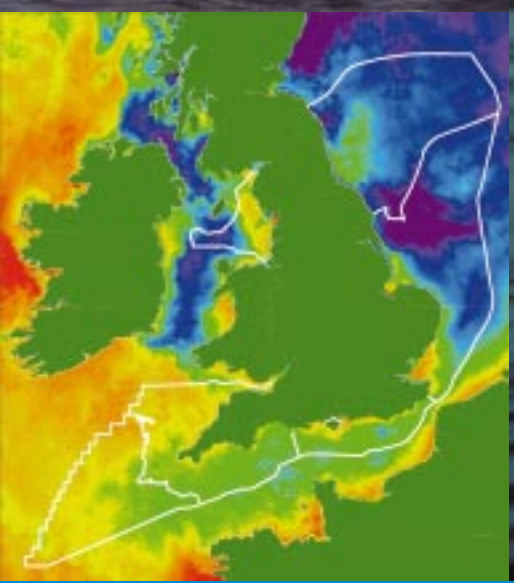
ENGLISH NATURE

The Western Approaches Marine Natural Area

A contribution to regional planning and management of the seas around England



working today
for nature tomorrow

Foreword

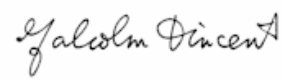
Over the last few years, there has been a greater recognition not only of the need to manage our maritime environment in a more holistic way, but also the ways in which this might be achieved. In their report *Safeguarding our Seas*, Defra (2002a) set out a vision and ideas to address this need, founded on an ecosystem approach. English Nature also set out the case for such an approach in its *Maritime State of Nature* report (Covey & Laffoley 2002). Both documents emphasise that we need to take a more integrated approach to managing human activities in order to restore and maintain healthy ecosystems. This will benefit both present and future generations. The UK Government's commitment to developing this approach is reflected in various European and international statements such as the output of the World Summit on Sustainable Development. The challenge now is how to put the ecosystem approach into practice. The Marine Natural Areas concept and the information set out in this document is a positive step forward in meeting this challenge.

English Nature initially conceived the idea of 'Natural Areas' on land and in the nearshore zone. They were identified on the basis of their underlying geology, natural systems and physical processes. As wildlife is not restricted to designated sites, Natural Areas provide an essential context that help us to manage specific sites better. They also help us to understand the nature conservation value of the wider countryside. Natural Areas provide a strategic framework for English Nature, in consultation with stakeholders, to set objectives at a broad scale, to plan action and resources to achieve these, and to bring partners on board. It was a logical step to extend the concept into the marine environment. So, English Nature has identified and described, together with the Joint Nature Conservation Committee and in consultation with other organisations, six Marine Natural Areas. Though the boundaries of the Marine Natural Areas reflect a number of natural factors, the boundaries only encompass the seas around England, not other parts of the UK. However, we hope that the approach set out here, together with initiatives such as the Review of Marine Nature Conservation's Irish Sea Pilot project, will help catalyse a more comprehensive approach to regional seas that incorporates areas of sea beyond England's borders.

Marine Natural Areas take account of natural processes and the interaction between them, the underlying geology and wildlife. They offer a biogeographic framework within which we can develop and implement an ecosystem approach to managing human uses of the marine environment. The information contained within this report provides advice on the nature conservation value of large areas of sea. It also outlines our knowledge of where natural features are and the context this provides for a variety of human uses. This information should continue to be updated and refined. Such spatial data is essential if we are to consider tools such as sea use planning for the range of activities that occur in the marine environment.

We need a healthy, resilient marine environment supporting biodiversity and a variety of sustainable economic uses. That requires new ideas and initiatives and as such we commend this report as a contribution to the debate about how best to achieve this.

Sue Collins
Director Policy
English nature



Malcolm Vincent
Science Director
Joint Nature Conservation Committee

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*Joint first authors

1 Introduction

1.1 Definition and role of Marine Natural Areas

Marine Natural Areas are areas of sea around England that have been identified using oceanographic processes, bathymetry and biogeographic characteristics to define broad natural divisions in the marine environment. Marine Natural Areas seek to identify ecologically relevant boundaries at a broad scale for which ecologically relevant objectives and targets can then be identified. Like Natural Areas identified in the terrestrial and nearshore environment[1], Marine Natural Areas emphasise the importance of natural processes, the interaction between these, geology, and wildlife. We have identified six Marine Natural Areas, as explained below.

Natural Areas offer a biogeographic framework within which to develop and implement an ecosystem approach to managing human activities (see Appendix 1) and to securing a sustainable future for the marine environment. However, we recognise that the basis of 'regional seas' is likely to evolve as interest in a regional approach to the marine environment gathers momentum. This is especially so in relation to Scotland, Wales and the Irish Sea, as the boundaries of our Natural Areas are currently restricted to England's borders.

We hope that the Marine Natural Areas and the information presented in this document will be of use to those interested or involved in the stewardship of our seas. This includes those responsible for planning, regulating or managing human activities, other agencies, local, regional and national Government and the wider public. In particular, we hope that the Marine Natural Areas:

- provide an ecological rationale for defining broad regional units;
- suggest an appropriate scale and potential framework in which to manage and govern the seas adjacent to England;
- provide information on habitats and species, physical features and nature conservation importance across the wider marine environment, and the key human activities relevant to these;
- complement or assist other initiatives, such as the 'regional seas' approach currently being piloted under the Defra-led Review of Marine Nature Conservation[2];
- presents information in a structured and easily accessible manner which can be adapted for use by others as required.

[1] 120 Natural Areas, including 23 coastal Natural Areas, each identified by distinctive habitats, physical features and species that distinguish it from neighbouring areas. (Profiles for terrestrial and coastal Natural Areas can be found at **(**www.english-nature.co.uk/Science/natural/NA_search.asp**)**

[2] The Irish Sea Marine Natural Area is only part of the area covered by the Irish Sea Pilot (ISP). The ISP Project has dealt with some of the issues discussed in the Marine Natural Area profile in much more detail. We have published the Irish Sea Marine Natural Area Profile because it contains some information not considered by the ISP. It also highlights what could be achieved in other regional areas by building on Marine Natural Areas.

English Nature will continue to use and build on Marine Natural Areas, within the context of our developing Maritime Strategy and initiatives led by the Joint Nature Conservation Committee (JNCC), Government and others. We will use them to:

- draw up objectives and targets for nature conservation at a regional scale together with key stakeholders and Government;
- promote a strategy and policies for the management of seas around England; and
- manage our work and resources to achieve objectives and targets, including those under the UK's Biodiversity Action Plan.

1.2 The basis for Natural Area boundary selection

Marine Natural Areas take account of oceanographic processes, bathymetry and broad biogeographic characteristics. Using these features as a basis for delimiting the individual areas, English Nature explored options with the Joint Nature Conservation Committee to identify the six Marine Natural Areas shown in Figure 1.1.

The boundaries between adjacent Marine Natural Areas are partly based on the 50 metre isobath. This is the approximate depth at which wave action on the seabed (a mechanism for driving sedimentary processes) tends to become of minimal significance. The 50 metre isobath also marks the transition between shallow, well-mixed turbid conditions and deeper, seasonally stratified waters such as that found in the North Sea (Brampton and Evans 1998). This delineation between well-mixed and seasonally stratified water masses is significant in plankton dispersal and therefore in distinguishing between marine biological assemblages (Hiscock 1996). In addition, such transitions sometimes form 'fronts' with associated high biological productivity. For example, the distribution of seabird breeding colonies may indicate not only suitable nesting conditions, but also the distribution of important marine feeding grounds, for example to the north east of Flamborough Head (Skov *et al* 1995).

Broad biogeographic characteristics were also used to set the boundaries between some of the Marine Natural Areas. In particular, a well established biogeographical transition has been used to derive the boundary between the English Channel and South Western Peninsula Natural Areas. The transition occurs between the relatively warmer Boreal-Lusitanean region to the west and colder Boreal region to the east. Such a transition has a marked influence on the distribution of temperature-sensitive marine species (Hayward and Ryland 1995). The boundary selected, ie a line running from Portland to Cherbourg, was recognised by Holme (1966), who divided the English Channel on the basis of differences in tidal streams and water temperature stratification either side of this boundary, and is the same as that used by Dinter (2001) in relation to the OSPAR Convention.

The offshore extent of Marine Natural Areas is the 200 nautical mile limit or the median line of UK Controlled Waters[3].

[3] There are clear differences in the legal and institutional frameworks within 12 nautical miles (Territorial Waters) and beyond (UK waters). For example, beyond 12 nautical miles, the remit for providing advice on nature conservation changes from English Nature to the JNCC. However, wildlife and human activities cross such artificial administrative boundaries and therefore there is a need to work closely together to address issues of common concern. For the same reason, we feel it would be inappropriate to limit Marine Natural Areas to the 12-mile administrative boundary. For convenience, the term 'seas adjacent to England' is used when referring to waters within and beyond 12 nautical miles.

Inshore, we have used the Mean Low Water Mark as the boundary of the Marine Natural Areas. This means that the Marine Natural Areas overlap with the previously identified coastal Natural Areas (which extend from about 6 nautical miles to above Mean Low Water). These were based on the coastal process cells and sub-cells in which sediment movement is largely contained within discreet zones. However, the Marine Natural Areas span much greater areas as they reflect other, broader scale processes and the need to take account of large areas for pelagic species.

Estuaries and inlets are generally excluded from Marine Natural Areas as they are already covered within Coastal Natural Area descriptions. However, in discussing and implementing an ecosystem approach to the maritime environment, it will be essential to take account of Coastal and Marine Natural Areas together.

1.3 The audience for this document

We hope that the Marine Natural Areas and the information presented in this document will be of use to those interested or involved in the stewardship of our seas. We envisage this will include those responsible for planning, regulating or managing human activities. This document is therefore aimed at a wide audience that includes local authorities, regional government, and the Regional Development Agencies. We hope that the Marine Natural Area will also be of interest to a wider public as well as to national government, other agencies, marine authorities, industry and the scientific community.

1.4 The aim and structure of this document

The main product from our work on Marine Natural Areas is a series of 'profiles', documents which provide a thumbnail sketch of each Area including its physico-chemical characteristics, key habitats and species, and, in brief, relevant human activities.

These documents are not intended to be a comprehensive description of all the wildlife and human interest within each area. Rather, they aim to highlight and describe key features of each Marine Natural Area from a nature conservation perspective. The main text begins with a description of the geology, physical processes and chemical conditions of each Natural Area. This provides the 'big picture' within which to consider nature conservation and human values of the area. The next two sections briefly describe the nature conservation value of the area in terms of habitats and then species. The final descriptive section outlines significant human activities.

Whilst we are publishing paper copies of the documents, the profiles will also be provided on CD and via the Internet (www.english-nature.org.uk). This is largely to facilitate use of the text by others, eg those progressing a regional approach to managing the marine environment.

Whilst the document contains some technical information it does not attempt to go into any great level of detail on any particular topic. Therefore the reader may wish to follow up on a particular topic by referring to other technical reports such as the JNCC's *Coastal Directories,* the Marine Nature Conservation Review (eg Hiscock 1996), the Joint Cetaceans Atlas (Reid *et al* 2003), and Regulation 33 advice published by the Agencies for European marine sites designated under the Habitats and Birds Directives. Further sources of relevant information and links to websites can be found at www.english-nature.org.uk and

www.jncc.gov.uk. This document also provides references to material from other organisations.

A glossary of terms used throughout this report can be found in Appendix 4.

1.5 Geographic Information System

In addition to producing the profiles, English Nature has used a Geographic Information System (GIS) to hold and display the data referred to in this document. A number of other organisations have provided the data including the British Geological Survey (BGS), Centre for Environment, Fisheries and Aquaculture Science (CEFAS), the Crown Estate and Department for Environment, Food and Rural Affairs (Defra). GIS is invaluable for viewing data on different subjects altogether, often enabling a better understanding of the interaction between them. The Marine Natural Areas GIS is no exception and allows more detailed and dynamic use of data than can be shown in document form. We hope that the data will be useful in the further development of Marine Natural Areas and the implementation of any regional seas approach. We also hope to make the data available more widely but this will require agreement with those organisations that have provided data. Such access may be facilitated by initiatives to improve data sharing and integration in response to recommendations in *Safeguarding our Seas* (Defra 2002a).

1.6 Conservation objectives

We hope that the information set out in these profiles will contribute to a more comprehensive regional seas approach. We also intend to develop nature conservation objectives relevant to each Natural Area. However, we will do this within the current debate and emerging ideas about conservation objectives for broad sea areas, particularly through the work of the Irish Sea Pilot (see Lumb *et al* 2004 for example). This work will depend on the extent to which Marine Natural Areas become part of a more comprehensive regional approach to managing the seas around the UK.

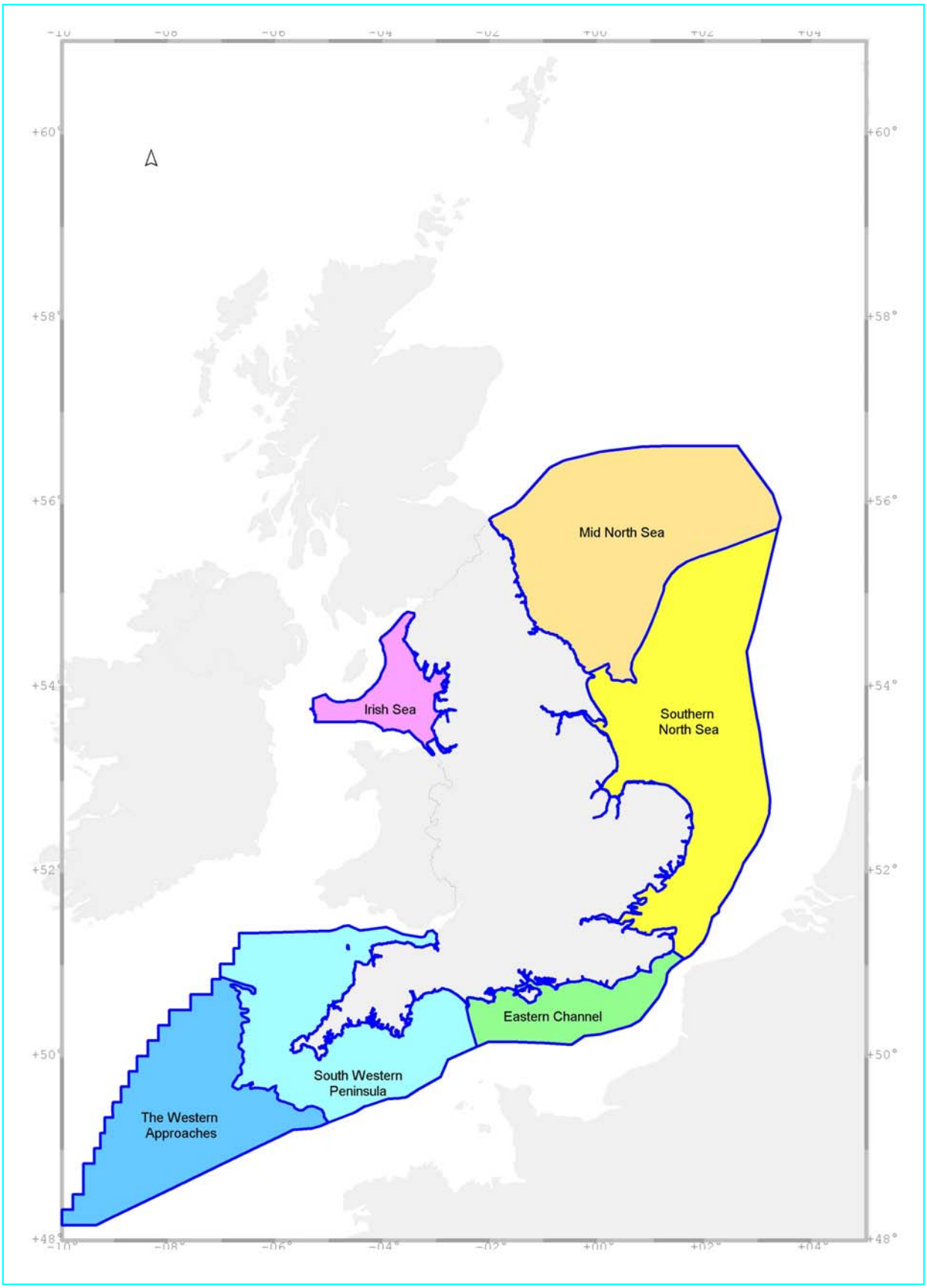

Figure 1.1 The six Marine Natural Areas around England.

