and Lewis are very strong and sufficient to transport seabed sediments (Figure A3d.2).

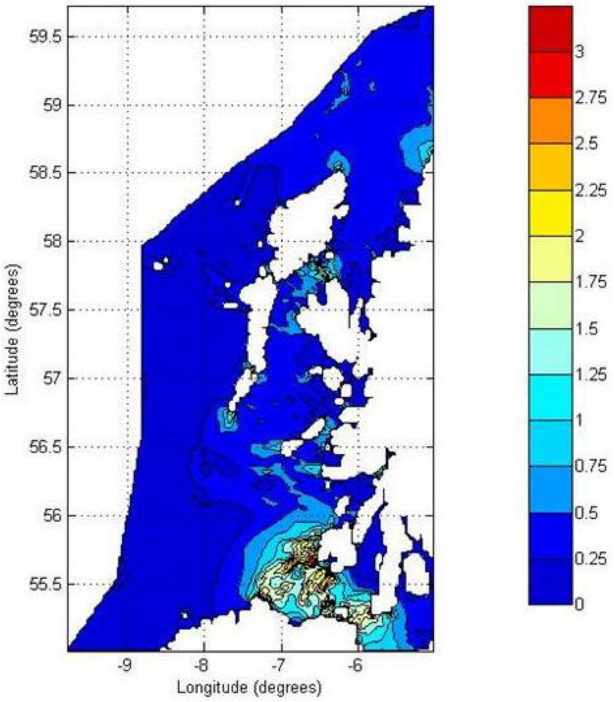


Figure A3d.2 - Maximum depth-averaged currents for a mean spring tide (ms^{-1})

Source: SAMS 2006

During the winter months on the open shelf the water column is vertically well mixed. On the outer parts of the shelf the water is of Atlantic origin with a sharp boundary between coastal and oceanic water. This front lies approximately two thirds of the distance from Barra to the shelf break, running parallel to the Hebrides and passing close to St Kilda although there is considerable variability in its shoreward extent. Much of the shelf remains mixed or weakly stratified during the summer with strong thermal stratification restricted largely to sheltered sea lochs.

At the south west approaches to the Firth of Lorne which drains a large part of the western highlands (Ellett & Edwards 1983), a persistent shelf sea front, the Islay Front, which exhibits strong salinity influence, extends from Malin Head on the Irish north coast to the southwest tip of the Isle of Mull, a distance of approximately 65km (Simpson *et al.* 1979).

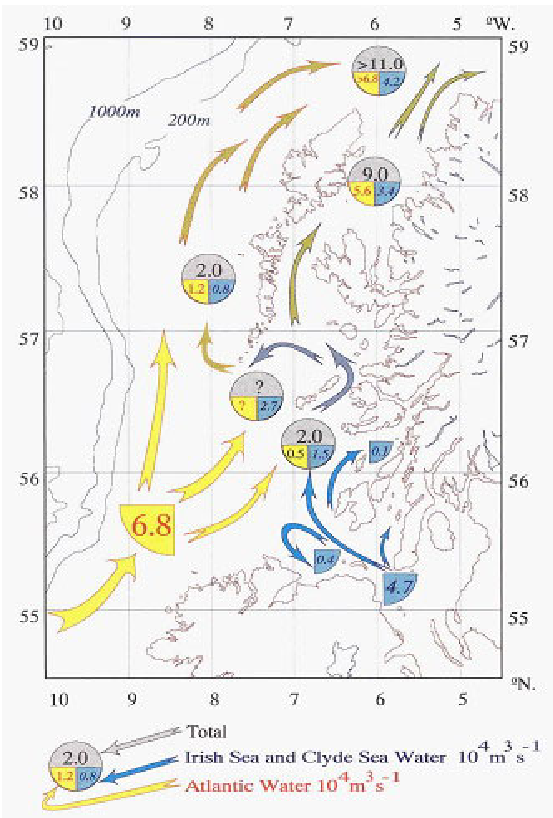


Figure A3d.3– Shelf circulation pattern and approximate volume fluxes

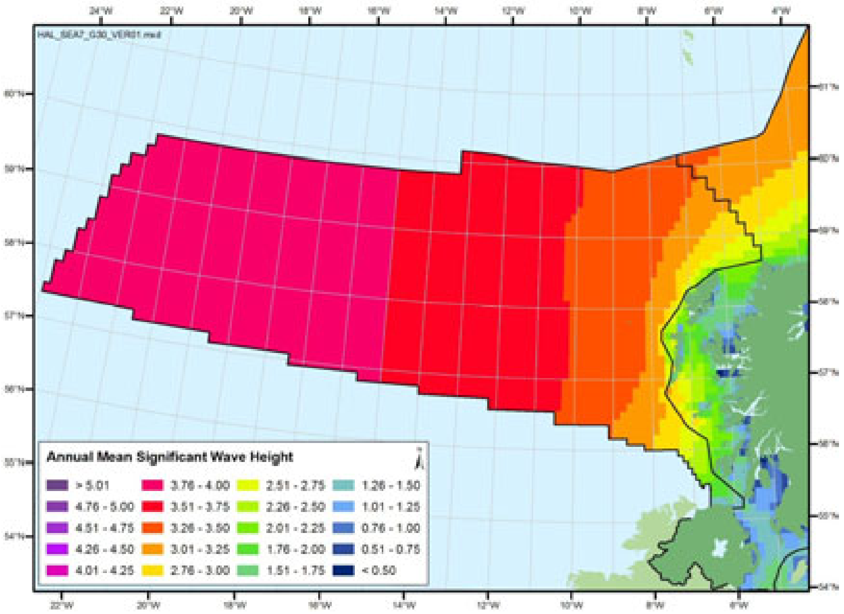
Source: Courtesy of A. Edwards.

As mentioned, the slope current transports clean oceanic water northward along the outer reaches of the UK continental shelf. Some or all of the current intermittently meanders onto the shelf north of Ireland where it dilutes the relatively polluted mixture of Irish and Clyde Sea waters flowing north through the North Channel (Figure A3d.3). This mixture forms the Scottish Coastal Current (SCC), which continues northward (~0.05ms^{-1}) modified continually by mixing with the less saline terrestrially influenced coastal waters and more saline shelf and slope water. At the entrance to the Minch the SCC divides with one branch flowing on northwards between the Outer Hebrides and Scottish mainland and the other turning south then west around Barra Head to continue northwards up the west coast of the Outer Hebrides. Ultimately this blended water flows into the North Sea between Orkney and Shetland.

Waves and storms

The SEA 7 area experiences some of the harshest metocean conditions in the world. The region is exposed to the full force of storms generated in the Atlantic Ocean, particularly during winter months, which are associated with waves of considerable size developed over the long Atlantic fetch. The region also experiences exceptionally high interannual variability, and monthly averaged significant wave heights can vary by as much as a factor of two between consecutive years (Woolf *et al.* 2002). Much of this variability can be attributed to changes in the North Atlantic Oscillation Index (IACMST 2005). For example, a unit change in the NAO will induce a 0.42m increase in the mean winter wave height, and a 1.28m change in the 100 year return value (Woolf *et al*. 2002).

Figure A3d.4 – Annual mean significant wave height



Source: DTI (2004).

The annual mean significant wave height (Figure A3d.4) varies from about 4m over deep water to 2-3m on the shelf with smaller waves in sheltered shelf areas (DTI 2004).

The largest wave recorded in the Rockall Trough to date was measured at 29.1m in February 2000 (Holliday *et al.* 2006).

Storm surge elevations with a return period of 50 years (Howarth 2005) show maximum values between 1 and 1.25m east of the Outer Hebrides, with associated currents generally between 0.4 and 0.6ms^{-1}, and exceeding 0.8ms^{-1} in the Minch and west and north of Lewis.

Contamination

In general, the SEA 7 marine environment is considered relatively pristine with contamination of sea water likely to be restricted to areas close to point discharges, and industrial and population centres such as the Firth of Clyde. Further information on the level of contamination within the SEA 7 area is provided in Appendix 3b.

Ambient noise

Ambient noise is made up of contributions from many sources, both natural and anthropogenic. These sources add together in a complex manner resulting in significant spatial and temporal variations in the noise field. In recent years there has been an increasing awareness that offshore activities have contributed to significant increases in the levels of underwater ambient noise.

QinetiQ (Harland & Richards 2006) were commissioned by the DTI to provide information on background ambient noise levels in SEA 7 including identifying the main sources of noise.

Potential sources of ambient noise

Potential sources of ambient noise in the SEA 7 area are described below. Details of noise generatation, for example, by impact and bubble mechanisms are detailed in Harland & Richards (2006).

Wind-sea noise

Noise is generated by the interaction between wind and the sea surface. Higher wind speeds result in breaking waves which produce noise by impact and bubble mechanisms. At lower wind speeds noise results from flow noise as the wind passes over the sea surface and from bubbles entrained at the sea surface. The contribution of wind-sea noise to ambient noise levels varies with changes in meteorological conditions over various timescales (e.g. daily, seasonal and inter-annual).

Precipitation noise

Precipitation hitting the sea surface generates noise by impacting the sea surface and, in some instances, by oscillation of the bubbles entrained by the impact. Increasing winds can modify the noise from precipitation. In the SEA 7 area, particularly during the winter months, precipitation is likely to be a significant contributor to ambient noise.

Surf noise and sediment transport

Noise generation in the surf zone is a highly complex process but the resulting noise can be heard up to 9km offshore. The noise results from individual and collective bubble oscillation in the water column, sediment transport in the backwash, splashing, pounding and turbulence. The character of noise from surf is dependent on the beach profile, the wave direction relative to the beach and the sediment size. The noise characteristics are further modified by the immediate offshore bathymetry which will determine the acoustic propagation of the sound out into deeper waters.

Because of the exposure to waves coming in off the Atlantic, it is likely that shore and surf noise will be a major contributor to ambient noise in coastal waters in the SEA 7 area. The noise will mostly be impact noise as the wave hits the rocks, spray noise as the water falls back onto the sea, bubble oscillation noise and some limited sediment transport noise.

Aggregate extraction

The noise resulting from aggregate extraction is made up of three contributions: ship noise; dredge noise; and sediment noise. Dredge noise is that noise from the dredging machinery over and above normal ship noise while sediment noise results from the movement of the seabed material across the seabed and through the suction tube.

Commercial shipping and leisure craft

Commercial shipping mostly originates from traffic to and from the major ports of Liverpool, Dublin, Belfast and the Clyde moving into and out of the North Channel. In addition, shipping passing around the north of Scotland and out into the Atlantic will also make a significant contribution. There are no major ports within the SEA 7 area, but within the coastal waters of Scotland a significant contribution to shipping noise will be from the inter-island ferries. Away from the main shipping lanes a major contribution is likely to come from fishing boats. There is a variety of fishing activity in the SEA 7 area, ranging from inshore potting to offshore deep-water trawling. As the fishing boats move around the area they are likely to provide a significant contribution to shipping noise. Shipping noise will vary on a diurnal cycle (ferry and coastal traffic) and an annual cycle (seasonal activity).

Industrial noise

Industrial noise can result from a number of offshore activities including oil and gas exploration and production, wind farms, construction activities and power transmission. Some onshore industrial activity can also generate sound in the water. In the SEA 7 area this is not a major contributor to ambient noise.

Military noise

The military can generate underwater noise by the use of ships, aircraft, explosives and active sonar transmissions. There are a number of areas where military exercises and trials may take place in the SEA 7 area, including the Benbecula ranges, the Raasay BUTEC (British Underwater Test and Evaluation Centre) range and the Cape Wrath bombing range. In addition, the whole area, particularly out to 12 degrees west is widely used by the Royal Navy for research trials, exercises and live firings.

Sonar

Active sonar generates a high power pulse in the water and then listens for the echo from a desired target to determine range and direction. The most common sonar in use in the SEA 7 area is the echosounder carried by most ships. Other sonars in use include fish finders and fishing gear control sonars, acoustic modems, air guns for seismic exploration and military sonars.

Military sonars use high power transmitters to generate tonal signals in the range 1-300kHz and with pulse lengths between 0.1 and 4 seconds, depending on mode of operation. High frequencies above 80kHz are used by mine hunters and the high attenuation at such frequencies means that any impact is limited to a very small area around the ship, typically less than 3km. Lower frequencies (<3kHz) are used in the deeper waters but can insonify a whole ocean basin. In the shelf region to the west of the Hebrides medium frequencies are most likely to be used (3-10kHz).

It is not clear how many civilian and military sonars are operating in the SEA 7 area at any one time so it is not possible to judge the contribution to ambient noise levels.

Aircraft

The noise of aircraft can couple into the water, particularly in the case of helicopters operating low over the surface of the water.

Fishing activity

The act of dragging a trawl across the seabed is an inherently noisy operation. Other contributions are from ship noise and fishing sonars.

Biological noise

Many marine organisms can generate noise. There is a widespread source of clicks which can be found in the very shallow waters of the west coast of the UK thought to be made by a crustacean. Fish and cetaceans also make sounds that contribute to ambient noise levels.

Cetaceans are the most vocal of marine species, and species found in the SEA 7 area can produce sounds over the range 15Hz-200kHz. In the deep waters off the shelf fin whales and sperm whales can be major contributors to ambient noise levels. In the inshore waters smaller species, particularly Atlantic white-beaked dolphins and harbour porpoises may contribute to the ambient noise levels.

Seals are also very common in the waters around the Hebrides and, although not as vocal as cetaceans, can make a significant contribution to ambient noise at certain times of year.

Dominant sources of ambient noise in SEA 7

Distant shipping noise is likely to dominate across large parts of the SEA 7 area, particularly in deep offshore waters. The coastline is likely to be dominated by surf noise and shore noise. Figure A3d.5 below shows the areas in which local shipping activity is likely to dominate the ambient noise level. These areas include the shipping lanes which pass through the region and also the shelf edge, which is where fishing activities are likely to be most prevalent. In addition there are a number of ferry routes operating between the Hebrides and the mainland which will also contribute to the local shipping noise. Also plotted is the location of the Foinaven offshore oil production facility as, under the right conditions, sound could propagate into the SEA 7 area.

Figure A3d.5 represents the situation at low wind speeds and no precipitation noise. When the weather deteriorates it is likely that wind and rain noise will dominate over large areas and that the area in which shore and surf noise dominates will extend further offshore. The areas affected by different noise contributions will vary through the year as acoustic propagation loss varies through the seasons.

It should be noted that just because a particular noise source is dominant in a given area does not necessarily mean that other sources may be neglected in that area. The total noise level from all sources may be significantly higher than the level due to the dominant source alone; different sources may dominate in different parts of the spectrum; and bio-receptors may be more sensitive to a less dominant noise source in a different frequency range.

Measurements of ambient noise in SEA 7

Data from a series of automated recording units (ARUs) deployed within the SEA 7 area indicated considerable temporal and spatial variability in the ambient noise measured on the 9th and 14th June (Figure A3d.6). Whilst some care is required in the interpretation of these figures, they show that, for these snapshots at least, the noise level is generally higher in the shallow water area than in the deep water area. Most of the sensors in the deep water area showed a marked increase in noise level over the deployment period and this is believed to be due to increasing wind speed, which was typically around 3.5 knots at the beginning of the deployment, increasing to typical values of 7.5 knots near the end of the deployment.

Figure A3d.5 - SEA 7 area dominant noise sources

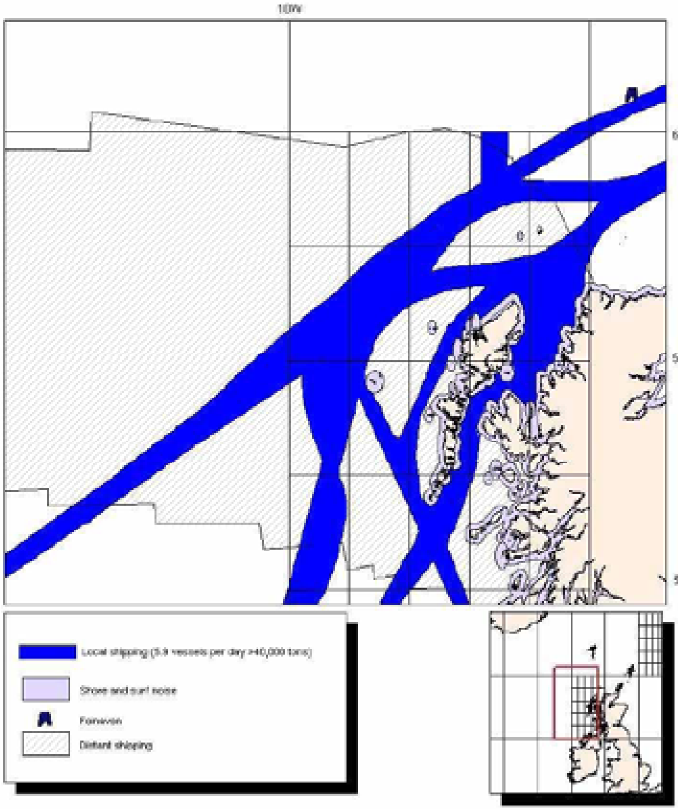
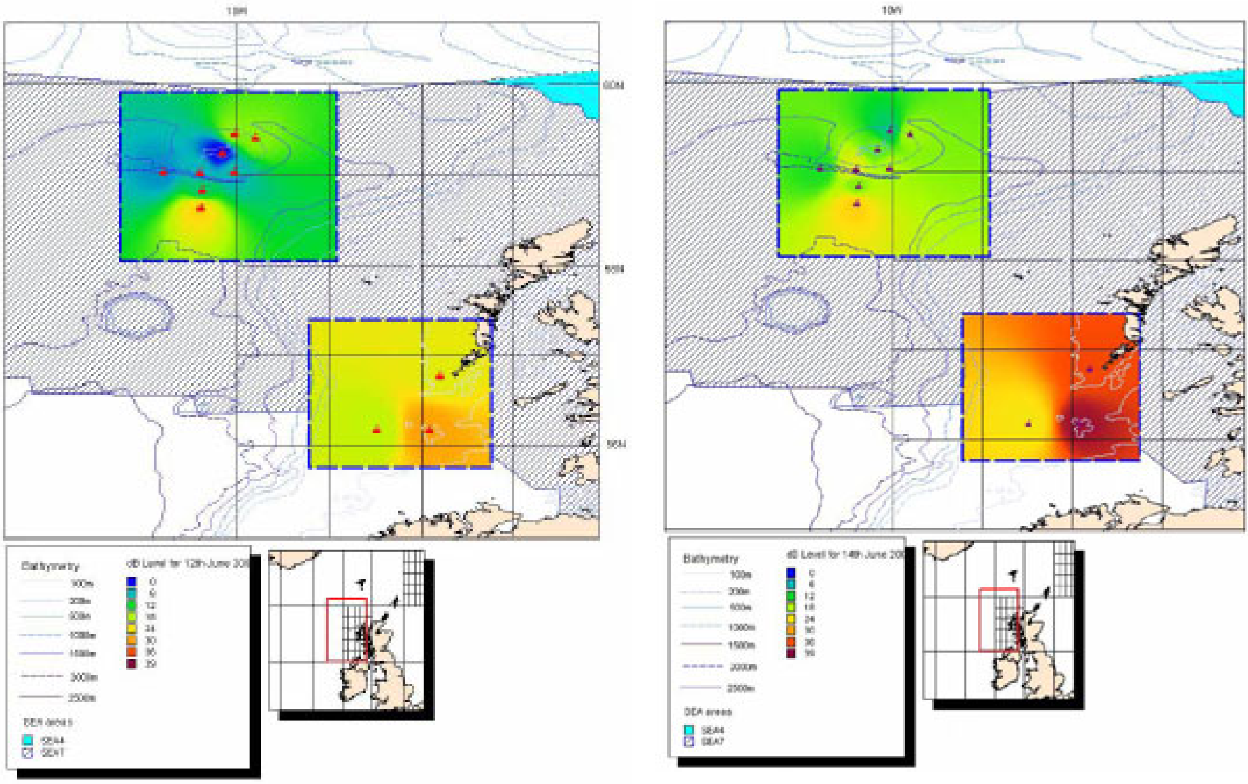