2 General summary

This Marine Natural Area includes the expanse of open ocean that forms what is historically known as the Western Approaches (Figure 2.1). The eastern boundary follows the 100 metre isobath, running south from the northern corner and then, to the west of the Isles of Scilly, south eastwards to the median line. This boundary was chosen to represent the delineation between the shallow coastal and deep offshore waters. The boundary then runs south westwards to the limit of the UK Continental Shelf Designated Area (ie the area within which UK sovereignty is exerted over the seabed). The north west boundary has an unusual 'stepped' appearance as it follows the official UK median line[4]. The western part of the Marine Natural Area lies just on the edge of the continental shelf (Pater 1999). This Natural Area lies adjacent to the South Western Peninsula Marine Natural Area (Figure 1.1)

When compared to the other five Marine Natural Areas around England's coastline, relatively little is known about the Western Approaches. Surveys have been carried out to assess the types of sediment and hard substrata which cover the seabed, although the survey coverage of the area is incomplete. The Natural Area includes all the offshore broad habitat types included within the UK Biodiversity Action Plan (BAP) and supports numerous pelagic species also recognised in the BAP. Much of the seabed is composed of mixed sand and gravel sediments, with muddy sand being more prevalent in the northern part of the Marine Natural Area. Hard reefs are limited to two discrete areas along the western edge of the Natural Area. There are two priority habitats (as defined by the UK Biodiversity Action Plan) in the Natural Area: sublittoral sands and gravels, and mud habitats in deep water. There are no protected areas for habitats within this Natural Area, although work is currently underway to identify potential SACs.

The marine conditions influencing the Natural Area are those most associated with the Lusitanean biogeographical region (Dinter 2001), which has its centre further to the south. The plankton is characteristic of species associated with the North Atlantic Drift with some temperate shelf sea species (Lee & Ramster 1981). Species considered at the'edge of their range' and which are more normally associated with warmer waters to the south (including the Mediterranean), such as turtles and some exotic fish species, are occasionally reported within this Natural Area (Pater 1999).

Several important species (described under the chapter 'key species') occur within this Natural Area, including a wide range of cetaceans and the basking shark. Several of these key species are covered by UK Biodiversity Action Plans (BAPs). There are grouped BAPs for dolphins, baleen whales, toothed whales, marine turtles and commercial marine fish species, with a single species BAP for the basking shark. There are no protected areas for species within the Marine Natural Area as yet, although the identification and selection of offshore marine Special Areas of Conservation for species interest features, and Special Protection Areas for birds, is underway.

The main commercial activity within this Natural Area is fishing. The main commercial fish species targeted are mackerel, hake, cod, megrim, plaice and sole.

[4] The official UK median line follows "the exact limits of the UK Continental Shelf as set out in orders made under section 1(7) of the Continental Shelf Act 1964".

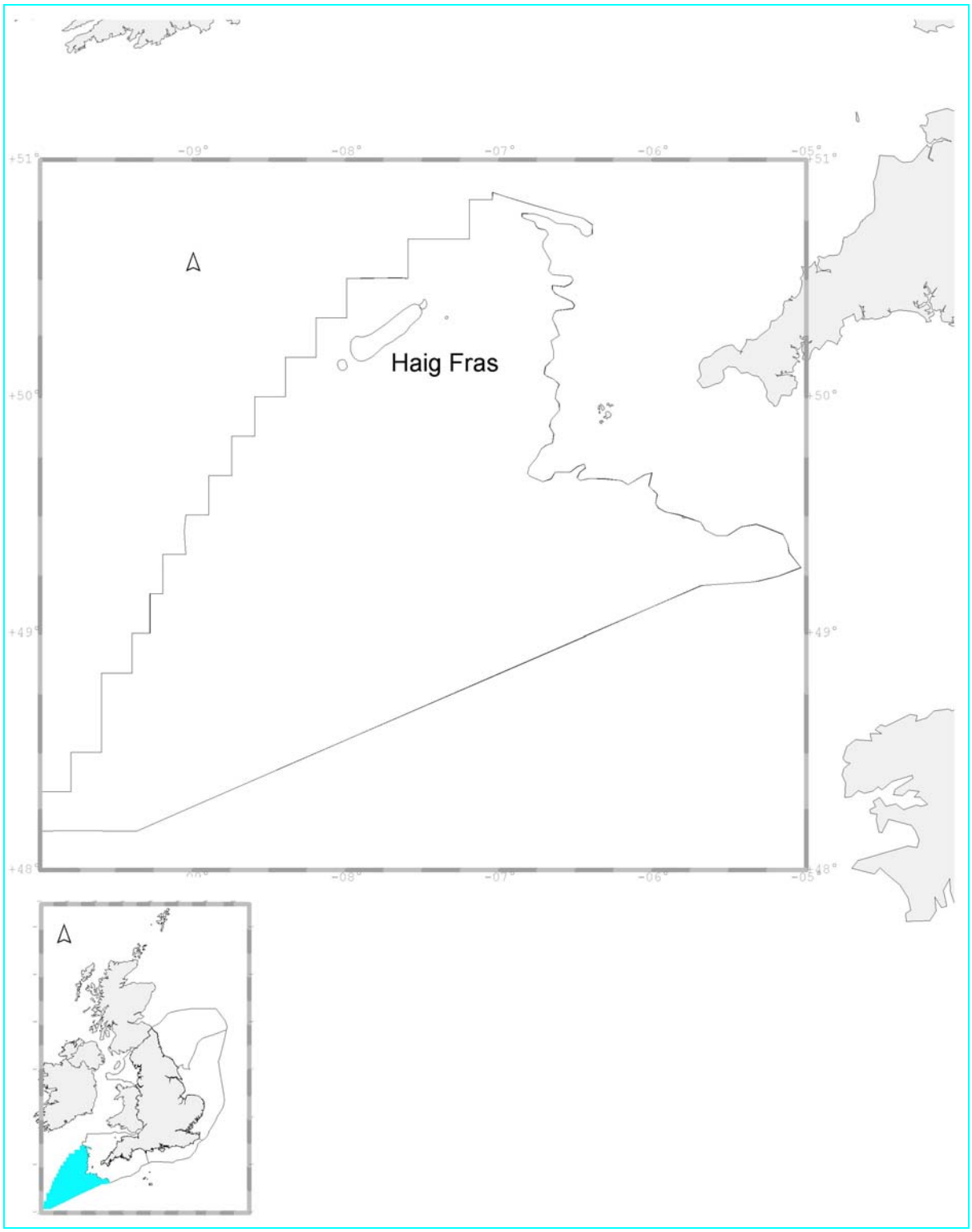

Figure 2.1 Western Approaches Marine Natural Area.

3 Physical environment and character of the Natural Area

This section outlines the geology, physical processes and chemical characteristics of the Natural Area. It describes the underlying processes that determine the presence of natural features and biodiversity, and which in turn influence human activities. For simplicity, the human influences on physical and chemical characteristics, such as water quality, are described in the same section.

3.1 Geology

The geology of the Natural Area influences the morphology of the seafloor, the distribution of seafloor sediments, and the distribution of many of the associated habitats. Many of these influences form a complex set of inter-relationships. The broader geological patterns (such as range of rock types and geological structures) were set in the early geological history of the area. But, more recent geological events (in particular the sea-level changes associated with glaciation, as well as the glaciers themselves) have had a profound effect upon the distribution of modern seafloor topography and sediments. Given the complex geology, the description given below is necessarily brief.

The Natural Area is underlain by bedrock ranging from late Precambrian to Neogene in age. Pleistocene and Holocene sediments of variable thickness rest upon the bedrock. The outcrop pattern of the bedrock shows predominant east west or east north east – west south west trends. This reflects a complex history of continental separation, continental collision, crustal extension, thinning and rifting. The diverse range of rock types in the Natural Area represents this complex history.

During the Devonian and Carboniferous Periods, most of this area was covered by sea. The collision of Britain and Ireland with France during the Carboniferous led to the folding and metamorphosis of these rocks. It also caused the intrusion of the granites that extend westwards at depth from the Scillies, forming part of the Cornubian Ridge, but these are at the surface on the Haig Fras Platform to the north. During this process deep low-angle thrust faults developed. The faults were reactivated later as the crust underwent extension during the earliest stages of the opening of the Atlantic Ocean. The effect of this extension was to open up a series of elongate troughs with a general east-west orientation, and a second set at the western margin of the area with a predominant north north west – south south east trend. In the eastern part of the Natural Area these troughs or sedimentary basins were the focus for the deposition of sediment of Permian through to Eocene age. The red sandstones, conglomerates and mudstones of the Permian and Triassic were deposited in deserts, arid alluvial plains and coastal plains. Mudstones, sandstones and limestones of a marine origin were deposited over the eastern part during the Jurassic and Cretaceous. In the west of the area at the shelf break, Permian to Triassic sediments are not present as they were either never deposited or were removed by erosion, as a consequence of the uplift prior to the rifting and opening of the North Atlantic. Late Cretaceous global sea-level rise resulted in chalk being deposited throughout the area. With a few breaks, sedimentation continued into the Eocene when regional uplift, associated with the growth of the Alps, eventually led to the erosion of tertiary rocks beyond the South Celtic Sea Basin. The western half of the area is

underlain by Miocene to Pleistocene sediments that thicken progressively towards the shelf break.

Most of this area lies to the south of the Pleistocene ice sheets. As a consequence of low sea levels during the Pleistocene any sediments deposited during periods of high sea level were removed by erosion. It is only in the western part of the area that sediments deposited during the rise in sea level at the end of the last glaciation are preserved.

Much of the seafloor in the Natural Area is covered with a thin layer of sediments (mainly sands and muds) that have been deposited over the past 10,000 years (see Figure 3.1). These are still partially mobile. The grade of the sediment, its degree of sorting, mobility and carbonate content all have an influence on the types of habitats that can develop on these substrates, and are largely indirect and are controlled by the bedrock topography.

In some cases the links may be more direct. Raised areas such as Haig Frais are influenced by the presence of the granite intrusions and contain rock and boulder reefs. Rock reefs are also associated with the steep fault scarps present at the shelf break. During the sea-level rise that followed the last glaciation, tidal sand waves developed on the outer shelf. The sediment starvation that took place as sea level continued to rise, caused the sand waves to be left as relict features in the western part of the area below 120 metres OD.

3.2 Bathymetry

The depth of the seabed for the whole of this Natural Area is greater than 100 metres (see Figure 3.3). The north eastern boundary of the Natural Area follows the 100 metre depth contour. The seabed then gradually slopes away in a south westerly direction to 200 metres, after which the gradient increases at the edge of the continental shelf.

One noticeable anomaly to the gradual slope of the seabed is the granitic sea mount of Haig Fras, located approximately 110 kilometres north west of the Isles of Scilly within the Celtic Sea (see Figure 4.4). This outcrop, which measures approximately 45 kilometres by 15 kilometres, rises from a surrounding seabed depth of 100-110 metres to within 38 metres of the surface. There is also a system of relict sand waves present within the south western part of the Marine Natural Area. These run approximately south west/north east and extend along their length for 50 kilometres or more. The waves, which are likely to be a mixture of sand and gravel, may vary in height from 3-40 metres and have wavelengths of at least several hundred metres (Lee & Ramster 1981). Typically, one side of the wave is steeper than the other (Lee & Ramster 1981).

3.3 Tidal currents and range

In the Atlantic Ocean the tidal streams are very weak, but as they reach the shallower areas of the European continental shelf, their magnitude increases greatly. Throughout the Natural Area, maximum tidal current speeds during mean spring tides range from 0.5 to 2 knots. Current speed maxima during mean neap tides are approximately 40-50% of these values (Lee & Ramster 1981).

The driving force behind water movements within this Natural Area is the North Atlantic Drift. Having started out as the Gulf Stream in the Caribbean, the North Atlantic Drift divides to the south west of Ireland, with one mass of water moving north eastwards off the

western coast of Ireland and the other heading south eastwards towards the Bay of Biscay (Lee & Ramster 1981). It is this latter body of water which has the most influence within this Natural Area, particularly with regard to the presence of oceanic species here and nearer to the south west peninsula. Whilst the general near-surface direction of water movement is from the north west, there is also a gyre close to the southern Cornish coast at the entrance to the English Channel. This may produce a smaller current in the northern part of the Natural Area, from the north east. A further deep-water current flows northwards from the Mediterranean, surfacing in the Western Approaches and continuing northwards and eastwards to influence the whole of the south west peninsula and beyond. This current in particular is of great importance to the distribution of larval stages of 'warm water' species to the south west.

Within the Western Approaches, the tidal range at mean spring tides is between 3-4 metres (Lee & Ramster 1981).

3.4 Sea-level change

3.4.1 The past and present

Changes in sea level arise from the combined effect of two phenomena. The first are 'local crustal movements' where Scotland is rising and southern England sinking, due to the removal of the weight of ice since the last glacial period. This is also known as isostatic or post-glacial adjustment. The second is a global rise in sea level, which has been estimated as rising at between 1.5 and 2 millimetres per year (IPCC 2001). This is known as eustatic sea-level change.

Geological evidence for sea-level change in the past may be found in the presence of fossil coastlines (raised beaches, etc) on or inland from the present shorelines, or in the presence of peat and alluvial gravels on or below the sea floor. Multiple or individual raised beaches, ie former beaches which are now higher than the contemporary shoreline or platforms, may produce a stepped or staircase profile to the coast. These features are higher than their modern equivalents, implying a higher sea level during their formation. There is also evidence for shoreline change in deposits below present sea level and this indicates where coasts have been submerged since the sediments were laid down.

Sea-level rise is occurring within this Natural Area, but there are no figures available relating to the changing levels within this area. It is not clear as to whether a rise in sea level of the magnitude currently estimated will produce any significant impacts within this Natural Area.

3.4.2 The future

As with all predictions of climate and sea-level change, the following figures carry a range of uncertainty with them. Global mean sea level increased by 1.0–1.5 millimetres per year during the 20th century. The Intergovernmental Panel on Climate Change (IPCC) have predicted that mean sea level would rise by 48 centimetres by 2100 and the range will vary by 9-80 centimetres, as a result of the thermal expansion of ocean water and melting ice from the poles. Although perhaps not of direct relevance to this Natural Area, it should be noted that the rise in sea level relative to the land will be greater than the global average in the southern and eastern England Natural Areas because the land here is sinking. The predicted increase in storminess around our coasts may be of greater significance. A good source of

further information is on the Proudman Oceanographic Laboratory website (www.pol.ac.uk/ntslf/reports).

3.5 Water temperature

Sea surface temperatures in this Natural Area are strongly influenced by the Gulf Stream. There is also a smaller, yet still significant, warm-water Lusitanean current that emerges from the Mediterranean and flows northwards across the Bay of Biscay, influencing the marine life present around the south western peninsula.

Average February surface water temperatures at the edge of the continental shelf (some 200 kilometres south west of Land's End, and at the south western extreme of this Natural Area) are 10.5 ºC, more than 1 ºC warmer than Cornwall's coastal waters. In August, surface water temperatures are on average 16 ºC, with mean bottom temperatures only reaching 10-11.5 ºC at the edge of the continental shelf (Lee & Ramster 1981). A thermocline (temperature gradient) develops between the surface and bottom water during the late spring and remains throughout the summer. This has a bearing on the composition and abundance of the plankton present in the surface waters at this time.

3.5.1 Predicted rises in seawater temperatures

According to UK Climate Impact Programme predictions (www.ukcip.org.uk), a gradual rise in seawater temperature in the coastal waters surrounding Britain and Ireland may already be occurring, and by 2100 average temperatures may be 2 °C higher compared to 2000. Air temperatures are also rising. Hiscock *et al* (in prep) report that it is most likely that seawater temperatures in inshore waters around Britain and Ireland will increase progressively over the next 50-100 years, according to the most recent predictions and historical precedents. By the 2050s, surface seawater temperatures may be as much as 2.5 °C higher in summer and 2.3 °C higher in winter than in 2000 (Viles 2001). Hiscock *et al* (in prep) predict the effects that seawater temperature rises may have on marine wildlife. Increasing temperature may induce changes in the abundance and distribution of species, but there will not be a wholesale movement northwards of southern species, or a retreat northwards of northern species. Factors such as the hydrodynamic characteristics of water masses, the reproductive mode of species, the presence of geographical barriers and the longevity of already established species will be important in determining whether or not there is a significant change in species distribution and abundance in the next hundred years.