Figure A3d.6 – Snapshot of ambient noise distribution on:

a) 9th June b) 14th June



Appendix 3e - Air quality

Air quality in the SEA 7 area

Whilst air quality is not monitored routinely at offshore sites, regular air quality monitoring is carried out by local authorities in coastal areas adjacent to SEA 7. The air quality of all local authorities within the SEA 7 area were within national standards set by the UK government's air quality strategy (DEFRA 2006) with no areas declared as Air Quality Management Areas. In 2004, emissions of atmospheric pollutants were very low over the vast majority of the coastal SEA 7 area with higher emissions from parts of Northern Ireland.

In general, the lack of industrial development and remoteness of the SEA 7 area means that air quality is likely to be good over nearshore and offshore waters. The atmospheric deposition of pollutants to the SEA 7 area is likely to be low.

Air Quality Management Areas (AQMAs)

The Government's Air Quality Strategy for England, Scotland, Wales and Northern Ireland set national air quality standards to protect human health (DEFRA 2006).

Objectives based on the national standards have been set for certain pollutants. Local authorities must assess whether the air quality standards will be met in their area by the specified target date. If a local authority finds any places where the objectives are not likely to be achieved, it must declare an Air Quality Management Area there. This area could be just one or two streets, or it could be much bigger. The local authority will then put together a plan to improve the air quality - a Local Air Quality Action Plan (Local Air Quality Management website - http://www.airquality.co.uk/archive/laqm/laqm.php).

There are no AQMAs within the SEA 7 area although several local authorities close to the SEA 7 boundary in Northern Ireland (e.g. Strabane, Derry City and Limavady) have been declared as AQMAs.

Atmospheric emissions of pollutants

The National Atmospheric Emissions Inventory (http://www.naei.org.uk/index.php) contains an inventory of a range of pollutants across the UK. Emission inventories are estimates of the amount and the type of pollutants that are emitted to the air each year from all sources. The estimated emissions of a number of pollutants in 2004 are described below.

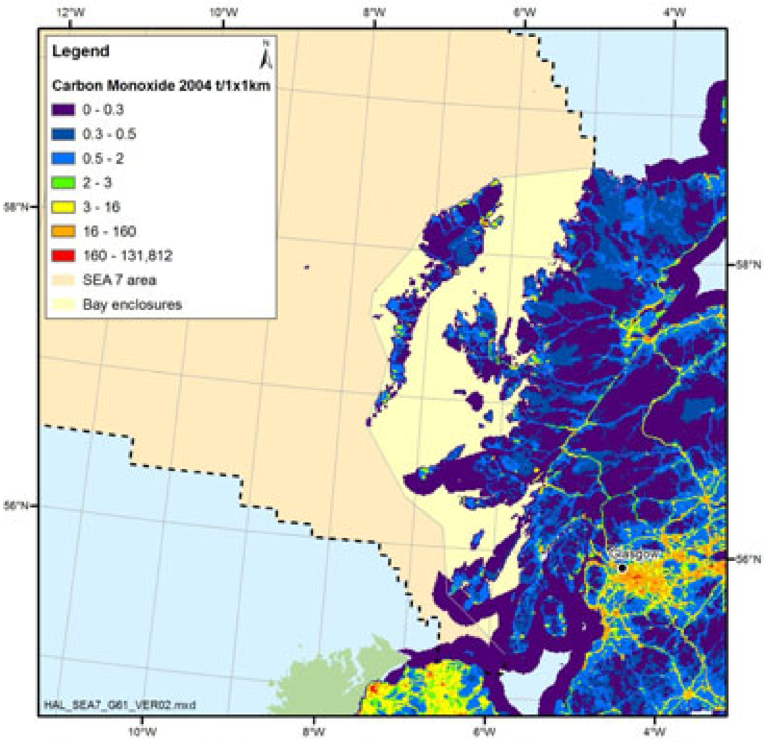


Figure A3e.1 – Emissions of Carbon Monoxide 2004

Source: All maps © Crown Copyright. All rights reserved Defra. Licence Number 1000018880 2006

Carbon monoxide (CO) arises from incomplete fuel-combustion with total UK emissions dominated by those from road transport. Concentrations have been declining since the early 1990's due to significant reductions in emissions from road transport because of the introduction of catalytic converters and the switch from coal to gas and electricity in the domestic sector (DEFRA 2006).

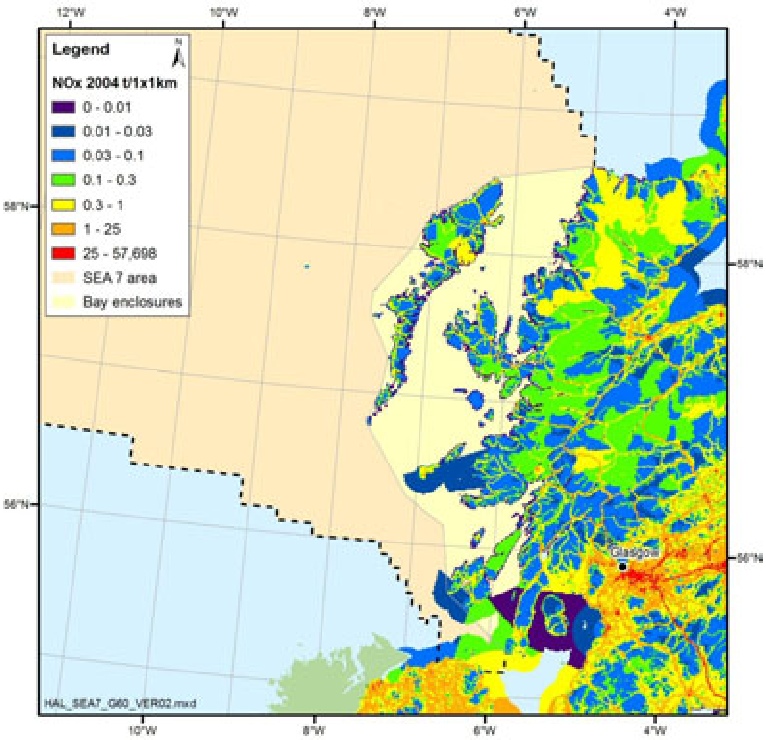


Figure A3e.2 – Emissions of Nitrogen oxides 2004

Source: All maps © Crown Copyright. All rights reserved Defra. Licence Number 1000018880 2006

Oxides of nitrogen (NO_x), a mixture of NO and NO_2, are mainly emitted from combustion processes. There are a wide variety of sources of NO_x but road transport and the electricity supply industry are the main ones. Emissions of total NO_x are expected to continue to decrease to 2020. The main sectors contributing to this decrease are road transport and electricity generation (DEFRA 2006).

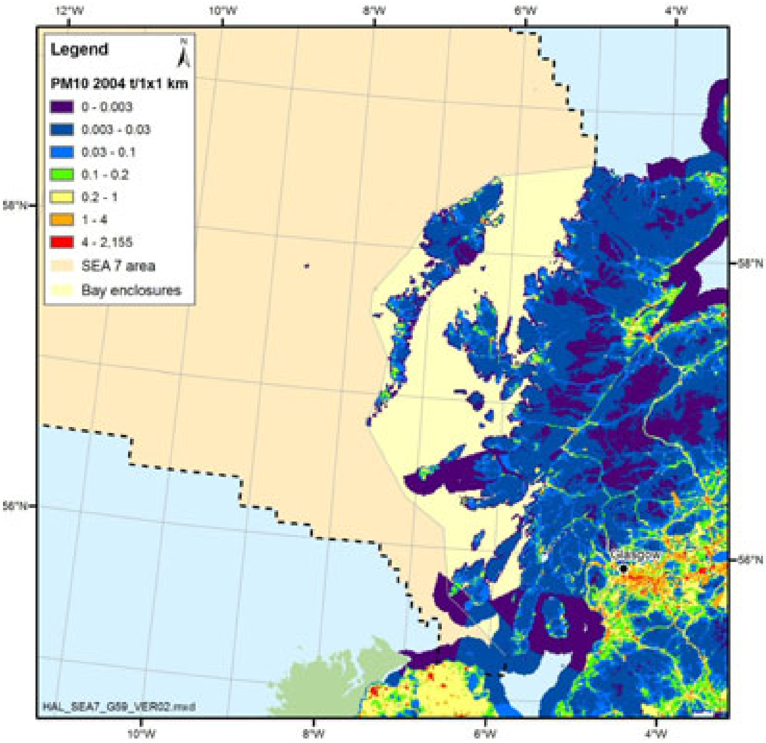


Figure A3e.3 – Emissions of Particulate matter 2004

Source: All maps © Crown Copyright. All rights reserved Defra. Licence Number 1000018880 2006

Particles as PM_{10} and $PM_{2.5}$ are emitted by a wide variety of sources including road vehicles, domestic heating (coal and wood fuels), quarrying, and other industrial sources. A large proportion of ambient PM arises from atmospheric reactions between other pollutants, such as ammonia reacting with NO_x or SO_2. Natural sources, also contribute to ambient PM concentrations. Emissions of primary particulate matter, both PM_{10} and $PM_{2.5}$, are expected to continue to decrease (DEFRA 2006).

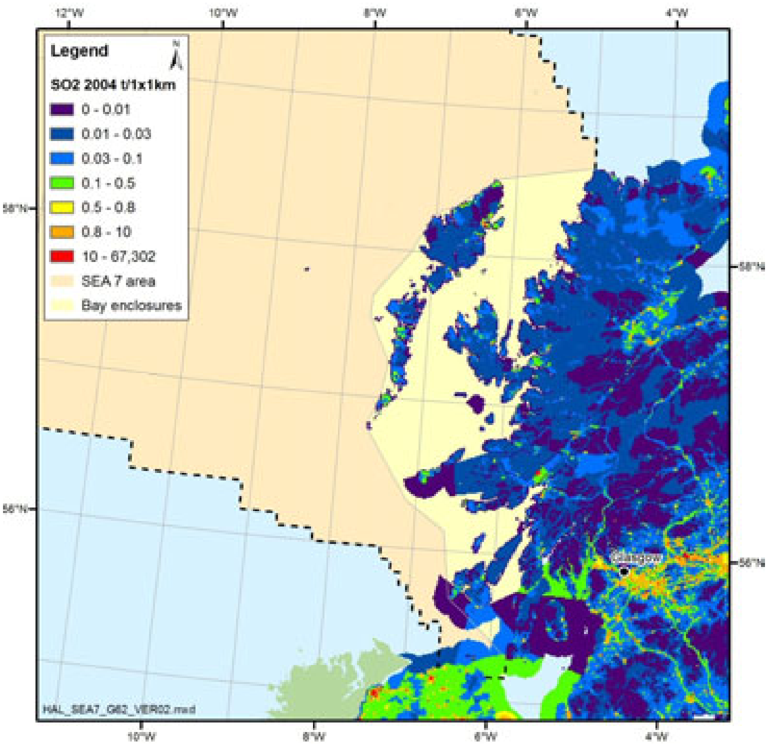


Figure A3e.4 – Emissions of Sulphur dioxide 2004

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SO_2 mainly emitted as a by-product of burning fuels containing sulphur. Main source of emissions is from electricity generation fuelled by coal, dominated by the electricity generation sector. SO_2 concentrations have been declining at many sites for a considerable number of years mainly due to large emission reductions in solid fuel and fuel oil use and a reduction in the sulphur content of diesel used in cars and lorries and gas oil (DEFRA 2006).

Atmospheric deposition of pollutants

For offshore areas remote from riverine and direct discharges, atmospheric inputs of pollutants are likely to dominate (OSPAR 2000a). The estimated deposition of heavy metals in precipitation to the OSPAR area is recorded as part of the OSPAR Comprehensive

Atmospheric Monitoring Programme. UK data recorded from the Lough Navar monitoring site near the Northern Ireland coast (54°26'N 7°54'W) is of relevance to SEA 7 (Table A3e.1).

Table A3e.1 – Estimated mean annual deposition of heavy metals in precipitation ($\mu g/m^2/p.a.$) at Lough Navar in 2004

	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Precipitation (mm)
Mean annual deposition	396	20	185	702	483	97	3,991	1,641.3

Source: OSPAR (2006c).

In general, estimated depositions to the OSPAR area have declined since 2000 for all metal components. Deposition also declines with distance from the European continent. Therefore, deposition over much of the SEA 7 area is likely to be low given the predominant wind direction (W/SW), distance from mainland Europe and lack of industrial and population centres on the SEA 7 coast (OSPAR 2006c).

Appendix 3f - Climatic factors

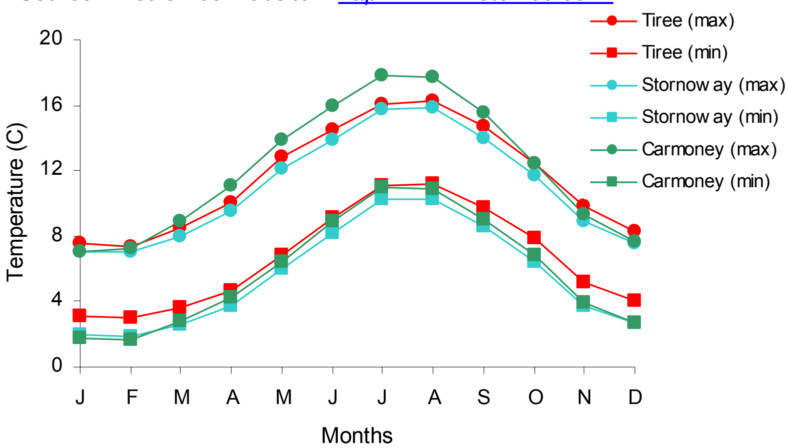
The North Atlantic Oscillation (NAO) is an important influence on the North Atlantic and European weather and climate. It is generally expressed as an index based on the pressure difference between the Azores high and the Icelandic low pressure areas. When the pressure difference is large, with a deep Icelandic low and a strong Azores high, the NAO is said to be in a positive phase, and is negative when the opposite occurs. When in a positive phase, the storm tracks moving across the North Atlantic are stronger, bringing depressions north eastward into Europe. A positive NAO index is, therefore, associated with an increase in wind speeds from the west, together with an increase in temperature and rainfall in Northern Europe in winter. The index is most relevant in winter when the pressure gradients are at their strongest (IACMST 2005). In recent decades the NAO has been found to explain over 30% of variation in monthly sea surface temperature and has also been linked with variations in wind strength and direction and rainfall (IACMST 2005).

Air temperature

In general, the coldest months are January and February and the warmest are June, July and August. Over the open ocean, the mean air temperature in January is about 7°C in the west and 5°C in the east. By July, the mean air temperature is around 12°C in the north and 14°C in the south (UKHO 2004).

Figure A3f.1 – Mean maximum and minimum coastal temperatures, 1971-2000

Source: Met Office website – http://www.metoffice.com/



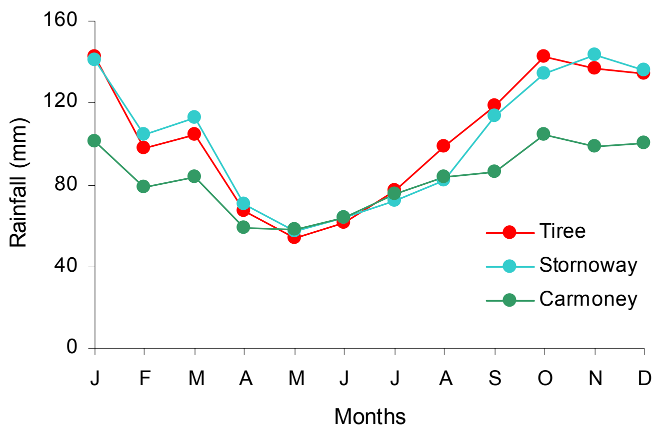
Air temperatures along the west coast are much more variable than over the open sea and have a daily range of about 5°C. Figure A3f.1 describes monthly mean maximum and minimum temperatures recorded from Tiree and Stornoway in the Outer Hebrides and Carmoney in Northern Ireland.

Rainfall

At sea, rain can be expected on about 25 days a month in winter and, in late spring and early summer, on about 20 days per month in the north west of the area and 15 days in the south and east. The amount of precipitation, and the duration, can vary significantly from one day to the next (UKHO 2004).

Figure A3f.2 – Mean coastal rainfall, 1971-2000

Source: Met Office website – http://www.metoffice.com/



On the coast precipitation varies according to exposure to the prevailing wind, and the elevation and proximity to high ground. Precipitation along mountainous wind-facing coasts is generally considerably higher than at sea. The driest months are from April to June and the wettest from October to January (Figure A3f.2).

Fog, except in the vicinity of the Clyde in winter, is uncommon. Visibility is often good, although the average humidity and cloud cover are high (UKHO 2004).

Wind

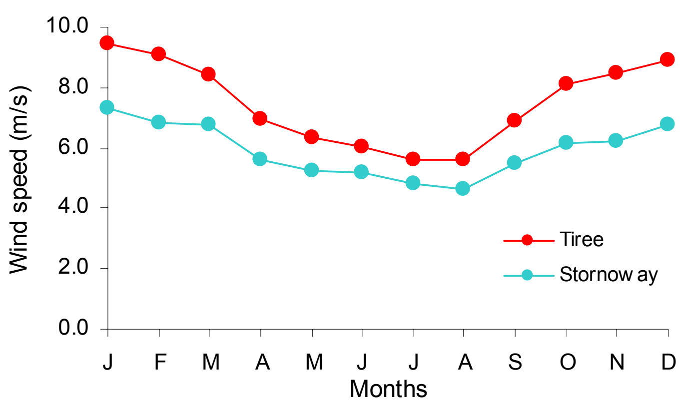
Over the open ocean, winds blow most frequently from between the west and south in all seasons. In winter, winds of Force 5 (~9.3ms^{-1}) and over are reported on about 70% of occasions in the west of the area and around 60% in the east. By July, the frequency falls to about 35% in the west and 30% in the east (UKHO 2004).

Gale force winds, over the open ocean, can be expected in all seasons with, in winter, 20% of all observations recording winds of Force 8 or more (>18.9ms^{-1}) in the west of the area and 17% in the east. In the spring the frequency is between 4 and 8% and, in the autumn, between 8 and 12% with the higher frequencies in the west. Severe gales (Force 10 or more) (>26.4ms^{-1}) have a percentage frequency, in winter, of about 6% in the west but only around 2 to 3% in more sheltered areas to the east (UKHO 2004).