3.6 Salinity

Salinity values are typical of oceanic water, with surface values ranging from 35.3-35.6 in February and from 35.2 to 35.5 in August (Lee & Ramster 1981).

3.7 Water quality

About 80% of marine pollution comes from a variety of land-based activities (Defra 2002a). Most pollutants enter the marine environment through direct discharges of effluents or land run-off (mainly via rivers). The highest concentrations of contaminants, and hence the greatest effects, are therefore often in inshore areas. Additional inputs include sources at sea (ships, offshore platforms, dumping of dredged materials) and atmospheric deposition. On

entering the sea, the fate and behaviour of chemicals will vary markedly depending on their physio-chemical properties, and the physical characteristics of the receiving environment.

With its remoteness from land-derived sources of pollution, and the flow of water into the area coming primarily from the west/south west, there is little monitoring of water quality within this Natural Area. However, based on the limited studies undertaken, there is little evidence of pollution. The following section provides a summary of the water quality in the Natural Area, including consideration of sediment and biota quality.

3.7.1 Turbidity

Turbidity is a measure of the decrease of light in down through the water column and is mostly due to suspended particulate matter (SPM), including plankton; plankton is dealt with in greater detail in section 4.1.1. Turbidity can affect water quality in a number of ways, especially in relation to oxygen levels, algal growth, nutrient cycling and the availability of particle reactive contaminants. However, most of these impacts are only likely to occur in estuarine or near-shore areas.

The oceanic waters of this Natural Area are virtually free of all terrestrially-derived suspended sediments. Consequently, turbidity levels for the most part are extremely low, although occasional plankton blooms at the surface increase turbidity temporarily.

3.7.2 Non-toxic contaminants

3.7.2.1 Organic matter

The organic matter present within this Natural Area will be almost wholly due to the breakdown of marine animal and plant tissue. The typical inputs of organic matter from terrestrial sources (such as erosion of coastal material or anthropogenic sources such as sewage treatment works, industrial effluents and agricultural run-off), are so remote as to be negligible.

3.7.2.2 Nutrients

Nutrients (dissolved and particulate forms of nitrogen, phosphorus and silicon) play an important role in aquatic ecosystems as they form the basis for primary productivity. The levels of nutrients within the oceanic waters of this Natural Area are low for much of the year, and are not significantly influenced by nutrient-rich freshwater inputs. Slightly raised levels will occur as a result of winter storms, when lighter seabed sediments are suspended releasing nutrients into the water column.

3.7.3 Toxic contaminants

3.7.3.1 Oil

The input of any petroleum hydrocarbons within this Natural Area is most likely to be the result of sea-based activities – ie from shipping or oil/gas extraction (see also sections 6.4 and 6.2 respectively). Oil spills from ships and offshore installations can be the result of both legal and illegal discharges or accidents. The majority of these spills consist of ship's 'bilge

oil', and, increasingly, heavy fuel oil, but crude oil and lubricating oils also occur along with non-mineral oils (OSPAR Commission 2000).

Currently, there is no oil exploration or exploitation activity within this Natural Area to produce discharges from cuttings. In addition, as a result of UK legislation, the discharge of oil and synthetic oil-based drilling fluids has effectively ceased in other areas of the UK continental shelf, particularly for exploration drilling (pers. comm., Mick Borwell, UKOOA).

3.7.3.2 Trace metals

Trace metals reach the marine environment predominantly via rivers, direct discharges, and from some sea-based activities, such as exploitation of offshore resources and disposal of dredged materials. Highest concentrations of trace metals are found near freshwater outlets, with much lower levels in the open sea. CEFAS (1998) reported relatively low levels of metals in water collected within this Natural Area, compared to other sites around the UK. These results could be explained by the correspondingly high salinity, reflecting little influence from fresh water inputs.

3.7.3.3 Trace organics

It has been estimated that there are probably more than 60,000 organic pollutants present in the marine environment (Maugh 1978). The following section provides information on some of the more commonly studied groups of chemicals.

Organo-tin compounds

Tributyl tin (TBT) is widely used as an anti-fouling agent in paint for ships. Its use has been banned for vessels under 25 metres in length since 1987, since it was shown to be having a harmful effect on species of mollusc such as dogwhelks and oysters. However, it is still commonly used in vessels over this length. These vessels still act as a major input source to the marine environment. TBT concentrations in offshore waters are generally less than 1 ng/l when compared with values recorded up to 100 ng/l in frequently used waterways. The current Environmental Quality Standard for tributyl tin in seawater is 2 ng/l (Cole *et al* 1999). CEFAS (2001) could not detect TBT in water collected at any offshore stations.

Thomas *et al* (2000) concluded that there would be little accumulation of TBT in offshore sediments. However, TBT has been detected in the tissue of pelagic cetaceans, for example CEFAS (2001) reported concentrations in the livers of a variety of species inhabiting coastal waters of the UK.

The International Maritime Organisation adopted a Convention on the Control of Harmful Anti-fouling Systems at a Conference in October 2001. Amongst other measures, this (a) prohibits the application or re-application to ships of organo-tin (TBT) compounds as biocides in antifouling systems from 1 January 2003; and (b) requires that vessels already painted with organo-tin compounds acting as biocides either remove the paint or cover it with an impermeable barrier by 1 January 2008[5].

[5] The provisions of the Convention are being implemented in Europe by two instruments:

Polychlorinated biphenyls (PCBs)

Historically, the majority of PCBs entering coastal waters have been from river inputs, whereas atmospheric deposition was a more important input to the open sea. The main source has been the disposal of electrical equipment (OSPAR Commission 1998). It is estimated that more than 90% of the total release of PCBs occurred before 1980, though low levels of release do still occur. Due to the hydrophobicity (water repellence) of these compounds, concentrations in surface waters are extremely low, and in most cases undetectable (MPMMG 1998). PCBs may also accumulate in sediments and accumulate up the food chain, and can therefore usually be detected at low levels in sediment and wildlife. However, these will be markedly higher in nearshore areas rather than the open sea.

Polycyclic aromatic hydrocarbons (PAHs)

PAHs are formed during the incomplete combustion of fossil fuel, and are also components of petroleum products. They can enter the open ocean via industrial and sewage discharges, surface run-off, atmospheric deposition and oil spills. MPMMG (1998) found that the highest concentrations of PAHs in the water column were in estuaries. Like PCBs, most PAHs show a strong affinity for particulates, and will accumulate in sediments and may bioaccumulate up the food chain.

CEFAS (1998) could not detect PAHs in sediments collected within this Natural Area.

3.7.3.4 Endocrine disruptors

Some contaminants can act as endocrine (hormone) disruptors, as they have the ability to adversely change endocrine function in fish and other animals. Known, or potential, endocrine disruptors include natural and synthetic hormones, and industrial chemicals. The Quality Status Report on the North Sea (OSPAR Commission 2000) highlighted that more research was needed into the effects of endocrine disruption in marine species. Allen *et al* (2000) reported that reliable information on the effects of endocrine disruptors in aquatic wildlife is patchy, with the most complete data available is that on fish exposed to oestrogens and their mimics. Relatively poor information is available on other marine vertebrates such as birds and mammals. Knowledge of endocrine disruption in invertebrates is even sparser because their endocrine systems are poorly understood, although there is one example (the effects of TBT in molluscs) which is well documented.

Although the effects of endocrine disruptors tend to be greater in estuaries, less severe oestrogenic effects have been observed in offshore flounder *Platichthys flesus* in the Southern Bight of the North Sea (off Holland) (Allen *et al* 1997). The effects on the offshore spawning populations of flounder are likely to be due to exposure to oestrogenic compounds in estuaries. However, the possibility of contamination in the open sea cannot be excluded.

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1 Directive 2002/62/EC, which amends Directive 76/769/EEC and prohibits the placing on the market of organotin compounds as biocides to prevent the fouling of all craft used in marine, coastal, estuarine and inland waterways and lakes.

2 Council Regulation (EC) 782/2003 addressing vessels already treated with organotin compounds as biocides.

A recent report on Endocrine Disruption in the Marine Environment (Defra 2002b) details the findings of a £1.5 million 3-year project involving Defra, Government agencies and the chemical industry's Long-Range Research Initiative. The project found that endocrine disruption does occur in some species at certain estuarine locations, and a range of chemicals may be implicated. There is insufficient field data currently available to assess whether such changes impact on reproductive success.

Due to the remoteness of this Natural Area, there is likely to be lower levels of exposure of endocrine disruptors compared with other areas around the UK.

3.7.3.5 Radionuclides

No data are available on the presence of radionuclides in the water column for this Natural Area. Radioactivity enters the marine environment via rivers, waste water outfalls or from the atmosphere. There are also low levels of naturally-occurring radionuclides present in granite rock, of which there are a number of outcrops within this Natural Area (see section 4.2.4). Thus inputs to this Natural Area would either be from these rocks, the water masses flowing through the Natural Area (primarily from oceanic waters moving from south west to the north east) or from atmospheric fallout onto the surface waters.

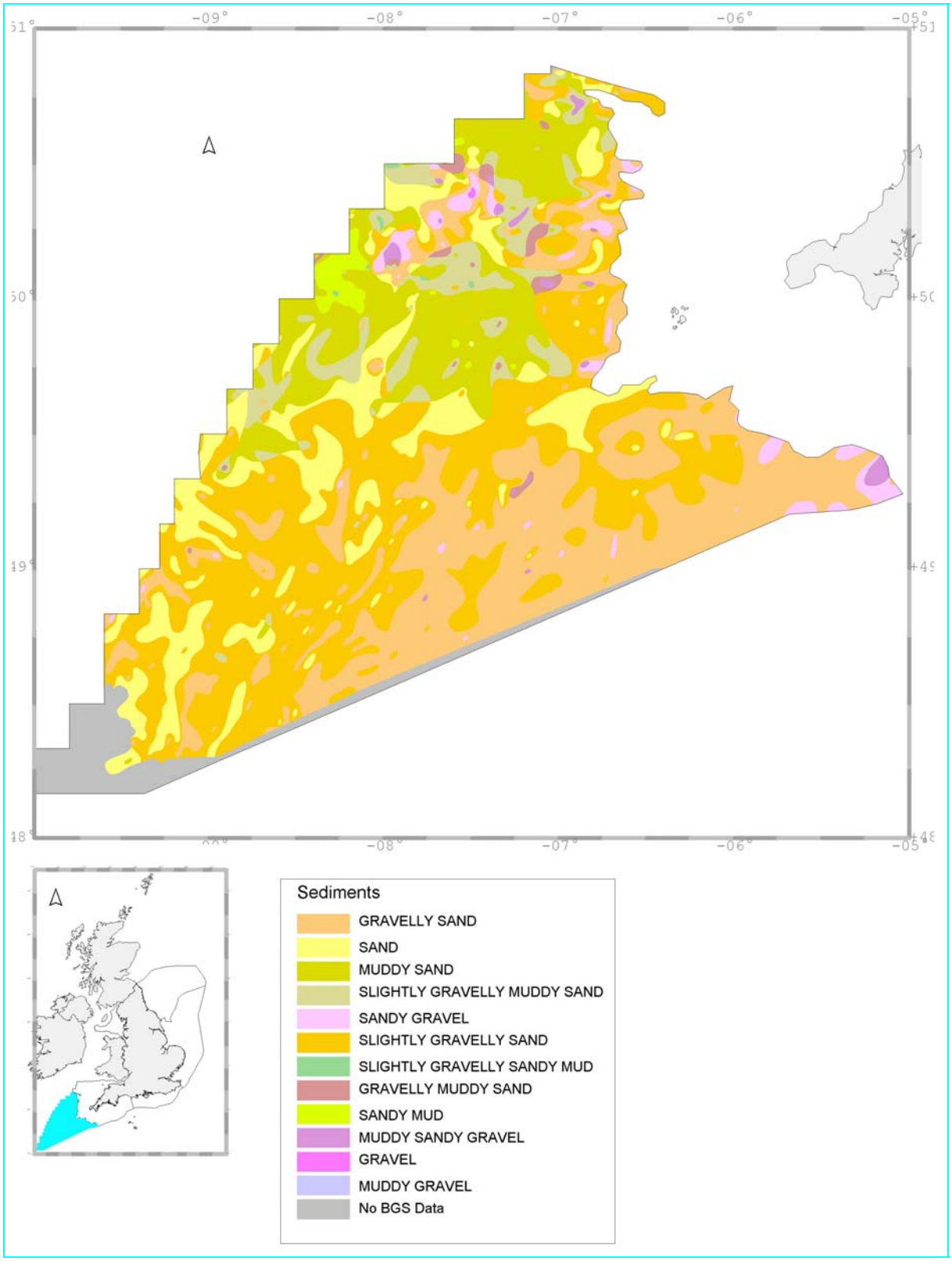


Figure 3.1 Seabed sediments of the Western Approaches Natural Area (taken from Poulton *et al* 2002). See Figure 3.2 for definition of sediments.

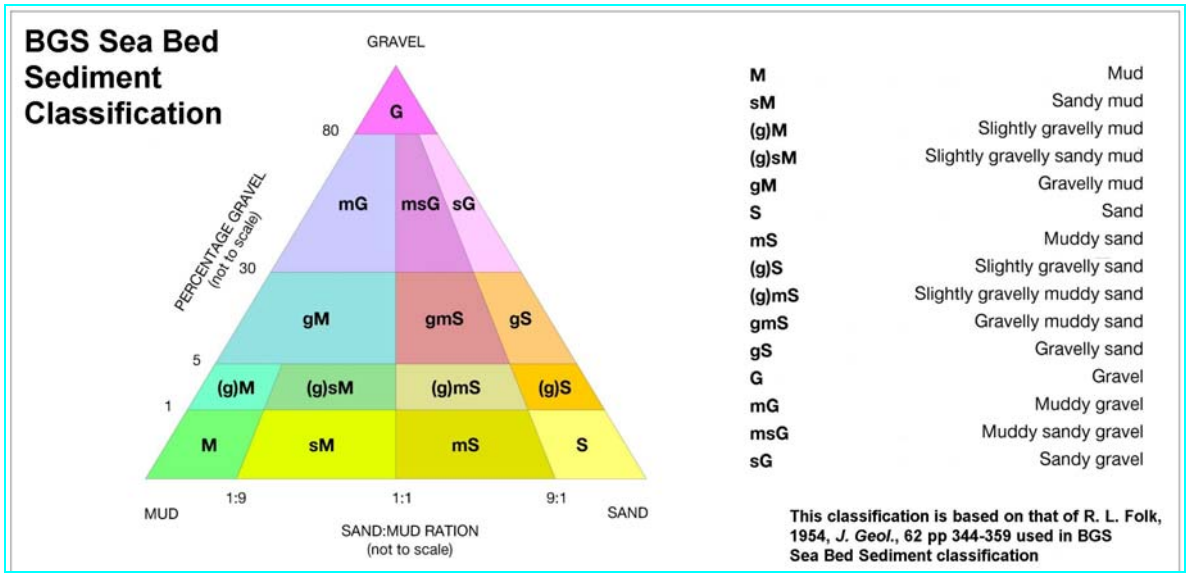


Figure 3.2 BGS seabed sediment classification taken from Poulton *et al* (2002).