The most frequent direction for gales is from between the south west and west and although gales from between the south and south east are not uncommon they are usually short-lived.

Figure A3f.3 – Mean coastal wind speeds, 1971-2000

Source: Met Office website – http://www.metoffice.com/



Wind speeds tend to be higher at sea with more frequent gales than on land. However, exposed coastal areas experience relatively strong winds, particularly in winter (Figure A3f.3). The rugged, mountainous topography and numerous islands of the west coast may also lead to local wind effects including increases in wind strength due to funnelling in steep-sided sounds and lochs.

Climate change

Scientific knowledge of climate change has improved over recent years as described in the recently produced *Climate Change 2007: The Physical Science Basis - Summary for Policymakers. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC 2007).

The report describes progress in understanding the human and natural drivers of climate change, observed climate change, climate processes and attribution, and estimates of projected future climate change. It builds upon past IPCC assessments and incorporates new findings from the past six years of research (IPCC 2007).

The main findings of the report include:

- Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land-use change, while those of methane and nitrous oxide are primarily due to agriculture.

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.

- At continental, regional, and ocean basin scales, numerous long-term changes in climate have been observed. These include changes in Arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones.

- Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely*[3] due to the observed increase in anthropogenic greenhouse gas concentrations. This is an advance since the Third Assessment Report (TAR) conclusion that "most of the observed warming over the last 50 years is *likely* to have been due to the increase in greenhouse gas concentrations". Discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes and wind patterns.

- For the next two decades a warming of about 0.2°C per decade is projected for a range of SRES (Special Report on Emissions Scenarios) emission scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected.

- Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century.

[3] From the Summary for Policymakers, the following terms have been used to indicate the assessed likelihood, using expert judgement, of an outcome or a result: Virtually certain >99% probability of occurrence, Extremely likely >95%, Very likely >90%, Likely >66%, More likely than not >50%, Unlikely <33%, Very unlikely <10%, Extremely unlikely <5% (IPCC 2007).

- Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilised.

Appendix 3g - Population and human health

Population

Much of the following information is taken from Section 3 of the *Technical report on the other users of the SEA 7 area* (Stocks & Hobbs 2006).

The coastal region of SEA 7 lies within the Scottish council areas of Argyll and Bute, Eilean Siar (the Western Isles) and Highland and the Northern Ireland council area of Moyle. The total population of these administrative areas was 342,655 at the 2001 census. However the Highland council area includes a large area outside SEA 7.

The Scottish Coastal Socio-Economic Scoping Study, 2002, which looks specifically at coastal areas, divides Scotland up into coastal regions. Combining the 2001 census results for the Western Isles and Moyle with the populations of the west coast and Caithness and Sutherland coastal regions from this study, the total population is 134,646.

The population density of the SEA 7 area (between 4-19 persons/km^2) is very low in comparison to the general figure for Scotland (65 persons/km^2) and extremely low in comparison to Northern Ireland's population density (119 persons/km^2) (Scottish Executive Social Research 2002).

Coastal settlements

The coastal region of the SEA 7 area is generally rural in nature with a number of relatively small settlements. The largest settlements are the small towns of Fort William (4% of Highland population), Stornoway on the Isle of Lewis (33% of Outer Hebrides population); Oban in the Argyll and Bute council area (9% of Argyll and Bute population) and Ballycastle in Northern Ireland (32% of the Moyle population).

Industry of employment

Despite the general decline in the fishing industry, fishing remains an important part of the coastal economy in Scotland. The significance of the industry varies by region, with the Outer Hebrides, being one of the few regions found to be particularly dependent on sea fishing. The main sources of income in Moyle district, Northern Island, are farming, tourism and a little light industry.

Human health

The UK Government utilises a series of Community Health Profile Indicators to gain a general understanding of the health and well-being of the population.

SEA 7 is an offshore area and the following relates to the populations adjacent to the area.

One of these indicators, *Feeling "in poor health"*, uses the age standardised percentage of household residents who reported their health over the previous 12 months as having been "not good". Evidence suggests that this self-reported measure of health has good predictive validity of mortality and health care utilisation. Overall in Scotland, 10.2% of people described their health for the 12 months prior to Census day (29 April 2001) as "not good". This compared with 9% in England, 12.5% Wales and 10.5% for Northern Ireland (Healthscotland 2004).

Adjacent to the SEA 7 area, there was little variation in the percentage of people describing their health as “not good”, with figures ranging from 9.5% in Argyll & Bute to 8.4% in Ross, Skye & Inverness West and 8.8% in the Western Isles.

Life expectancy for both males and females adjacent to the SEA 7 area increased over the period 1993/95 to 2003/05, with the highest increase in Argyll & Bute, where male life expectancy increased by 3.5 years to 75.1 years and females increased by 2 years to 80.7 years (National Statistics 2006). Life expectancy in Northern Ireland increased on average for both sexes from 75.6 years to 79.5 years.

Appendix 3h - Material assets (infrastructure, other natural resources)

The following section provides a summary of information presented in the underpinning *Technical report on the other users of the SEA 7 area* (Stocks & Hobbs 2006). Fisheries information comes from Gordon (2006) and Chapman (2006).

Significant coastal industries within SEA 7 include ports and shipping, mariculture and coastal tourism. The scenic value and pristine nature of the coastal environment is also a valued feature of the region. Existing activities beyond 3 nautical miles include fishing, shipping, military activity, submarine cables and marine waste disposal sites, particularly munitions dumps. There is also interest in developing marine renewables in SEA 7, but technological restrictions will limit the sector to coastal waters for the foreseeable future. Key features and activities in the SEA 7 area are summarised in Figure A3h.1.

Fisheries

Demersal

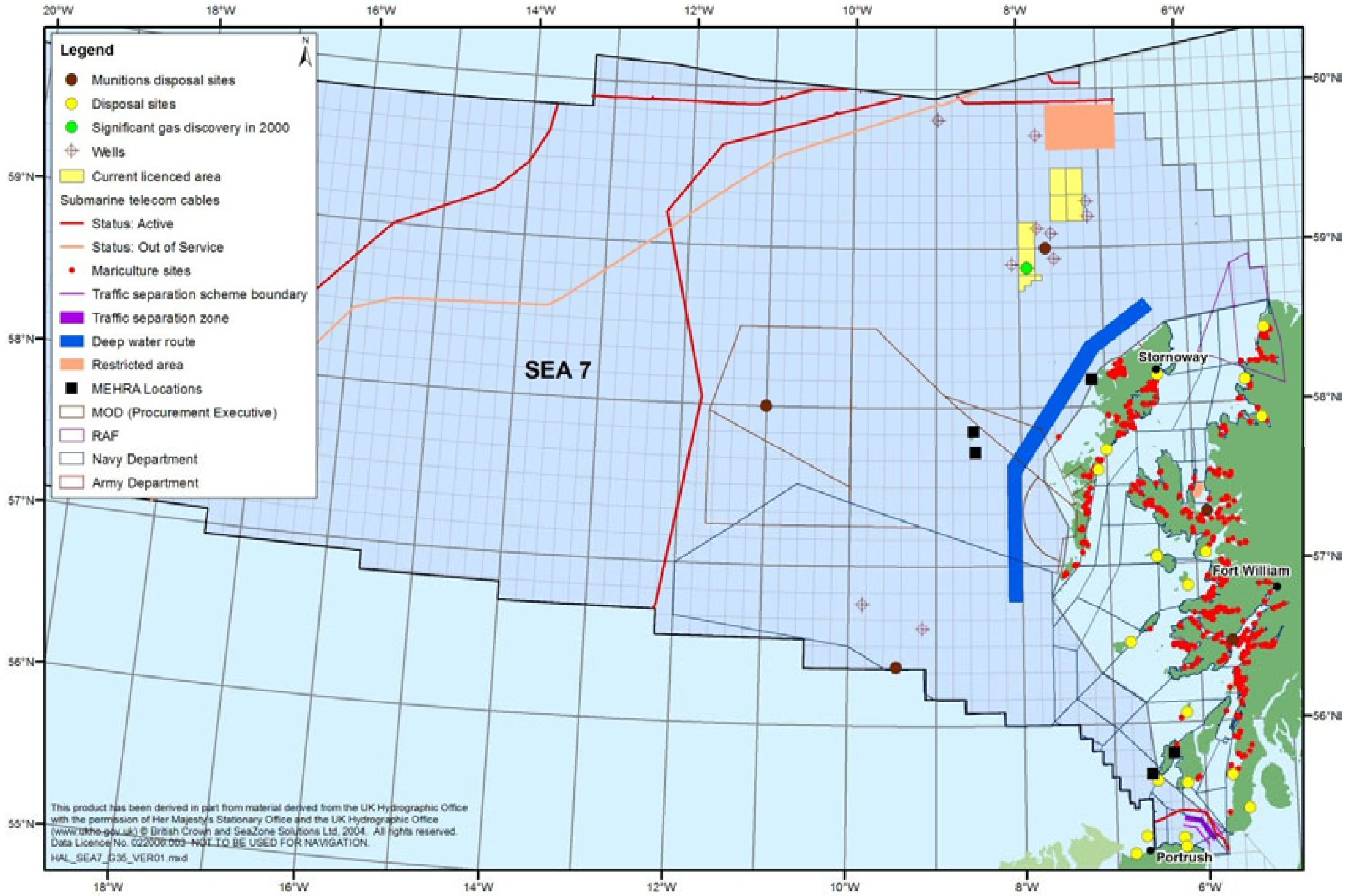
The demersal bottom trawl fisheries of the shelf and upper slope can be divided into four main categories.

- A mixed roundfish otter trawl fleet targets cod, haddock anglerfish and whiting with a bycatch that includes saithe, megrim and lemon sole. Mostly by Scottish trawlers although vessels from Ireland, Northern Ireland, England, France and Germany also participate in the fishery.
- A mixed *Nephrops* trawl fishery consisting of about 200 Scottish trawlers targeting *Nephrops* on inshore grounds with Irish vessels on offshore grounds. Main areas of exploitation are in the North Minch, South Minch and the Sound of Jura. The level of discarding of fish, especially of haddock and whiting is high.
- A bottom trawl fishery targeting anglerfish, megrim and hake which in recent years has moved to deeper waters on the outer shelf and upper slope. This deeper fishery is probably exploiting mature adult anglerfish.
- A trawl fishery for saithe mainly by French vessels takes place along the shelf edge.

Demersal fishing effort is fairly high over the entire shelf but particularly high south of Barra and to the north of the Outer Hebrides.

The deep-water bottom trawl fisheries of the Rockall Trough began in the late 1980s as markets were developed for the bycatch of the French fishery for blue ling. The bottom-trawl fisheries extend from the shelf-slope break down to about 1,700m and the target species varies with depth. The smallest vessels in the fleet fish on the upper slope, where an important target species is the anglerfish. On the mid-slope the main target species are blue ling and roundnose grenadier, with bycatches of black scabbardfish and deep-water sharks. On the lower slope orange roughy is an important target species (Gordon 2001). The fishery is dominated by France and TACs (Total Allowable Catches) were introduced in 2003. Scottish vessels target anglerfish and only land small amounts of deep-water species.

Figure A3h.1– Key features and activities in SEA 7



The fishery on the Rockall Bank has a long history with haddock being the dominant species. In 1977 the UK declared a 200 mile exclusive fishery zone around Rockall and the fishery was managed. However, in 1997 the UK relinquished this claim and the Bank reverted to international waters. The international fleets have moved in and there are concerns about the status of the stocks. A large part of the Hatton Bank was also included in the 200 mile fishery zone around Rockall. Since 1997 a Spanish deep-water trawl fishery has developed on the Bank targeting mainly roundnose grenadier and Baird's smoothhead.

Pelagic

The main pelagic fisheries of the west of Scotland are for herring, mackerel, horse mackerel and blue whiting. Historically, the drift net herring fishery was the major fishery on the west coast of Scotland but with marked fluctuations in landings. Pair-trawling began in the 1970s and the fishery was closed between 1977 and 1981. Now most of the catch is by Scottish vessels but foreign vessels, especially Dutch and German, make a significant contribution. The mackerel fishery takes place mostly in the fourth and first quarter of the year and exploits mackerel returning from the summer feeding grounds of the northern North Sea to the spawning grounds off south west England and Ireland. Horse mackerel is generally taken in the fourth and first quarter of the year mainly by Irish vessels.

The major semi-pelagic trawl fishery is a seasonal fishery on spawning aggregations of blue whiting. The rapid expansion of the blue whiting fishery on the upper slope in recent years has been a cause of major concern to ICES and the species is considered as being harvested at an unsustainable level. Blue whiting is a straddling stock with major components of the fishery in both national and international waters. Parts of both of these components lie within the SEA 7 area. The other semi-pelagic fishery is on spawning aggregations of the greater silver smelt or argentine (Gordon 2001).

Other fisheries

There is a small industrial fishery for sandeel, and the Norway pout fishery, mainly by Denmark, is subject to considerable annual fluctuations.

Static gear fisheries comprise a Norwegian longline fishery targeting ling and tusk on the shelf edge and Greenland halibut on the Hatton Bank, a Spanish longline fishery for hake and sometimes sharks and a deep-water gill net fishery targeting anglerfish and sharks.

Deep water red crab occur from around 300 to 1,000m on the Hatton, Rosemary and Rockall Banks, on the Wyville Thomson Ridge and west of St Kilda. They are landed as a main target species using tangle nets and baited 'inkwell' pots, and also as by-catch from bottom set gill-net fisheries for angler fish, sharks and other deep-water fish.

Other shellfish fisheries are primarily inshore and include mixed creel fisheries for lobster, edible crab, velvet swimming crab and shore crab. Crawfish are caught in baited creels and in the bottom-set tangle net fishery for monkfish. There are also fisheries for giant (North and South Minch, around the Outer Hebrides, Skye, Mull, Islay and Jura) and queen (off Rathlin Island, Northern Ireland) scallops, cockles (principally on Barra), mussels, razor shell, whelks and periwinkles. The wild fisheries for giant scallop, queen scallop and common mussel are augmented by production from a small but thriving farming industry. In addition, the native oyster and the Pacific oyster are also farmed.

Closed areas

The Darwin Mounds are noted for the cold water coral living on top of sandy mounds. They are located in the north east corner of the Rockall Trough at a depth of about 1,000m. In 2004 the EC took action to protect these unique features and prohibited all fishing with gear that makes contact with the seabed in a defined area around the mounds (see Restricted area on Figure A3h.1).

In 2003 the North East Atlantic Fisheries Commission (NEAFC) adopted a resolution to close an area of the Rockall Bank to all fishing except longlining to conserve haddock stocks. In 2005 the EC enlarged this area into the fishery zones of UK and Ireland.

A proposal was made by Norway to NEAFC in 2004 to create a closed area for trawling on the Hatton Bank with the objective of protecting areas known to have cold-water corals. This proposal was not adopted by the contracting parties.

At the NEAFC annual meeting in 2005 the EC introduced a proposal to close areas on the Hatton Bank, North West Rockall, Logachev Mounds, South Rockall, West Rockall Mounds and South West Rockall where these fell in the NEAFC Regulatory Area. A decision was deferred until criteria and guidelines could be established.

Ports and shipping

Commercial ports

In the SEA 7 area, there is one significant cargo port, Glensanda. Glensanda is the UK's largest port for traffic in minerals and aggregates. Situated on Loch Linnhe, the port serves a quarry complex with its sole traffic being crushed granite destined either for export or for other UK ports. The port handled 5.4 million tonnes in 2005 with 229 ship arrivals into Glensanda (Department for Transport website).

Fishing ports

The value of fisheries in and around the SEA 7 area is reflected in the presence of a number of significant fishing ports in the region. According to 2005 figures, four of the top 20 UK fishing ports are within the SEA 7 area in terms of both landed tonnage and value. These include Kinlochbervie (4,700 tonnes, £7.3 million), Ullapool (4,700 tonnes, 7.1 million), Mallaig (4,500 tonnes, £6.6 million) and Lochinver (3,200 tonnes, 7.2 million) (Marine Fisheries Agency 2006). There are no significant fishing ports on the relevant Northern Irish coast.

Shipping

Ferry routes

Scotland's coastal shipping consists of an extensive ferry system connecting the mainland with the Western Isles and inter-island, ferry services. In the west of Scotland, 6.6 million passengers travelled on services provided by Caledonian MacBrayne and Western Ferries in 2004. In Northern Ireland, the only ferry service within the SEA 7 area is between Ballycastle and Rathlin Island.

Shipping density and routes

Overall shipping density throughout SEA 7 is low to moderate. Moderate shipping density occurs in coastal waters between the mainland and Western Isles and from the southern tip of the Western Isles running south east to the North Channel. The highest density of shipping traffic occurs in the North Channel and there is a traffic separation scheme in place to control this traffic. West of the Western Isles shipping density is low.

The routes with greatest shipping density by volume of vessels is by ferries linking the west coast of Scotland to the Western Isles, cargo vessels using the Minches and North Channel and oil tankers from the North Sea running west of the Western Isles towards the west coast of Wales.

A deep water route lying between the Outer Hebrides to the east of St Kilda and the Flannan Isles was established in 1996. Laden tankers of over 10,000 gross tonnage are recommended, weather conditions permitting, to use this route in preference to sailing through the restricted waters of the Minches.

Following the Braer tanker oil spill it was recommended that areas of high environmental sensitivity, which are also at risk from shipping, should be identified and established around the UK coast. Five Marine Environmental High Risk Areas (MEHRA's) have been established in the SEA 7 area including Gallan Head on the Isle of Lewis, two cells at West Islay, and two further cells at North St Kilda and South St Kilda (Figure A3h.1). There has also been considerable NGO pressure for the Minch to be designated a MEHRA (e.g. Scottish Environment LINK website - http://www.scotlink.org/pdf/Coastal_Confusion_issue_paper_sept_04.pdf).

Oil and gas activity

Despite interest in the Atlantic Frontier (waters off the north and west coasts of Scotland) there has been little oil and gas activity in the SEA 7 area. Atlantic Frontier developments have so far focussed on areas west of the Shetland Isles. A small number of blocks have previously been licensed and two areas to the north of the SEA 7 area (north of the Western Isles) within quadrants 164 and 154 are currently under licence (Figure A3h.1). There has been one significant gas discovery in block 154. However, there are no existing oil or gas fields in production or under development.

A fabrication yard and service support at Arnish on the isle of Lewis has ceased construction operations for the oil and gas industry altogether, and in 2003 was being refurbished as a workshop for wind turbine towers and foundations for the offshore renewables sector.

Renewable energy

At present there is little development of offshore renewables in the SEA 7 area but there is huge potential from wind, wave and tidal resources. Development of offshore renewables in the area is limited by the low capacity of the existing grid system and seabed that shelves away too quickly in most areas to make shallow water projects viable. Expense and technological constraints are also factors, particularly for wave and tidal projects.

Comhairle nan Eilean Siar (Western Isles Council) have recently recommended that the Scottish Executive approve the development of a major wind farm on the Isle of Lewis. The Council recommendation was subject to the removal of 5 turbines from the revised Lewis Wind Power proposal of 181 turbines generating about 650MW of electricity. The proposal has generated considerable public interest over its potential environmental and socio-economic impacts and will now be considered by the Scottish Executive.