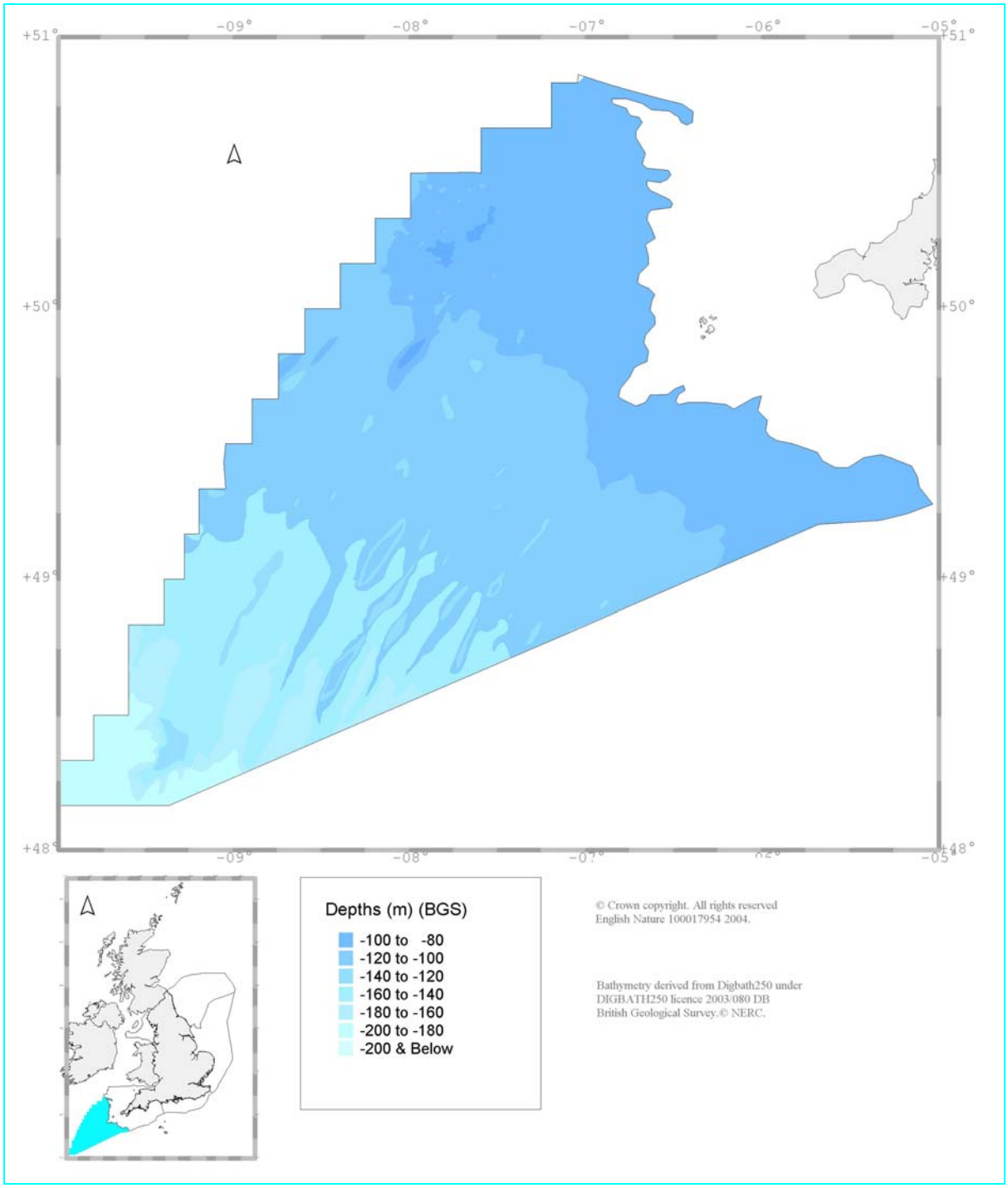


Figure 3.3 Bathymetry of the Western Approaches Natural Area.

4 Key habitats

This section describes the main habitats in the Western Approaches Marine Natural Area. Different initiatives have used different ways of classifying seabed habitats (particularly the Habitats Directive and the Biodiversity Action Plan systems identified in Table 4.1 and Appendix 2). Here we have taken account of both. This section gives a description of the water column (to highlight its importance), the seabed geology and the different types of sediment and rock habitat present, largely based on information provided by the British Geological Survey. However, certain habitats that are formed by plants or animals are also described to highlight both their conservation and functional importance. For each feature, the main specific conservation measures currently in place are noted, to indicate the effort being made towards their protection.

The intention is to provide the 'big picture' with selected highlights rather than a detailed description of habitats which would repeat information provided elsewhere (such as designated site citations or environmental statements).

4.1 The water column

The location of the Natural Area in the Western Approaches means that its waters are wholly oceanic (Atlantic) in origin, there being no coastal input. The variety of seasonal wildlife which occurs at the water surface and within the water column consists of both plankton (ie organisms drifting with the currents) and nekton forms (organisms able to swim against the currents).

Plankton (both phytoplankton and zooplankton) provides a fundamental role in the food chain of pelagic (oceanic) wildlife. Any stress imposed on the plankton will have consequences throughout the food chain and may affect the food available to fish, birds and marine mammals (Edwards and John 1996). The abundance of plankton is strongly influenced by factors such as water depth, tidal mixing and temperature stratification (layering), all of which determine the vertical stability of the water column. The distribution of planktonic species is influenced directly by salinity and temperature, by water flows in the area and by the presence of local seabed communities.

Blooms of phytoplankton occur through late spring to early summer as daylight increases and the seawater gradually warms. The dominant phytoplankton associated with the spring bloom in the Celtic Sea are *Skeletonema costatum* and *Thalassiosira* spp. (Edwards & John 1996). Zooplankton blooms follow soon after, often dominated (up to 75%) by species of copepods. Copepods are also the group with the highest diversity in the zooplankton, with overall zooplankton biodiversity increasing away from the coast and towards the open sea.

The species of plankton found within the Western Approaches derive from a blend of subtropical Atlantic (from the south/south west) and relatively unmixed Atlantic water influenced by the North Atlantic Drift (from the west). The water mass from the south/south west is characterised by certain species such as the chaetognath *Sagitta serratodentata* (*atlantica*), the siphonophoran *Muggiaea kochi*, the copepods *Euchaeta hebes* and *Centropages bradyi*, and the pteropod *Spiratella leseuri*. Those species associated with the North Atlantic Drift include the chaetognath *Sagitta tasmanica*, and the copepods *Rhincalanus nasutus*, *Pleuromamma robusta* and *Mecynocera clausi* (Tait & Dipper 1998). Generally, shallow shelf sea areas are more productive than deep ocean areas because levels

of nutrients are present in higher concentrations and are mixed throughout the water column by tidal streams. As a result, it is likely that within this Natural Area the waters beyond the shelf break are less productive than those waters over the continental shelf. Some limited mixing of the water column (particularly of the uppermost part) is likely to occur in deeper waters as a result of strong wave action deriving from storm events.

Besides the 'typical' species of nekton which one would expect to find in this area, such as various commercial species of fish and certain cetaceans, ocean vagrants may also turn up from time to time. These include certain species of fish and turtle which are brought in on the North Atlantic Drift. For example, the unusual-looking sunfish *Mola mola* may be recorded from the waters of this Natural Area, typically being seen close to the water surface in early summer. The most frequently seen species of turtle within the Natural Area are the leatherback *Dermochelys coriacea* and the loggerhead *Caretta caretta* (see also section 5.3).

4.1.1 Fronts

Fronts mark the boundaries between water masses and give rise to a significant horizontal temperature gradient in the surface layers with 1 ºC per kilometre being common. They are also transition zones between 'layered' and 'well mixed' waters. Vertical temperature differences may be as much as 6 ºC over a distance of as many metres. Such fronts are likely to be of significant biological importance, since they are usually rich in plankton which attracts other marine life. There are no distinct fronts in the Western Approaches, however, as the water mass in this region remains stratified, with a distinct thermocline present during the summer months (see also section 5.1.1). The thermocline provides a marked vertical temperature gradient within a zone termed the discontinuity layer, which usually occurs somewhere between 100 and 500 metres depth. In calm conditions, a distinct horizontal boundary can form between warmer waters above and colder waters below the thermocline.

Towards the western edge of this Natural Area, the seabed slopes steeply away from the continental shelf, resulting in the formation of temporary oceanic fronts from time to time. Within the frontal zone both primary and secondary production are enhanced and this attracts fish, birds and cetaceans.

4.1.1.1 Nature conservation measures

There are no conservation measures that specifically protect fronts. However, fronts may be subject to some indirect conservation measures if they support concentrations of individuals from a species that qualifies for protection.

4.2 The seabed substrata

There is little known about the benthic habitats of the Western Approaches Natural Area, other than the type of substratum that is present.

However, in general the sediments of the continental shelf are predominantly terrestrial in origin, consisting mostly of rock fragments, quartz sands and clay-rich muds. Local accumulations of carbonates (molluscan shells, calcareous algae and foraminiferan tests) also form an important constituent in certain areas.

In areas where tidal currents are present, mud deposition is low and these areas are often used as spawning grounds by demersal fishes. In areas where tidal currents are particularly strong, sand waves may develop or the sediment cover may be eroded to expose the underlying rock. Boundaries between the different habitats are generally gradual and are rarely clearly defined.

In the deep offshore waters of the Natural Area, the seabed is dominated by sediment habitats which are formed mainly of sand, mixtures of sand and gravel. Gravel occurs in the east and south of the area, grading to more muddy habitats in the north of the area (see Figure 4.1).

Sediments are generally classified by either the Folk (1954) or Wentworth (1922) systems (the Wentworth scale divides the Folk classes into smaller fractions) (see Appendix 3). The habitats below are described using a modified version of the Folk classification, since more detailed information of the seabed sediments is currently unavailable for the whole of the Marine Natural Area. An exception to this is the 'muddy gravel' which, in terms of ecology, is closer to mud rather than gravel habitats and is therefore included with the former. One outcome of using the Folk classification is that areas defined as gravel by the British Geological Society may include cobbles, boulders, pebbles, and granules (see Appendix 3). Stable aggregations of boulders and cobbles may be considered to constitute reef habitat (for example under the Habitats Directive, Johnston *et al* 2002) and this is reflected in the text.

The JNCC have developed the Marine Nature Conservation Review (MNCR) biotope classification system (Connor *et al* 1997)[6] which has been used in the other Marine Natural Area profiles to describe the biological characteristics of each habitat type. However, there are currently no MNCR biotopes identified for this Natural Area, probably due to the .2.3 remoteness of the area.

4.2.1 Gravel habitats

The particle structure of these habitats ranges from various combinations of sand and gravel to pure gravel (Figure 4.1). The diversity and types of community associated with this habitat type are determined primarily by the sediment type, and also a variety of other physical factors such as the relative exposure of the coast, and differences in the depth, turbidity and salinity of the surrounding water.

Sublittoral sand and gravel sediments are the most common habitats found below the low water mark around the coast of the UK (UK Biodiversity Group 1999)**.**

Gravel is scattered throughout the Natural Area (Figure 4.1). The gravel habitats found here in general tend to be less perturbed by natural disturbance than those found in shallower coastal waters, and as a result they tend to support a more diverse marine fauna. Little is known about the gravel habitats in this Natural Area. However it is likely that they support a wide range of anemones, polychaetes, bivalves and amphipods, and both mobile and sessile epifauna.

[6] At the time of writing, JNCC were revising the classification. Latest updates can be seen at www.jncc.gov.uk/marine/biotopes/default.htm.

4.2.1.1 Nature conservation measures

Gravel habitats are covered by a priority Habitat Action Plan[7] for sublittoral sands and gravels (UK Biodiversity Group 1999). However, no provision for gravel habitats is made under the Habitats Directive. They do not meet the definition of 'Sandbanks which are slightly covered by seawater all the time' given under the Directive, since this habitat is restricted to sediments which predominantly comprise sand (0.0625-2 millimetres). However, some gravel habitat may meet the definition of 'Reefs' under the Directive, where they are predominantly composed of stable boulders and cobbles, as these can form a reef-like structure.

At present, all marine candidate Special Areas of Conservation (which form part of the Natura 2000 network) are adjacent to the UK coast. Work is underway to identify offshore sites both in offshore waters, ie beyond 12 nautical miles (see Johnston *et al* 2002), and potentially in English territorial waters. Preliminary work has been undertaken to derive areas of seabed which contain qualifying habitat and this is shown in Figure 4.2. Further work is being undertaken to verify and refine these areas, eg to identify reef and reef-like habitat within areas of rocky or gravelly habitat. Prior to identification of proposed Natura 2000 sites, locations supporting relevant features of interest should be treated with care to ensure that they are not damaged or altered in such a way that might affect their selection as Natura 2000 sites. However, other than for boulder/cobble components of gravel habitat, there will be no sites identified for gravel since it is currently omitted from the Habitats Directive

See Table 4.1 for a summary of the conservation measures.

4.2.2 Sand habitats

Sandy sediments are scattered throughout this Natural Area, though no specific information is available (Figure 4.3). Due to their particle size, sands in moderate to strong currents are mobile whereas finer muds and clays remain in suspension. Stronger currents produce seabed sediments of clean sand (and occasionally shell fragments) with little mud or silt.

Offshore relict tidal sand-banks occur across the Natural Area as large bedforms, which may be up to 50 kilometres long, 6 kilometres wide and 40 metres high (Lee & Ramster 1981). They lie approximately parallel to the tidal direction (south west/north east) but they can lie at an angle of as much as 20º to this direction. These banks probably formed after the end of the last glacial period, but before sea level reached its present height (Lee & Ramster 1981).

Little is known about the sand habitats in this Natural Area. However it is likely that these areas of sand are characterised by a fauna comprising polychaetes, molluscs, echinoderms and crustaceans, with the species present varying according to the sediment type.

4.2.2.1 Nature conservation measures

Sand habitats are covered by a priority Habitat Action Plan for sublittoral sands and gravels (UK Biodiversity Group 1999).

[7] A Habitat Action Plan is a document which describes the current status of a particular habitat, gives costs and targets for its restoration, management or creation, and is endorsed by the UK Biodiversity Group

The Habitats Directive includes the habitat 'Sandbanks which are slightly covered by seawater all the time'. In the UK this has been interpreted as comprising a range of sandy sediments (particle size range 0.0625-2 millimetres and where sand is dominant), on distinct banks which may arise from horizontal or sloping plains of sandy sediment. Water depth for this habitat is seldom more than 20 metres below chart datum (European Commission 1999), so it excludes deeper relict sandbanks and therefore any sandbank features within this Natural Area.

4.2.3 Mud habitats (including muddy gravel)

There are some areas of sandy mud and some very small areas of slightly gravelly sandy mud in the northern part of the Natural Area (see Figure 4.4). Silty clay sediments were noted close to the shelf break as part of a cable-laying survey (pers. comm., Steve Jones, Submarine Systems). The areas of sandy muds may support populations of burrowing polychaetes, decapod crustaceans, molluscs and echinoderms, as well as an epifauna of brittlestars (Joint Nature Conservation Committee, in prep.).

4.2.3.1 Nature conservation measures

Two types of mud habitat are covered by Habitat Action Plans, 'Sheltered muddy gravels' and 'Mud habitats in deep water'. However, the former primarily covers muddy gravels in estuaries, rias and sea lochs which do not occur in this Natural Area. The latter Action Plan applies to mud habitats below 20 to 30 metres depth, which includes some of the habitat occurring in this Natural Area. Subtidal mud habitat is not listed on the Habitats Directive.

4.2.4 Rock habitats

Rock habitats include exposed areas of bedrock, which have a flat profile or rise from the seabed to form, together with stable areas of boulders and cobbles, reefs or reef-like habitats (often containing seacaves). The diversity of rock habitats is of considerable conservation importance as they often support sites of high biodiversity (Hill *et al* 1998). Different types of rock such as limestone, sandstone or chalk, also have an effect on biotope type.

4.2.4.1 Reefs

The term reef is generally used to refer to an area of rock habitat which arises from the surrounding seabed, although it has a specific definition under the Habitats Directive. In this Natural Area, the seabed lies below the photic zone so the reefs are dominated by animal communities, with turfs of bryozoans, hydroid, sponges and sea squirts. There are two areas of rocky reef present within the Natural Area (Figure 4.2). Haig Fras is a distinct topographical feature which is located approximately 150 kilometres offshore in the Celtic Sea, close to the north western boundary of this Natural Area. This granite outcrop measures approximately 45 kilometres by 15 kilometres, with a peak of less than 1 kilometre across. It rises from a surrounding seabed depth of 100-110 metres to within 38 metres of the surface. A remote camera survey (Rees 2000) demonstrated that the bedrock on the peak has three distinct deep-water reef biotopes associated with it, with a further, more complex and less well-defined biotope present where boulders and cobbles were partly embedded in sediment at the base of the shoal. The biotopes are:

- Biotope dominated by jewel anemones *Corynactis viridis*.
- Biotope dominated by Devonshire cup corals *Caryophyllia smithii*.
- Biotope characterised by cup sponges and erect branching sponges.
- Complex biotope with red encrusting sponge *Caryophyllia smithii* and featherstars (crinoids) on boulders with the bryozoan *Pentapora foliacea*, squat lobster *Munida* sp. and brittlestars (ophiuroids) also common.

A second area where rocky reef is thought to occur is along the shelf break where currents and steep gradients are likely to have exposed bedrock. However, no surveys are known to have been carried out in this region.