There is considerable political will to develop renewable energy in the region. A Strategic Environmental Assessment for the development of marine wave and tidal renewables is currently underway and the world's first commercially operational wave-power station has been operational on Islay for a number of years. The arrival of large scale marine renewables in the SEA 7 area is likely to be a number of years away but the industry may compete with oil and gas for sea areas at some point in the future. The availability of interconnection infrastructure is a significant constraint on development of both onshore and offshore renewable energy in the area. A recent Scottish Hydro Electric Transmission Limited (SHETL) consultation on the preferred option for an interconnection between Lewis and the mainland described the potential for underground cabling between Lewis and Little Loch Broom (Scottish and Southern Energy website - http://www.scottish-southern.co.uk).

Cables

Cables in the SEA 7 area include four international telecommunications cables of which three are active and one is out of service (Figure A3h.1). There are numerous smaller coastal cables, including power cables between islands and the mainland. Cables are unlikely to interfere with oil and gas activities given that their location would be identified early on in the screening stage of an oil and gas project and the appropriate measures to avoid or cross the cables would be taken.

Military activity

Almost the entire marine area to the west of Scotland is designated as military practice and exercise areas (PEXA) (Figure A3h.1). Waters between the Scottish mainland and the Western Isles, and south to include the sea area off the coast of Northern Ireland are used for naval exercises. The Royal Air Force (RAF) conducts air combat training in an area towards the northern extent of the study area and larger PEXAs extend beyond the Western Isles into the north east Atlantic, used by the Navy and the MOD Procurement Executive.

The spatial extent of the military exercise areas means that any future oil and gas development is likely to occur in areas designated for use by the armed forces. However, the presence of a PEXA does not preclude other activities and provided there is sufficient planning and consultation between the oil and gas industry and the MOD, conflict would be considered unlikely.

Dredging and aggregate extraction

There are currently no licensed marine aggregate extraction areas in the SEA 7 area. Some navigational dredging takes place periodically in and around the relatively small ports and harbours in the region and is disposed of at licensed marine disposal sites.

Marine waste disposal (including ordnance)

The dumping of most types of industrial waste and sewage sludge at sea is now prohibited and material from port and navigation channel excavation and coastal engineering works constitutes the majority of material disposed of at sea. Disposal licences are granted annually and new applications are made periodically when navigational dredging is required at local ports and harbours. There are no large ports or harbours in the SEA 7 area so the majority of disposal sites are only licensed every few years. In 2006 there were 3 licensed disposal sites (Campbeltown, Bruichladdich and Port Ellen) . A number of other disposal sites exist in the SEA 7 area that have been used in the past and for which new licences may be granted in the future (Figure A3h.1).

Disposal sites that are active or have potential to be re-licensed would constitute a restriction on oil and gas development in the immediate vicinity. However, the nearshore location of disposal sites would indicate that they are unlikely to restrict proposed oil and gas activity as a result of SEA 7 licensing.

There are 5 known munitions dump sites in the SEA 7 area. Conventional munitions were disposed of at two coastal sites and the three remaining offshore sites contain chemical weapons (see Figure A3h.1). The recovery of dumped munitions is not considered feasible at present and munitions have been shown to be present outside of the boundaries of known dump sites.

Mariculture

Mariculture is the cultivation of marine species in coastal waters. The west coast and the Western Isles are the focus of much of the mariculture industry in Scotland, making an important contribution to the economy of rural and island communities (Figure A3h.1 for relevant mariculture sites). Mariculture is also important in Northern Ireland, but is concentrated in five sea loughs located outside of the SEA 7 study area.

There are about 302 registered Scottish marine finfish farms in the SEA 7 area, of which 182 are currently active. Almost all of these sites are involved in the production of Atlantic salmon and in 2004, farmed salmon production in SEA 7 contributed 60% of the Scottish total. An increasing number of operations are also farming other marine species (e.g. sea trout, cod and halibut).

There are 475 registered shellfish cultivation sites in the SEA 7 area of which 342 are currently active. Like finfish, shellfish mariculture is located in sheltered sea lochs and coastal waters. Shellfish mariculture in the area accounts for almost all national production of Pacific and native oyster, giant and queen scallops. SEA 7 accounts for approximately half of national production of mussels and these are the only shellfish species farmed in the Western Isles.

Mariculture operations and management areas are located in the numerous sheltered sea lochs along the Scottish west coast, but the industry has grown to such an extent over the last 20 years that there are now few suitable coastal sites that do not have some production operations present. Marine fish farming can have negative impacts on the seabed, water quality and wild fish populations, and concern about the environmental impacts of mariculture has encouraged the development of sustainable management initiatives. The industry may in the future move to more exposed offshore locations in order to grow and relieve pressure on the finite number of inshore sites.

Any increased risk of pollution associated with new oil and gas exploration, production, and transport in the area would be of concern to the mariculture industry. For example, the Braer spill had severe impacts on the fish farming industry in the Shetland Islands.

Tourism and recreation

The SEA 7 coast is characterised by unspoilt and spectacular coastal scenery with few large population centres. It appeals to people who want to 'get away from it all' and enjoy nature. Popular outdoor activities include nature watching, walking, sailing and fishing. Tourism makes an important contribution to regional economies with around 10% of people employed in the tourism sector in some areas. The relative remoteness of the Northern Highlands and Western Isles means that they receive fewer tourists than south west Scotland and the coast of Northern Ireland.

The north coast of Northern Ireland has a developed tourist infrastructure and a number of coastal attractions. The Causeway Coast Way, for example, takes in attractions like the Giant's Causeway, Dunluce Castle ruins, and the Carrick-a-rede Rope Bridge. Beaches are used in the summer months, most of which are rural in nature. Ballycastle, on the coast of County Antrim is the only significant resort beach in the SEA 7 area and held a Blue Flag award in 2005.

Sailing and yachting is popular in the more sheltered coastal waters, bays and sea lochs, and particular routes are used to traverse along the Scottish west coast, Northern Ireland and between islands. There are 13 Royal Yachting Association (RYA) clubs in the region and a number of associated training areas, cruising routes and sailing areas. Other popular coastal recreational activities include golf, sea angling, swimming, surfing, canoeing, windsurfing and scuba diving.

Scenery, wild landscapes, unspoilt environment, nature and wildlife together comprise four out of the top five qualities attributed to Scotland and these are particularly important characteristics of the SEA 7 area coastline. Given their link to tourism in the region, future oil and gas development in the area should avoid negative impacts on the natural environment and coastal landscape.

Other locally important activities

Mining, quarrying and construction are important at some locations, including the Glensanda super-quarry. However, these activities are unlikely to pose a significant restriction to any future oil and gas activity in the SEA 7 area.

Appendix 3i - Cultural heritage, including architectural and archaeological heritage

The following sub-appendix is based on information provided by two technical reports *The scope of Strategic Environmental Assessment of Sea Area SEA7 with regard to prehistoric and early historic archaeological remains* (Wickham-Jones & Dawson 2006) and *SEA 7 Maritime Archaeology* (Wessex Archaeology 2006).

Prehistoric submarine archaeology

Ten thousand years ago relative sea level was up to 45m lower along much of the SEA 7 coast and this corresponds with the period of early human settlement in the area. Some of these now submerged areas remained exposed well into recent times (5,000BP) and are thus likely to have been settled through the Mesolithic and into the Neolithic. The lack of Mesolithic sites in the Western Isles is notable and probably explained by this history of sea level change. The dearth of sites means that any archaeological sites found on the submerged landscape of the SEA 7 area would be particularly important. Nevertheless not all archaeological sites will survive submergence by the sea.

Known and likely submerged sites

Many intertidal peat deposits and examples of submerged woodland have been noted along the western coastal stretches of the Hebrides. Recent storm activity in the Outer Hebrides has uncovered many new exposures of intertidal peats and on-going studies including those on Coll (Dawson *et al*. 2001), and Raasay (Dawson, in press), have provided evidence of a slowly rising relative sea level with still stands of sufficient length to permit the growth of woodland. Conditions like this would have permitted the local Mesolithic inhabitants to settle in the vicinity of the (now submerged) coastline.

In 1991 a scallop boat dredged a gold torc from the seabed near the Shiant Isles (Cowie 1994). This artefact was Bronze Age in date and assumed to relate to loss at sea, whether deliberate or accidental. The characteristics of the Sound of Shiant mean that this artefact could have travelled into the area from some distance, but the find also indicates that similar prehistoric material might occur elsewhere on the seabed. In 1981 a group of divers recovered a gold arm-ring from the seabed near to Ruadh Sgeir at the north end of the Sound of Jura (Graham-Campbell 1983). This artefact was dated to the Viking period, probably 10th century AD, and is assumed to have resulted from a loss at sea.

There is great likelihood of finds relating to the Mesolithic (10,000BP–6,000BP) and Neolithic (6,000BP–4,000BP) periods on the shallower parts of the Scottish shelf (down to c.-45m) in areas where the conditions for site preservation can be met.

Potential locations for the survival of archaeological material on the seabed include the shelf to the west of the Hebrides; the Hawes Bank and seabed around Coll and Tiree; and between and around Islay, Jura, Colonsay and Oronsay. Smaller locations include parts of the Rum and Canna coastline, sheltered inlets and reaches to the east of the Hebrides, and sheltered inlets around Skye. Recent research at the University of Ulster, Coleraine, has highlighted the previous existence of a low energy strait with various islands between the Northern Irish coast and the south Hebrides in the early Holocene (Cooper *et al*. 2002), confirming this area as a potential archaeological hotspot.

History of maritime activity in SEA 7

The SEA 7 area has been used extensively by seafarers from at least the Mesolithic up to present times. The waters between the north east of Ireland and Scotland have been used as a means of communication throughout the centuries; at one stage the Irish kingdom of Dalriada even sat on both sides of the North Channel. Maritime activity within the area would have started with simple log boats and hide covered vessels, moving up to Viking clinker built vessels and their successor, the Highland Galley.

The great innovations of the post-medieval period in ship design were stimulated by large-scale mercantile businesses carrying goods from around the world to Europe. For example, the Dutch East India Company (Verenigde Oostindische Compagnie or VOC) frequently travelled round Scotland and down the western side of Britain to avoid various naval battles, English privateers and prevailing winds in the English Channel. Three VOC wrecks have been located off Shetland and one (the *Adelaar*) within the SEA 7 area off Barra. There are likely many more similar wrecks in the area. Some of the first trans-atlantic crossings would have traversed the study area, and with the advent of steam the shipbuilding yards of Harland and Wolf in Belfast, and those on the west coast of Scotland and in the Clyde would have added to the volume of shipping across the area.

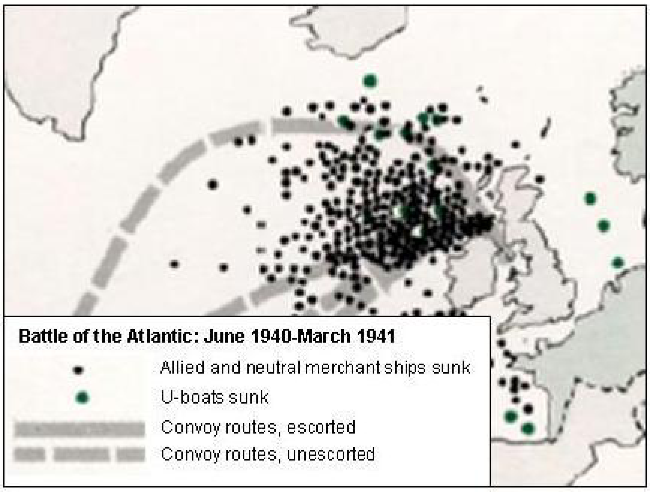


Figure A3i.1 - Shipping losses June 1940-March 1941

During both World Wars the SEA 7 area was one of the main supply routes into Britain. Convoys converged in the SEA 7 area, often near Rockall and were then escorted into home waters via the the North Channel between Ireland and Scotland. U-Boats were active during both wars and were responsible for considerable shipping losses in SEA 7 (Figure A3i.1).

The maritime cultural heritage around St. Kilda is currently protected as a World Heritage Site. The World Heritage Site of the Giant's Causeway and Causeway coast does not protect the maritime cultural heritage as yet, but may do so if its designation is reconsidered in the future.

Wrecks

There are more than 3,000 wrecks within the Northern Ireland shipwreck database, and the Royal Commission on the Ancient Historical Monuments of Scotland (RCAHMS) holds records for over 14,417 maritime sites. Whilst these figures give some indication of the number of wrecks located in the SEA 7 area, they are only a proportion of those lost.

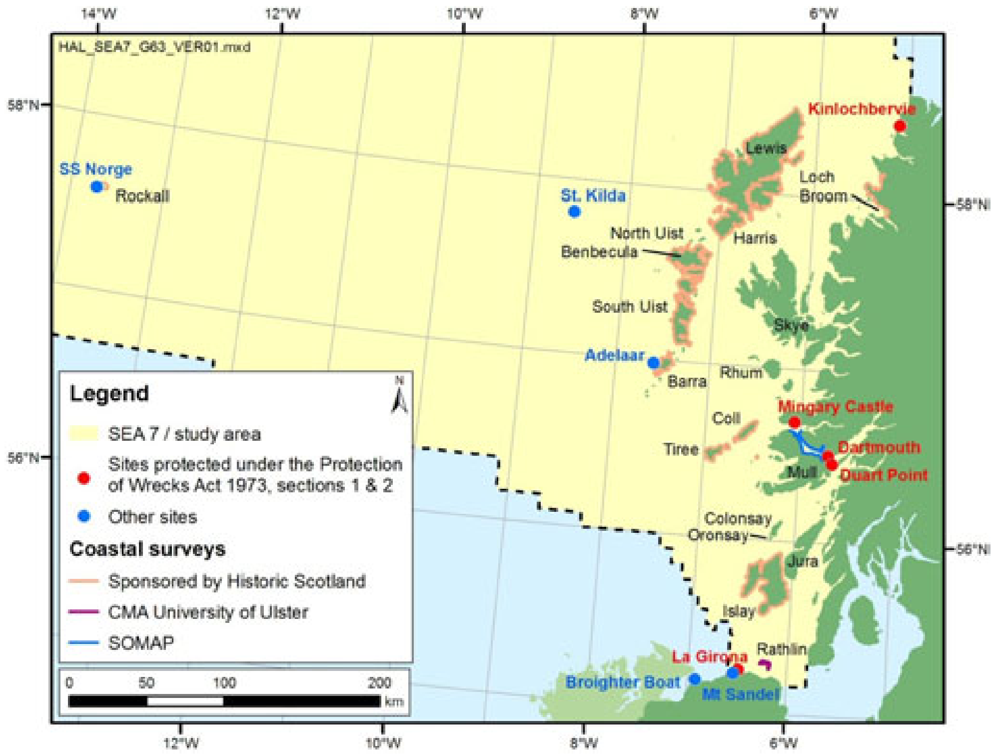
Existing records are likely to seriously under-represent losses of smaller vessels such as coasting craft and fishing boats. There is also no comprehensive record that can be relied upon for shipwreck losses prior to the 18th century and the recording of such wreck events is sporadic. These limitations and the inherent bias toward documented wrecks can give a misleading impression on the quantity and distribution of wreck and underwater sites.

One area of wreck concentrations is the Sound of Mull off western Scotland, where navigational hazards like submerged rocks combined with strong tides caused numerous shipping casualties. Two other extremely dangerous routes include the two main channels, notably the Minch between the Hebrides and the Scottish mainland and the North Channel connecting the Irish Sea to the Atlantic. In addition to the navigational danger, there were also historical and political reasons, with parties trying to obtain control over these entrances, for example during medieval periods, and especially during both world wars when U-boats focussed on these areas because of the convoys passing through them.

Protected wrecks

There are five wrecks protected under the *Protection of Wrecks Act 1973* within the SEA 7 area, the *Swan*, the Kinlochbervie wreck, *HMS Dartmouth* and the Mingary castle wreck off the Scottish coast, and *La Girona* off Northern Ireland (Figure A3i.2). These protected wrecks are described in more detail in Wessex Archaeology (2006).

Figure A3i.2 – Protected wrecks and archaeological surveys in SEA 7



Section Two of the *PWA 1973* provides protection for wrecks that are designated as dangerous due to their contents and is administered by the Maritime and Coastguard Agency (MCA) through the Receiver of Wreck (ROW). There is currently only two wrecks protected under this section and neither fall within the SEA 7 study area. However, it is highly likely, given the quantity of naval and merchant vessels lost with the SEA 7 area during both World Wars, that wrecks containing dangerous cargo may be located in the future.

To date no wrecks are protected under the *Protection of Military Remains Act 1986* in the SEA 7 area. However, given the volume of naval and merchant shipping, aviation and U-boat activity in the area during both wars, the potential identification of vessels eligible for designation is high.

Relevant archaeological investigations

Maritime

Apart from the work undertaken at the protected wreck sites, shipwreck research on the Scottish west coast has mainly focussed on the Sound of Mull area. The Nautical Archaeological Society Scotland (NAS Scotland) initiated the *Sound of Mull Archaeological Project* (SOMAP) which has been running since 1994. This has been directed at three of the four protected wrecks within the Scottish part of the SEA 7, the *Swan, HMS Dartmouth* and the Mingary castle wreck site as well as several other wrecks (e.g. *SS Hispania*, *SS Shuna*, *SS Rondo*, *John Preston*, the Scallastle Bay wreck site and the *Thesis*).

In 1997, the University of Ulster in partnership with the Environment and Heritage Service Northern Ireland embarked on a programme of seabed mapping to record the submerged and buried archaeological resource. This research has imaged 80 19th and 20th century wrecks, and 20 targets of further archaeological potential (Quinn *et al.* 2000). In 1999, a reconnaissance side-scan sonar survey combined with diving investigations around Rathlin Island identified 13 shipwrecks (Quinn *et al.* 2002).

The Irish National Seabed Survey (INSS) is a seven year project which started in 2000. The multibeam sonar dataset obtained as part of the survey highlighted many shipwrecks on the Irish seabed and suggests that a similar potential exists within the adjacent SEA 7 area (INSS website - www.gsiseabed.ie/).

Coastal

Figure A3i.2 above highlights the extent of coastal archaeological surveys in the SEA 7 area. These include the recent *Coastal Zone Assessment Surveys*, mostly sponsored by Historic Scotland (HS), which covered around 20% of the Scottish coastline. Within the SEA 7 area, the survey was targeted to the Isles of Lewis, North and South Uist, Benbecula, Barra and Vatersay on the Outer Hebrides, to Islay, Coll, Tiree, Fladda and Lunga on the Inner Hebrides and to the peninsula surrounding Inverpolly Forest on the mainland (Ashmore & Dawson 2002, Dawson 2003).

The Centre for Maritime Archaeology (CMA) has mapped and documented approximately 200 sites around the shores of Rathlin Island off Co. Antrim. In 2004, several excavations were carried out as part of the *Rathlin Island Research Project*, undertaken by the Centre for Archaeological Fieldwork of the Queen's University Belfast in partnership with the CMA.