4.2.4.2 Nature conservation measures

There are no priority Habitat Action Plans for the rock habitats that occur within this Natural Area. The Habitats Directive includes 'reefs' as an interest feature for which SACs can be designated. At present, all marine candidate Special Areas of Conservation (which form part of the Natura 2000 network) are adjacent to the UK coast. Work is underway to identify offshore sites both in offshore waters, ie beyond 12 nautical miles (see Johnston *et al* 2002), and potentially in English territorial waters. Preliminary work has been undertaken to derive areas of seabed which contain qualifying habitat and this is shown in Figure 4.2. Further work is being undertaken to verify and refine these areas, eg to identify reef and reef-like habitat within areas of rocky or gravelly habitat. Prior to identification of proposed Natura 2000 sites, locations supporting relevant features of interest should be treated with care to ensure that they are not damaged or altered in such a way that might affect their selection as Natura 2000 sites.

4.3 Notable biogenic habitats

Animals and plants can have a profound influence on the habitats in which they live. For example, the presence of large numbers of kelp plants on flat bedrock makes a very different habitat to bare flat bedrock. In this section, a small number of biogenic habitats are considered. This reflects their nature conservation importance but also demonstrates that there are habitats in the seas around England that are formed by plants and animals rather than simply being based on the seabed substrata.

Particular biogenic habitats are often associated with specific broader habitats, for example, maerl is usually associated with 'gravel', and seagrass beds with 'sand'. However, reefs formed by animal such as the ross worm *Sabellaria* spp. can be associated with a range of habitats such as gravel, pebbles and cobbles, and bedrock.

4.3.1 *Lophelia pertusa* reefs

It is believed that the cold-water coral *Lophelia pertusa*[8] occurs on the shelf break, close to the western boundary of this Natural Area, since Le Danois (1948) as reported in Johnston *et*

[8] *Lophelia pertusa* is a colonial bank-forming species of ahermatypic coral, found in deep, dark, cold waters. Typically it may be found in depths down to 1,000 metres (though it has been found as deep as 3,000 metres), in water temperatures of 4-12 ºC. Unlike tropical corals, *L. pertusa* does not contain symbiotic algae but captures food from the water column.

al (2002), discovered large quantities of *L. pertusa* reef on the shelf break in French waters. However, no specific information is currently available to confirm the presence of biogenic reef in this location. *Lophelia pertusa* grows as either small colonies or as reefs which support a wide range of fauna, increasing the biodiversity when compared to the surrounding habitat (Hall-Spencer *et al* 2002).

4.3.1.1 Nature conservation measures

There is a priority Habitat Action Plan for *Lophelia pertusa* reefs.

The Habitats Directive includes the interest feature 'reefs' for which SACs can be designated. Biogenic reef, including thickets and banks formed of *Lophelia pertusa,* is included within this interpretation of reefs. However, at present, all marine candidate Special Areas of Conservation (which form part of the Natura 2000 network) are adjacent to the UK coast. Work is underway to identify offshore sites both in offshore waters, ie beyond 12 nautical miles (see Johnston *et al* 2002), and potentially in English territorial waters. Prior to identification of proposed Natura 2000 sites, locations supporting relevant features of interest should be treated with care to ensure that they are not damaged or altered in such a way that might affect their selection as Natura 2000 sites.

Lophelia pertusa is also listed under the Convention on International Trade in Endangered Species (CITES), the aim of which is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Table 4.1 Summary of nature conservation measures.

Habitat type	**EU Habitats Directive** [1]	**UK Biodiversity Action Plan** [2]		
	Reefs [a]	Sublittoral sands and gravels	Mud habitats in deep water	*Lophelia pertusa* reefs
Gravel habitats	• Boulders and cobbles	•		
Sand habitats		•		
Mud habitats			•	
Reefs	•			
Lophelia pertusa reef	•			

[1] 'Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora' is commonly known as the Habitats Directive.

[a] Annex I natural habitat of community interest whose conservation requires the designation of special areas of conservation.

[2] The UK Government's plan for the protection and sustainable use of biodiversity, published in 1994. It represents a commitment to joint action nationwide through the securing and better use of resources.

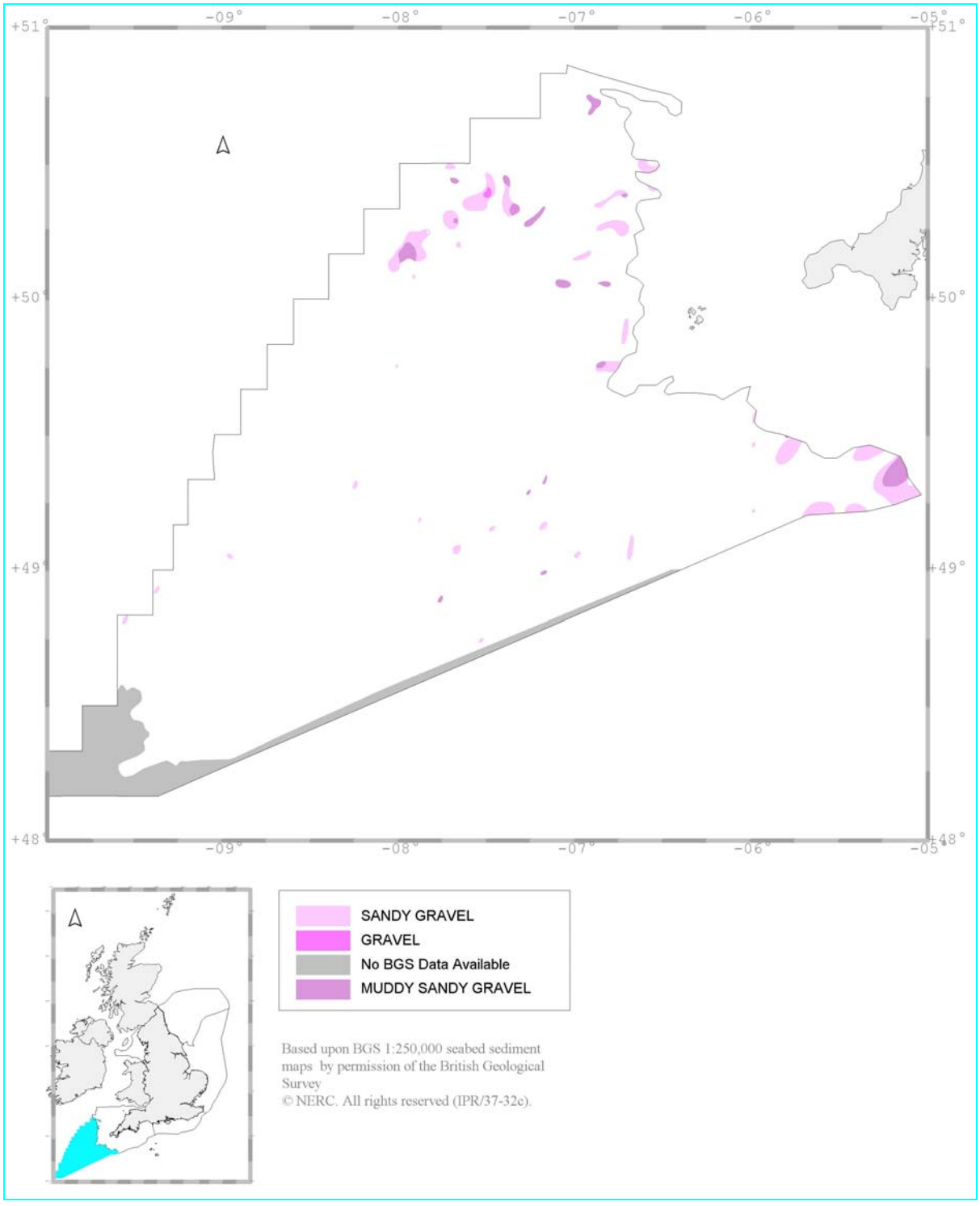


Figure 4.1 Gravel habitat in the Western Approaches Natural Area.

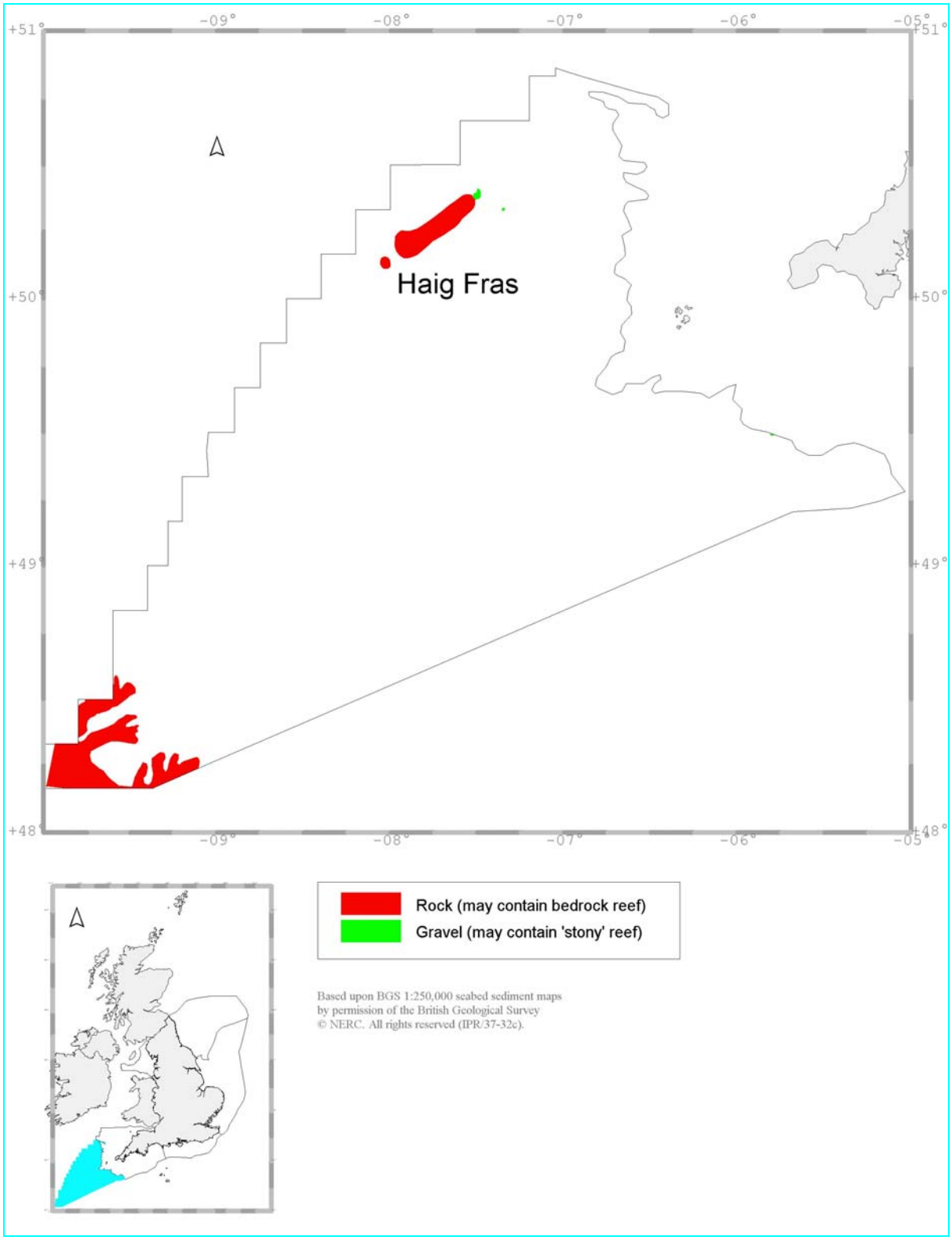


Figure 4.2 The distribution of rocky habitat and gravel which indicates the potential location of 'reef' (*sensu* the Habitats Directive) in the Western Approaches Natural Area. Further refining of these areas will define seabed which qualifies as Habitats Directive habitat. Gravel is included here as some gravel habitat may meet the definition of 'Reefs' under the Directive, where they are predominantly composed of stable boulders and cobbles as these are stable and can form a reef-like structure (ie. 'Stony' reef).

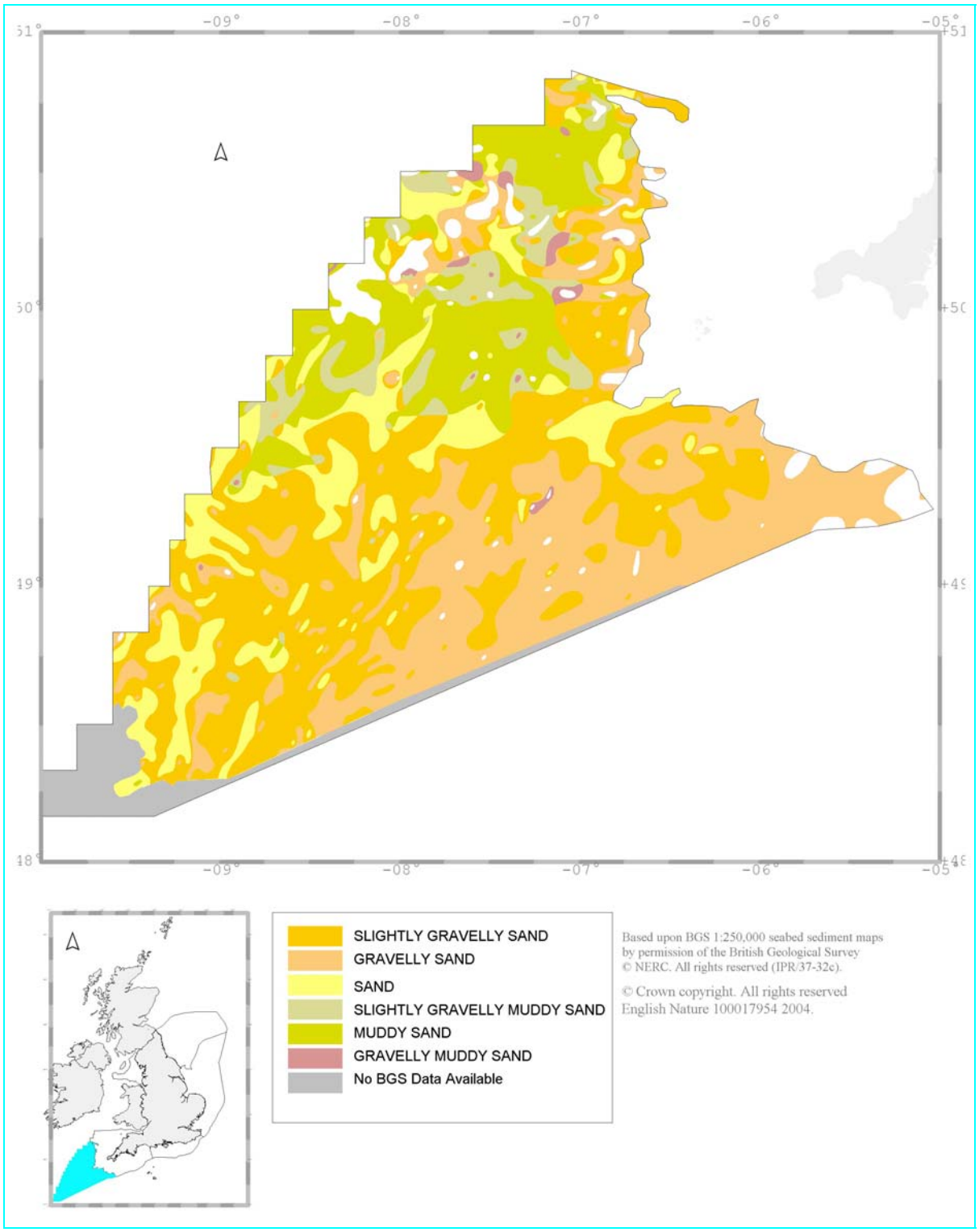


Figure 4.3 Sand habitats in the Western Approaches Natural Area.

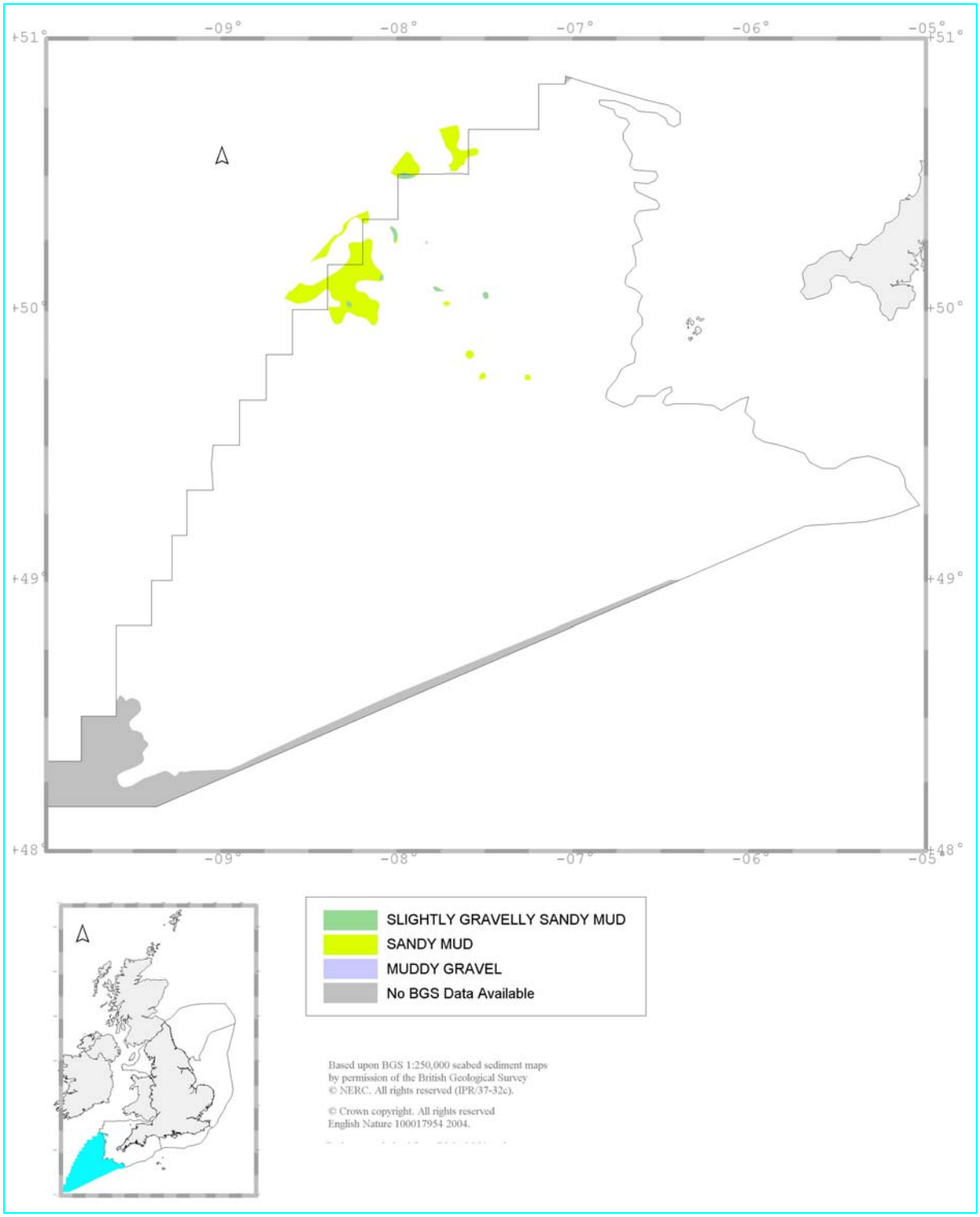


Figure 4.4 Mud habitats in the Western Approaches Natural Area.

Western Approaches

Seabed characterised by cup sponges and erect breaching sponges from Haig Fras, the granite mound close to the North-west boundary of the Natural Area.
Ivor Rees/UW Bangor (right)

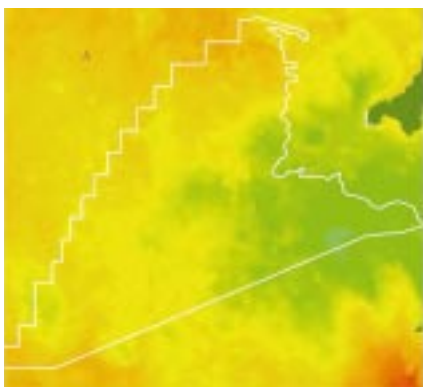
Feather star on Ross coral at Haig Fras.
Ivor Rees/UW Bangor (below)

Sunfish believed to be brought into the Natural Area on the North Atlantic drift. Colin Speedie (above)

Leatherback turtle occasionally migrate through the waters of this Natural Area. Colin Speedie (left)

Pair trawling for whiting in the Western Approaches. Phil Lockley (bottom left)

Seawater surface temperature in the Western Approaches Natural Area in June 1997. © Natural Environment Research Council (NERC) & Plymouth Marine Laboratory (PML) 2004 (below)



5 Key species

This section describes key species of nature conservation value in the Western Approaches Natural Area. We have used the UK Biodiversity Action Plan and the Habitats and Birds Directives as a basis for structuring the text. Hence, for example, whilst a number of the fish species described are of commercial importance, they are included here because they are covered by Species Action Plans under the UK BAP. The main specific conservation measures currently in place are noted for each feature, to indicate the effort being made towards their protection.

5.1 Marine birds

5.1.1 Background

The UK's coastal and offshore waters are of exceptional importance for several species of resident and migratory marine birds[9]. For example, of the 25 species of seabird which regularly breed in the UK, 17 are present in UK waters in numbers greater than 50% of the EU population (Lloyd *et al* 1991).

The distribution of marine birds is influenced by a wide variety of factors. Perhaps the most important of these is food availability (Hunt & Schneider 1987), though proximity to suitable nesting habitat is of crucial importance throughout the breeding season (Skov *et al* 1994).

Fish are the main prey for the majority of marine bird species. Among the most important are sandeel (Ammodytidae), herring *Clupea harengus*, sprat *Sprattus sprattus* and mackerel *Scomber scombrus* (Skov *et al* 1995). The larvae of many of these species feed on plankton and occur at elevated densities where plankton is abundant. Such conditions occur at fronts, where deeper, nutrient-rich waters mix with warmer, sunlit surface waters (Lloyd *et al* 1991; Pingree *et al 197*8). The abundance of food at fronts attracts both fish and marine birds (see for example Stone *et al* (1995).

During the breeding season, the distance over which a nesting species will forage, varies according to the species. Northern fulmar *Fulmarus glacialis* may feed 400 kilometres or more from their breeding colony (Dunnet & Ollason 1982), whilst others, such as the black guillemot *Cepphus grylle*, rarely feed more than than a few kilometres offshore (Lloyd *et al* 1991). Outside the breeding season seabirds generally disperse over a wider area.

Many species congregate at high densities to feed, nest and moult. In such situations, a large proportion of the total population is susceptible to local incidents, such as oil spillages. The majority of marine birds are long-lived, do not reach breeding condition for several years. For example, on average, fulmar do not breed until their ninth year and may live for at least another 35 years (Dunnet & Ollason 1978). Many marine birds also have low reproductive

[9] Marine birds include all birds that are wholly or partly reliant upon the sea. For the purpose of this document marine birds have been divided into two categories (following Tasker & Leaper 1993):

1. True seabirds – birds reliant on the sea all year. These include terns, gulls, petrels, cormorants, auks, skuas and the northern gannet.
2. Coastal birds – birds reliant on the sea (open coasts as well as estuaries) for only part of the year. These include divers, grebes and seaduck.

rates, hence even highly localised incidents can have a significant impact upon a population (Tasker *et al* 1990).

Several species of marine bird, most notably the auks, divers, grebes and seaducks, moult their flight feathers simultaneously, becoming temporarily flightless. Such species are particularly vulnerable at this time.

5.1.2 Distribution of marine birds

The Western Approaches Marine Natural Area is important for marine birds. The 22 regularly occurring species that this Natural Area supports are listed in Table 5.1, together with a brief summary of their distribution and abundance. The extent to which these birds depend upon the waters of the Western Approaches Marine Natural Area varies between species and is not well understood.

This Natural Area includes the only area of continental shelf edge in seas adjacent to England. This marks the boundary between the shallower, continental shelf waters and deeper oceanic waters. A major oceanic front occurs along this boundary, attracting large numbers of feeding marine birds, particularly the more pelagic species such as the shearwaters, storm-petrels and skuas. Away from the shelf edge, densities of marine birds are generally low and fairly evenly distributed across the area (Stone *et al* 1995).

Species that rely upon shallow coastal waters adjacent to breeding sites, such as terns, pass through this area whilst on passage, but they rarely occur in the Natural Area at other times.

This Natural Area is at the northern edge of the range of several species such as Cory's shearwater *Calonectris diomedea*, Wilson's storm-petrel *Oceanites oceanicus* and great skua *Stercorarius skua*. On occasions, these species can occur in large numbers (Wright *et al* 1964), possibly in response to lateral shifts in warm-water currents such as North Atlantic Drift (pers. comm., I. Carter, English Nature).

Species such as grey phalarope *Phalaropus fulicarius*, Sabine's gull *Larus sabini* and little gull are also known to occur in the area (Stone *et al* 1995), apparently in large numbers (based on unpublished observations). They are therefore likely to rely upon the abundant food source of the area whilst on passage to and from breeding grounds.

5.1.3 Nature conservation measures

Areas that regularly hold important concentrations of birds require special protection measures. Under the EC Council Directive on the Conservation of Wild Birds (The 'Birds Directive') the UK Government is obliged to identify and classify the most suitable territories in size and number for rare and vulnerable species and for migratory species. These requirements apply to both sea and land areas. The most 'suitable territories' are designated as Special Protection Areas (SPAs).

Currently, the majority of SPAs extend no further seaward than mean low water, although work is underway to identify additional marine areas that should be considered for designation. These sites will include areas where birds aggregate, eg for feeding and over-wintering. However, in the period prior to identification of proposed Natura 2000 sites, locations supporting relevant features of interest should be treated with care to ensure that

they are not damaged or altered in such a way that might affect their selection as Natura 2000 sites.

Table 5.1 Summary of regularly occurring marine birds in the Western Approaches Natural Area. This information has been compiled from a variety of sources including county avifaunas, county bird reports, Stone *et al* (1995), Lloyd *et al* (1991), Mavor *et al* (2001), Stroud *et al* (2001), Skov *et al* (1995) and Brown & Grice (in press).

Species	Jan Dec	Comments	Status
Northern fulmar			PM
Cory's shearwater			M
Great shearwater		Low densities, scattered throughout.	M
Sooty shearwater		Low densities, scattered throughout.	M
Manx shearwater		Low densities, scattered throughout.	M
Balearic shearwater		Low densities, scattered throughout.	M
Wilson's storm-petrel		Low densities, scattered throughout.	M
Storm-petrel		Low densities, scattered throughout.	M, A1
Leach's storm-petrel		Low densities, scattered throughout.	M, A1
Northern gannet		Low densities, scattered throughout.	PM
Grey phalarope		Main densities found during autumn passage.	M
Pomarine skua		Numbers peaking during passage.	M
Arctic skua		Numbers peaking during passage.	M
Long-tailed skua		Passage migrant. Small numbers in May, peak occurring in Sept.	M
Great skua		Northernmost extreme of wintering range.	M
Little gull		Passage migrant.	M
Lesser black-backed gull		Northernmost extreme of wintering range.	PM
Great black-backed gull		Relatively low numbers throughout.	PM
Sabine's gull		Passage migrant to area.	M
Black-legged kittiwake		Main concentrations over shelf edge during non-breeding season, dispersed at other times.	PM
Common guillemot, Atlantic puffin		Main concentrations over shelf edge during non-breeding season, dispersed at other times.	PM

Table notes:

Graded lines indicate relative seasonal abundance within a species.

- Scattered or irregular
- Present in small numbers
- Uncommon
- Common
- Abundant

Status: A1 = Listed on Annex 1 of Birds Directive
M = Migratory species
PM = Partially migratory species

5.2 Cetaceans

Cetaceans (whales, dolphins and porpoises) form a group of top predators in the marine environment. Those species recorded in the Western Approaches include large and small cetaceans and are divided into two suborders:

- **Baleen whales** (Mysticeti), which use plates of baleen (keratin) to filter out food from the water column.
- **Toothed whales** (Odontoceti), which have teeth. These include dolphin and porpoise species.

Figure 5.1 shows sightings of cetaceans within the Natural Area over the period 1992-2001. Although very large, the dataset used to compile the map reflects the degree of observer effort and the location of observers such as on ferries, coasts and offshore platforms. Therefore, it should only be considered as illustrative and not as a definitive picture of cetacean distribution in this area. A more qualified account is given by Reid *et al* (2003) which also includes an analysis of species abundance within a defined area. This work can be viewed at www.jncc.gov.uk/publications/cetaceanatlas.

The Western Approaches Marine Natural Area (and the neighbouring South Western Peninsula Marine Natural Area) forms a region that is relatively rich in cetaceans (Evans 1996). The most common offshore species are the common dolphin *Delphinus delphis* and the long-finned pilot whale *Globicephala melas*. Both of these species seem to concentrate along the continental shelf edge, although they are also seen closer inshore. The distribution and status of other species recorded in this Marine Natural Area are described below.

5.2.1 Baleen whales

Three species of baleen whale have been recorded from within the Natural Area: the fin whale *Balaenoptera physalus*, the humpback whale *Megaptera novaeangliae* and the minke whale *Balaenoptera acutorostrata*. The migration patterns of fin whales are less distinct than other rorqual whales (ie members of the family Balaenopteridae), though some of those in the north east Atlantic are thought to migrate along the edge of the continental shelf northwards in spring and south again in autumn. Humpback whales are occasionally seen within the Natural Area, though they are more frequently seen off the west coast of Ireland and north west Scotland during the summer months. These are en route from wintering grounds in the vicinity of the Cape Verdes off north west Africa to feeding grounds centred around Iceland and the Greenland Sea (Evans 1987). Minke whales are the commonest rorqual whales likely to be seen off western Britain and Ireland. One or two are likely to be present off the Isles of Scilly during the summer months and may even venture into coastal waters of the western English Channel.

5.2.2 Toothed whales

The common dolphin *Delphinus delphis* is a relatively deep-water species recorded mainly from offshore areas. Common dolphins are not known to migrate, but they clearly travel a great deal, becoming very common in some areas one year and vanishing the next (Watson 1985). They are known to travel above submarine ridges. The long-finned pilot whale *Globicephala melas* is another deep-water species, recorded mainly more than 10 kilometres

from the coast. It tends to approach coastal waters mostly during late summer and autumn, and is commonly reported from the Bay of Biscay, the Western Approaches and south west of Ireland. The bottlenose dolphin *Tursiops truncatus* occurs offshore along the shelf edge close to the 1,000m isobath and is often found in association with long-finned pilot whales (Evans 2003). The harbour porpoise *Phocoena phocoena* has also been recorded from the Natural Area but only rarely, being more frequently encountered closer to coasts.

Sperm whales *Physeter macrocephalus* are recorded occasionally within the Natural Area on their migration from the Azores to areas in the North Atlantic.

The white-beaked dolphin *Lagenorhynchus albirostris* are occasionally recorded in this Natural Area. This is the only dolphin which inhabits the waters of the far North Atlantic, though in the winter it migrates as far south as the Bay of Biscay. It is gregarious, gathering in schools of up to 1,500, which move together as a broad migratory wave. During feeding and mating the schools seem to split into more compact social units of 6-30 individuals. Its range overlaps with the Atlantic white-sided dolphin *Lagenorhynchus acutus* in warmer waters further south. The southern limits of both species in winter are similar, though the white-sided dolphin sometimes occurs as far south as Portugal (Watson 1985).

5.2.3 Nature conservation measures

A summary of protection measures can be seen in Table 5.2.

All cetacean species found in this Natural Area are listed on either Appendix I or II of Convention on International Trade in Endangered Species (CITES). The former lists species that are the most endangered and therefore prohibits commercial trade and the latter lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled.

The Bonn Convention (1979) protects migratory wild animals across all or part of their natural range through international co-operation, particularly those species that are in danger of extinction. One of the measures identified is the adoption of legally binding agreements of which the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) is one. The Agreement was formulated in 1992 and has been signed by eight European countries (including the UK) bordering the Baltic and North Seas (including the English Channel). Under the Agreement, provision is made for protection of specific areas, monitoring, research, information exchange, pollution control and increasing public awareness of small cetaceans.

All cetaceans are protected by the Bern Convention (1979) which conveys special protection to those species which are vulnerable or endangered. Although an international convention, in England it is implemented through the Wildlife and Countryside Act 1981.

Under schedule 5 of the Wildlife and Countryside Act 1981 (as amended), all cetaceans are given full protection within British territorial waters. This protects them from killing or injury, sale, destruction of a particular habitat (which they use for protection of shelter), and disturbance. Common and bottlenose dolphins and harbour porpoises are also listed under schedule 6 of the Act, which prevents these species being used as a decoy to attract other animals. This schedule also prohibits the use of vehicles to take or drive them, prevents nets, traps or electrical devices from being set in such a way that would injure them and prevents

the use of nets or sounds to trap or snare them. Under the Countryside and Rights of Way Act 2000 is it an offence to deliberately or recklessly damage or disturb any cetacean in UK protected waters.

All toothed and baleen cetaceans are protected under Annex IV of the EC Habitats Directive because they are either endangered, vulnerable or rare. Harbour porpoise and bottlenose dolphin are also listed under Annex II of the Habitats Directive which requires Member States to designate Special Areas of Conservation (SACs) to ensure their conservation. However, no areas essential to life and reproduction have been identified for these species within this Natural Area.

Table 5.2 Summary of cetacean protection measures (see notes below for explanation of designations and abbreviations).

	Schedule 5 Wildlife & Countryside Act	**EC Habitats Directive (Annex)**	**CITES (Appendix)**	**Bonn Convention (Appendix)**	**IUCN Red Data List Species**	**Bern Convention (Appendix)**	**UK Biodiversity Action Plan**
Minke whale *Balaenoptera acutorostrata*	•	IV	I		LR nt	III	Baleen whales grouped plan
Fin whale *Balaenoptera physalus*	•	IV	I		EN	III	Baleen whales grouped plan
Humpback whale Megaptera novaeangliae	•	IV	I	I	VU	II	Baleen whales grouped plan
Harbour porpoise *Phocoena phocoena*	•	II IV	II	II	VU	II	Harbour porpoise Species Action Plan
White-beaked dolphin *Lagenorynchus albirostris*	•	IV	II	II		II	Small dolphins grouped plan
White-sided dolphin *Lagenorynchus acutus*	•	IV	II	II		II	Small dolphins grouped plan
Sperm whale *Physeter macrocephalus*	•	IV	I			III	Toothed whales grouped plan
Common dolphin *Delphinus delphis*	•	IV	II	II			Small dolphins grouped plan
Bottlenose dolphin *Tursiops truncatus*	•	II IV	II	II		II	Small dolphins grouped plan
Long-finned pilot whale *Globicephala melas*	•	III IV	II	II		II	Toothed whales grouped plan

(See table notes overleaf.)

Table notes:

Annex IV EC Habitats Directive – This annex includes 'Animal and plant species of community interest in need of strict protection'. Under Annex IV the keeping, sale or exchange of such species is banned, as well as deliberate capture and killing.

CITES (Convention on International Trade in Endangered Species)
Appendix I - Prohibits the commercial trade of species included on this appendix.
Appendix II - Imposes strict regulation on the trade of species that may not necessarily be currently threatened with extinction.

IUCN Red List of Threatened Species - LR = Lower risk
VU = Vulnerable
nt = near threatened

Biodiversity Action Plan
This is the UK Government's response to Article 6 of the Convention on Biological Diversity (1994). The overall goal is to conserve and enhance biodiversity in the UK. A Species Action Plan provides detailed information on the threats facing species and the opportunities for maintaining and enhancing populations. A 'Grouped' Species Action Plan has been produced for baleen whales as a range of common policies and actions are required for all species listed.

5.3 Marine turtles

Individuals of two species of marine turtle, the leatherback *Dermochelys coriacea* and the loggerhead *Caretta caretta*, are likely to occur within this Natural Area. Over the last 100 years, there have been around 500 records of marine turtles (both alive and dead) from UK waters, particularly along the western coast. The majority of those which can be identified were adult leatherbacks. Most of these records are from the last 40 years and sightings each year are continuing to increase.

Although sightings of live individuals happen from time to time, it is usually dead specimens which are encountered, caught in fishing nets at sea. Another cause of death can be a result of starvation caused by blockages to the intestinal tract by swallowed plastic bags (mistaken for jellyfish) – see also section 6.5.

Although most turtle species are believed to arrive in UK waters accidentally (with the possible exception of the loggerhead which may be at the extreme limit of its range), the occurrence of the leatherback is almost certainly the result of a deliberate, migratory movement.

5.3.1 Nature conservation measures

The leatherback turtle and loggerhead turtle are listed on Appendix I of the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES) 1975. They are also listed on Appendix II of the Bern Convention 1979, Appendices I and II of the Bonn Convention 1979 and Annex IV of the EC Habitats Directive.

The loggerhead is also listed as a priority species[10] on Annex II of the EC Habitats Directive, which allows for SACs to be designated in areas identified as essential for life and

[10] Priority species means a species for the conservation of which the Community has particular responsibility in view of the proportion of their natural range which falls within the territory. Priority species are indicated by an asterix in Annex II Habitats Directive.

reproduction. It is unlikely that any SACs will be identified in UK waters for loggerhead turtle.

Both the leatherback and loggerhead turtles are protected under Schedule 5 of the Wildlife and Countryside Act 1981 and the Conservation (Natural Habitats etc.) Regulations 1994. Under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), all marine turtles are given full protection within British territorial waters. This protects them from killing, injury, sale, destruction of a particular habitat (which they use for protection of shelter), and disturbance. Under the Countryside and Rights of Way Act 2000 is it an offence to deliberately or recklessly damage or disturb any turtle in UK protected waters.

There is also a Grouped Biodiversity Species Action Plan for Marine Turtles.

5.4 Fish

Populations of a number of commercial fish species are present within the Western Approaches Natural Area. The region is particularly important as a spawning area for mackerel *Scomber scombrus*. Fish are referred to in terms of being pelagic or demersal (ground-fish) species. Pelagic species are generally found in shoals swimming in mid-water, whereas demersal species are found living on or near the seabed.

5.4.1 Pelagic fish

Mackerel *Scomber scombrus* are present within this Natural Area during their migration between spawning and overwintering areas. Two stocks of mackerel are found in north west European waters: the North Sea stock and the continental Western stock. The Western stock overwinters in the Celtic Sea area off Cornwall and along the continental shelf edge. As the water begins to warm in spring and early summer, the mackerel move away from their overwintering grounds to spawn and feed. The Western stock spawns along the continental shelf edge in the Celtic Sea area and further south from February to June. It then begins its feeding migration to the west of Scotland and beyond (Lee & Ramster 1981) (see Figure 5.2a).

Perhaps the most notable (and certainly the largest) pelagic fish species present in the waters of this Natural Area, particularly during the summer months, is the basking shark *Cetorhinus maximus*. Although this is the largest fish in British waters (growing up to 12 metres in length), relatively little is known of its reproductive biology and population dynamics. Global populations have dramatically declined in areas where they have been hunted, primarily for the high value of their fins and also for their oil. Basking shark populations are particularly vulnerable to over-exploitation due to their biology – they produce few pups (6), have long gestation periods (1-3 years) and mature late (15 -20 years) (http://www.sharktrust.org/sharkconservation.html).

5.4.2 Demersal fish

Whiting *Merlangius merlangus* are taken in mixed trawl fisheries in the Celtic Sea, with the main gear used being otter trawls and seine nets. The main spawning areas of whiting in the Western Channel and Celtic Sea are off Start Point, Trevose Head and south east of Ireland. The spawning season is from February to May, with juvenile fish moving out of these inshore areas into the Western Approaches Marine Natural Area as they mature (CEFAS website).

Hake *Merluccius merluccius* is found in the deep water of the Celtic Sea and the western English Channel towards the edge of the continental shelf, where they spawn (Figure 5.2b). They are caught throughout the year, though peak landings are during the summer months (www.cefas.co.uk).

Sole (also known as Dover sole) *Solea solea* is known to spawn from February to March in an area to the west of the Isles of Scilly, which just impinges on this Natural Area (see Figure 5.2c).

5.4.3 Conservation measures

The Common Fisheries Policy (CFP) is the European Union's instrument for the management of fisheries and aquaculture. The CFP was created to manage a common resource and to meet the obligations set out in the Treaty of Rome. It provides the legal framework for the exploitation of living marine resources in EU waters and for those vessels registered in the EU fishing in non-EU waters. The CFP not only sets the framework for the allocation of fisheries resources amongst Member States and their rights of access to community waters, but also allows the introduction of technical measures for the conservation of fisheries resources. The Commission for the European Community has exclusive rights to administer up to the High Water Mark. However, in practice they devolve authority to the UK Government (Defra) to manage the fisheries within the 12 mile limit of the UK and to control the activities of UK registered fishing vessels.

5.4.3.1 Total Allowable Catch and Quotas

One of the four components of the CFP is the conservation and enforcement policy, which aims to set fishing activity at a sustainable level. An objective of the Conservation Policy is the sharing or allocation of resources to Member States. In order to regulate this, a fixing system of Total Allowable Catches (TACs) and quotas has been implemented. TACs are agreed annually by the Council of Ministers for each protected species in waters administered by the CFP and are divided so that each Member State receives a percentage or quota of a TAC. It is difficult to break down the species quota by Natural Area, as quotas are given for waters within the ICES fishing areas and there is often overlap between these and Natural Area boundaries.

5.4.3.2 Technical measures

Mesh size

This is the most basic form of technical measure. This sets a minimum mesh size that may be used for nets in a particular area or fishery, thus allowing small and immature fish to pass through the net. This can be a very successful conservation measure, as it allows more fish to reach sexual maturity and become part of the spawning stock. In addition, it avoids catching unmarketable fish that would be discarded. However, demersal fisheries often consist of mixed species of varying sizes. This can lead to immature fish of larger species being caught, such as cod.

Minimum Size (MS)

Another fisheries conservation measure is concerned with regulating the Minimum Size (MS) of fish. Fish smaller than the MS may not be retained on board or landed for sale and must be returned to the sea. The approach aims to discourage fishermen from targeting concentrations of juvenile fish and from using small mesh nets.

Grids, separator panels, veil nets, etc.

These devices are essentially adaptations of (or additions to) fishing gear, mainly demersal or pelagic trawls, which aim to reduce the by-catch of target and non-target species. Grids and panels, etc, essentially operate by excluding 'undersized' or otherwise unwanted species in a fishery. This is achieved by making use of the biology (size, age, behaviour, biodynamics) of the fish and other species, to develop such fishing gear adaptations.

5.4.3.3 Other conservation measures

Closed areas

Closures of a fishery can be spatial or temporal. There can be total closures, where no fishing is permitted; seasonal closures, where fishing is suspended at particular times of the year; temporary closures, where fishing may be suspended at short notice; and selective closures, where only specific fishing gears are permitted.

The South West Mackerel Box (Figure 5.3) was introduced in 1986 by Council Regulation (EEC) No. 3094/86. It is intended to protect juvenile mackerel by diverting fishing effort away from juvenile stocks to older fish. Vessels are prohibited from retaining mackerel caught in the Box if it exceeds 15% by weight of the total catch on board taken in the area (10% by weight of the total catch of mackerel, horse mackerel and pilchards for vessels of flags which have no quota for mackerel). Fishing by handline is still permitted within the Box. The South West mackerel season is usually from October to April, and considerable resources are devoted to ensuring that the integrity of the Mackerel Box is maintained and that pelagic vessels fishing in and around the area comply with the rules.

As part of the EU's Hake Recovery Plan, a Hake Box has also been proposed whose boundaries extend southwards from the south coast of Ireland and whose south easterly corner impinges on this Natural Area (Figure 5.3). The regulations are intended to reduce the catches of small hake in fisheries taking place in hake nursery areas. The Plan proposes that the minimum mesh size for all trawl fisheries within the Box will be 100 millimetres, unless hake comprise less than 20% of the total amount of marine organisms retained on board. In addition, there is a proposal to prohibit fishing with trawls with a cod-end mesh size of between 55 and 99 millimetres, and with fixed nets of mesh size less than 120 millimetres, within the area. Further, beam trawls with cod-end meshes of 70 millimetres or greater must have meshes of at least 180 millimetres in the upper part of the net in a panel extending back from the headline.

Reduction in fishing effort

Many of the commercially exploited fish stocks are too heavily fished and a reduction in fishing pressure is needed from both a biological and an economical point of view.

Following the reform of the Common Fisheries Policy, reductions in fishing effort to achieve a stable and enduring balance between fishing capacity and fishing opportunities have continued. These are detailed in Chapter III of the Council Regulation EC 2371/2002. Implementation of the reduction in the Community fleet capacity, in terms of tonnage and power, is provided in Council Regulation EC 1438/2003. In addition, a special incentive has been put in place (Council Regulation EC 2370/2002) for the period 2003 to 2006, to provide Member States with funds to co-finance the scrapping of fishing vessels to achieve the additional reductions in fishing effort resulting from recovery plans.

Fishing rights

Access rights to the waters around the UK also control the level of fishing activity. During a typical year, most nationalities with rights to fish in UK waters may be encountered at some time within the Western Approaches Marine Natural Area. The following registered fleets are listed here in descending order, according to their estimated level of activity: UK, French, Spanish, Irish, Danish, Belgian, Dutch, Faeroese (pers. comm., Anthony Hynes, Defra).

5.4.3.4 Nature conservation measures

There is a grouped Species Action Plan for Commercial Marine Fish. This provides detailed information on the threats facing species and the opportunities for maintaining and enhancing populations. A 'Grouped' Species Action Plan was produced as a range of common policies and actions are required for a number of similar species. The Commercial Marine Fish Action Plan differs from others in that it is aimed at particular stocks rather than the individual species as a whole. Within this Natural Area, stocks of plaice and sole are included in the Plan. The basking shark also has its own Species Action Plan.

The basking shark is a species protected under Schedule 5 of the 1981 Wildlife & Countryside Act (1998 Amendment), which prohibits the intentional killing, capture or disturbance within 12 nautical miles of the coast. The shark also has its own Species Action Plan. In November 2002 the basking shark was added to Appendix II of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES), which prohibits sale of the shark's body parts (liver, cartilage, meat and particularly its fins).

The basking shark is also listed as a vulnerable on the IUCN Red Data List as the species is considered to be facing a high risk of extinction in the wild.

5.5 Invertebrates

It is possible that certain benthic sessile invertebrate species which have their own Species Action Plans, such as the pink sea fan *Eunicella verrucosa* and the yellow cup coral *Leptopsammia pruvoti*, may occur on bedrock reefs within the Natural Area, but this is not yet known. Certainly, other sessile invertebrate species familiar in shallower waters, such as the Devonshire cup coral *Caryophyllia smithii* and the jewel anemone *Corynactis viridis*, are known to occur on the bedrock reef of Haig Fras in the Celtic Sea (see also section 4.2.4).

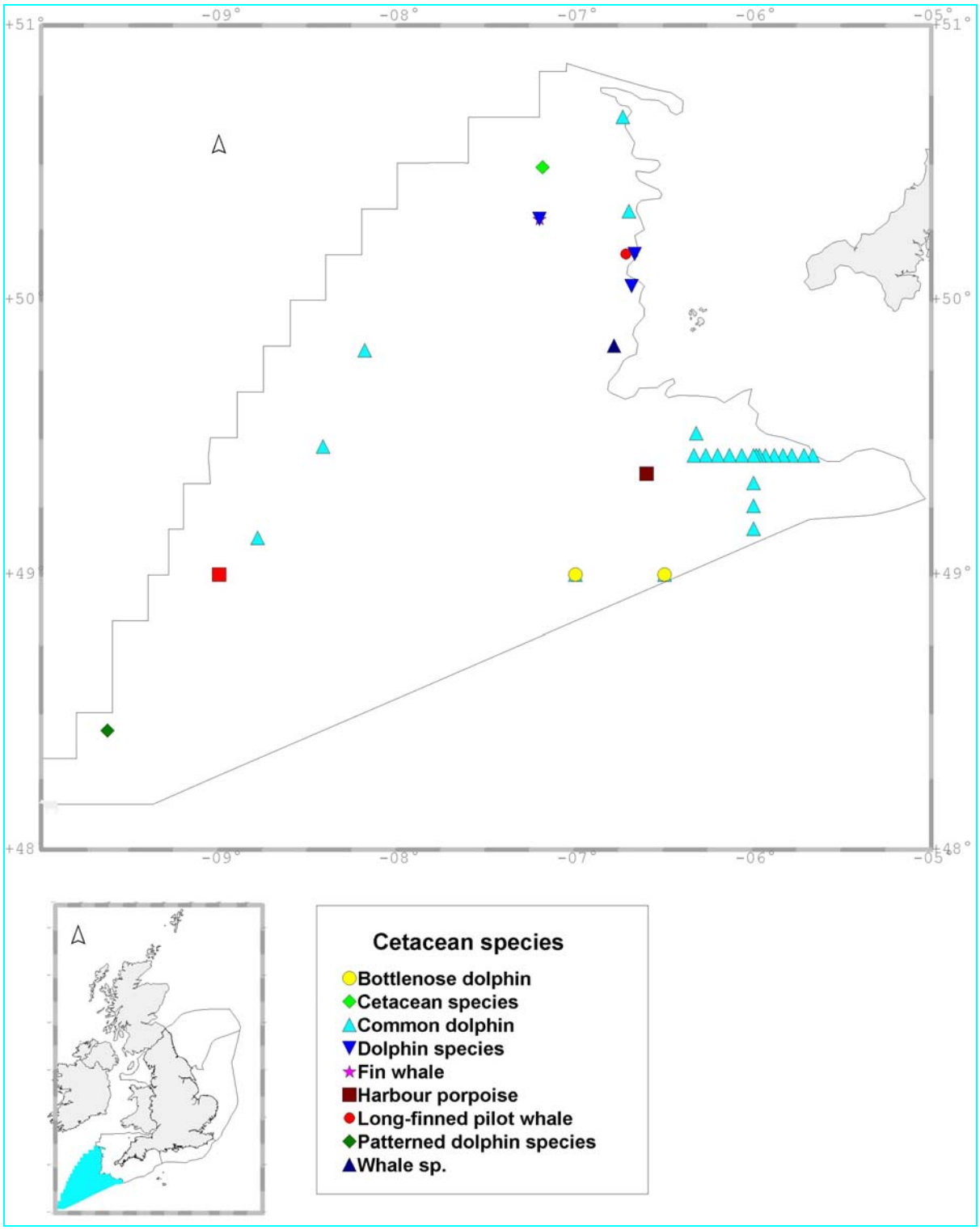
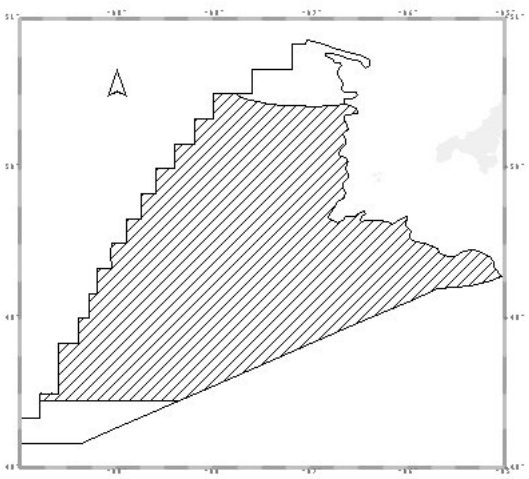
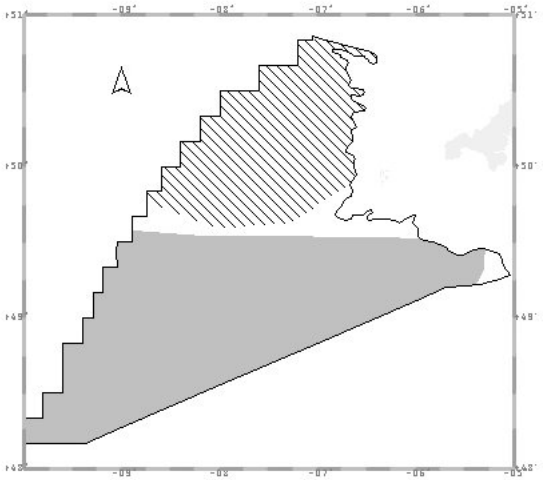


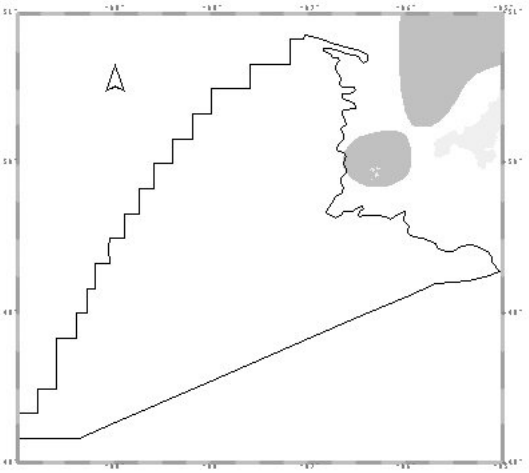
Figure 5.1 Records of cetaceans seen in the Western Approaches Marine Natural Area (after Evans *et al* 2003).



a) Distribution of **mackerel** spawning (May–Aug) areas within the Western Approaches Natural Area.



b) Distribution of **hake** spawning and nursery areas within the Western Approaches Natural Area.



c): Distribution of **Dover sole** spawning (Feb-Mar) and nursery areas within the Western Approaches Natural Area

Figure 5.2 Maps showing the distribution of fish nursery and spawning areas within the Western Approaches Natural Area (Data taken from Coull *et al* 1998 and provided by CEFAS).

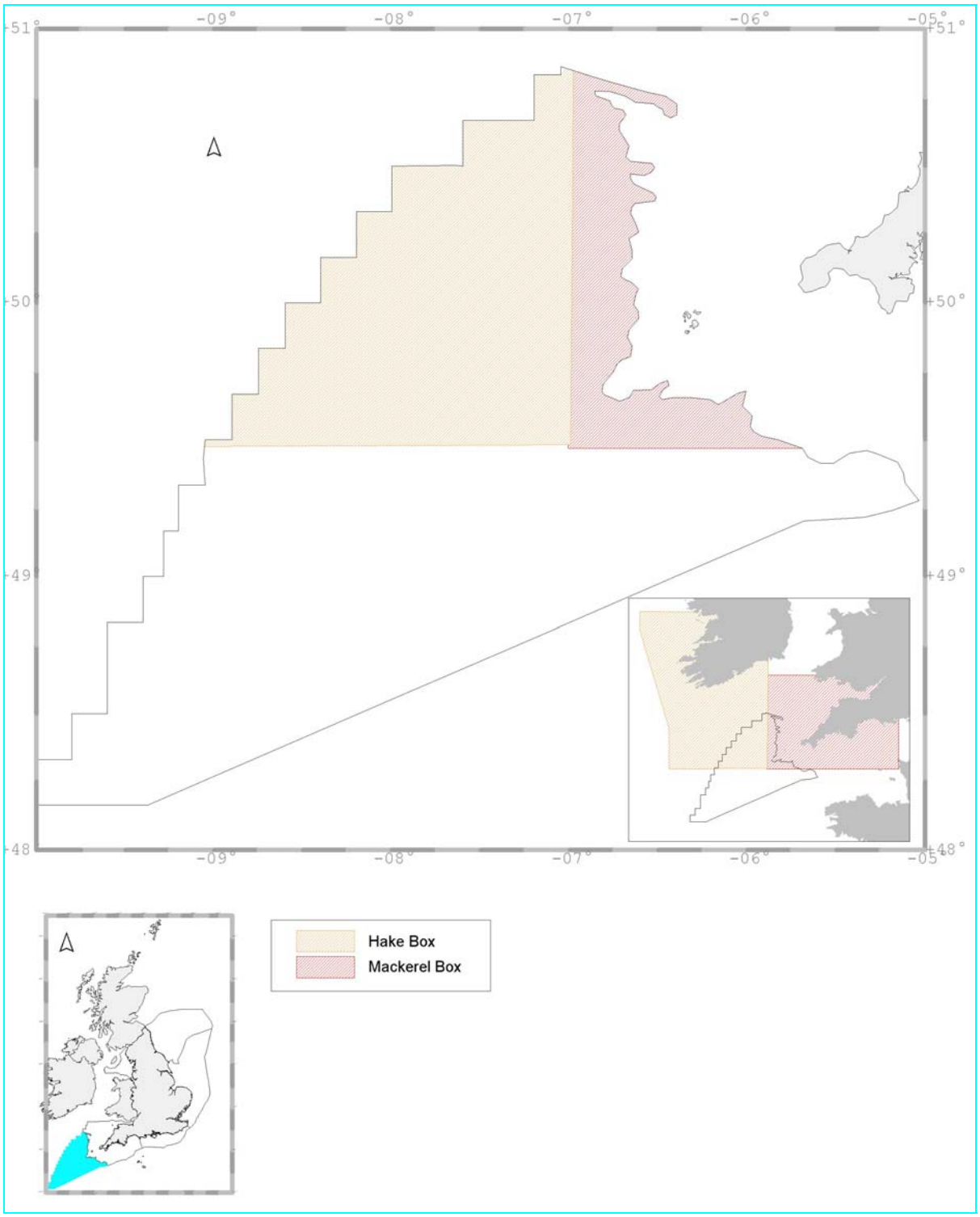


Figure 5.3 Location of hake and mackerel boxes within the Western Approaches Natural Area.

6 Human activities and uses

This section outlines significant human activities in the Western Approaches which are relevant to the nature conservation values described in the previous sections. This section does not provide a comprehensive listing of all the social and economic activities of the Western Approaches, and for those that are included, the descriptions are brief. Rather, the intention is to give an overview of the range of activities which do or could interact with the environment. We have emphasised the need to consider these together if we are to achieve sustainable use of the marine environment and its biodiversity.

6.1 Fisheries

Fisheries is the predominant activity within this Natural Area. The main target species for fishing within the Western Approaches Natural Area is mackerel, which is fished for by mid-water and deep-water pair trawling in the winter months, and by purse seine-netting in the summer months. Handlining for mackerel rarely takes place within this region, being more common closer to the coast. Many boats from Falmouth, Newlyn and Padstow target hake and monkfish using gill nets during the summer months. Besides mackerel, other important commercial species include cod, whiting, hake, anglerfish, sole and megrim, which are commonly harvested by trawl.

Fishing activity within this area has both direct and indirect effects on the environment. Although the most evident and direct impact of fishing is mortality and removal of fish from the marine ecosystem, other impacts are described in the following sections.

6.1.1 Physical impact of fishing gears

6.1.1.1 Towed or dragged gears

Mid-water and deep-water pair trawling

This method of fishing is used to catch mackerel during the winter months, when the fish remain close to the seabed and before they have started to migrate to their spawning grounds. The main impact is likely to be on non-target species being caught in the net (see section 6.1.4), although these and other trawl fisheries have been implicated in wider marine environmental damage.

Purse seine-nets

Purse seine-nets have been used in the past to catch pelagic species such as mackerel during the summer months.

6.1.1.2 Static gear

Gill nets. These can be set at or below the surface, on the seabed, or at any depth in between. Within this Natural Area, however, the majority of gill nets are set on or close to the seabed. Besides the main target species, this type of gear can result in the incidental capture of marine life, most notably marine mammals and seabirds. They also have the potential to continue fishing if lost or discarded, an effect which has been described as 'ghost fishing' (Kaiser *et al* 1996) (see section 6.1.3).

6.1.2 Stock depletion

The following is intended to highlight some of the issues of conservation concern relating to commercial fisheries, and which have implications for the wider marine ecosystem within the Natural Area.

Cod. In October 2002, the International Council for the Exploration of the Sea (ICES) determined cod in the Western Approaches (ICES division VIIe-k) to be outside safe biological limits (ICES stock status advice, 2002). For 2003, ICES recommended the complete closure of cod and several associated fisheries (haddock, plaice, sole, megrim) that are taken in mixed trawl fisheries and are of commercial importance to the UK, to improve chances of stock recovery. However, limited fishing for cod and associated species continues in this area.

Mackerel. The spawning stock biomass of mackerel has fallen since the mid-1980s and it is estimated that this decline will continue at all fishing mortalities. In order to reduce pressure on juvenile stock in particular, a 'Mackerel Box' was introduced in 1986 within which certain types of gear used to catch mackerel was restricted (see also section 5.4.3.4). ICES recommended limiting catches in 2003 to 113,000 tonnes for all ICES areas in which mackerel are harvested, including the Western Approaches. ICES further recommended that fisheries targeting mackerel, in which juveniles are abundant, should be restricted. Industrial fisheries (large volumes of fish harvested for processing into fishmeal), which occur most frequently off the west coast of Scotland, take mackerel as by-catch. It seems probable, however, that such industrial fisheries could have an impact on those stocks in the Western Approaches, which would affect local industry. ICES has advised that such fisheries be restricted in order to protect mackerel stocks.

6.1.3 Fishing debris

Fishing activity has been identified as one of the four major sources contributing to litter found on UK beaches (Marine Conservation Society 1999). Items such as fishing nets, fish boxes and buoys from the fishing industry account for 11.2% of the total amount of litter found. One of the consequences of fishing-related debris in the marine environment is 'ghost fishing'. This is where nets or pots, lost either because of bad weather, snagging, towed away by mobile fishing gears, or simply discarded, remain either on the seabed or in the water column and continue to fish (Santos *et al* 2001). Often though, lost or discarded nets are rolled up on the seabed by the action of currents or wave action and cease fishing relatively quickly. However, floating debris may entangle marine life close to the surface, such as cetaceans, seabirds, turtles and seals.

6.1.4 By-catch

One of the problems associated with most types of fishing gear is that of incidental capture or by-catch of non-target species. This may include other commercial and non-commercial fish, seabirds and sea mammals. In particular, concern has grown over the by-catch of cetaceans in a number of different types of gear, including bottom-set gill nets and trawl nets.

The impact of incidental capture on porpoise populations around the UK as a whole is not known. However, it has been suggested that incidental by-catch could be a significant contributory factor in the overall decline in abundance of harbour porpoise in European

Waters (Gislason 1994). Northridge *et al* (2000) addressed the by-catch of porpoises in the UK and Irish Celtic Sea hake gillnet fisheries, concentrating on the rates of by-catch by area. However, they could find no suitable areas (or seasons) for closure which would achieve their target of a 70% reduction in by-catch rate. Other potential means include actively deterring cetaceans from nets using 'pingers'. These are acoustic deterrent devices producing a relatively low frequency sound (Reeves *et al* 2001) that can be run for periods of months or years with a small battery pack. Pingers have been shown to be effective in mitigating small cetacean by-catch in fixed gear, both in controlled experiments and in fishing operations. However, they have only been tested on a few small cetacean species so far.

The UK Small Cetacean By-catch Response Strategy, launched on 20 March 2003 by the UK Government, reviews by-catch mitigation methods. It also recommends measures to be taken to reduce small cetacean by-catch, where levels are considered unacceptable. The Strategy includes a target that the by-catch of harbour porpoises by UK licensed vessels in the Celtic Sea should be reduced to less than 200 animals within 3 years. To achieve this, it recommends that there should be a legal requirement for UK fishing vessels operating outside 6 nautical miles that are using bottom set gill nets in ICES areas VII e, f, g, h and J to use pingers on their nets (pers. comm., Martin Willcox, Defra).

Other mitigation measures include the use of 'escape hatches' in nets, making nets more 'reflective'. Nets were coated with a layer of iron oxide or barium impregnated nylon to make them stiffer (Larsen *et al* 2002).

6.2 Oil and gas extraction

The UK Government has the right to grant licences to explore and exploit resources such as oil and gas. The UK Continental Shelf is divided into a series of blocks for which licences are granted.

There are a number of well heads remaining from exploration drilling within the Natural Area (Figure 6.1). However, the oil finds at these sites are not of sufficient quantity to make the extraction commercially viable. Currently, there is only one suspended wellhead (where oil production has been suspended) remaining in Block 73/12 (pers. comm., Mick Borwell, UKOOA). Further information on the locations of fields and installations can be seen at http:///www.og.dti.gov.uk/information/index.htm**.**

Further information can also be obtained from the DTIs Strategic Environmental Assessment reports which are available via the SEA website at http//www.offshore-sea.org.uk/sea/index.php.

The major activities associated with oil and gas developments that have potential impacts on the marine and coastal environments, can be summarised under the following categories:

- Evaluation.
- Exploration.
- Development and production.
- Abandonment and decommissioning.

However, given the lack of activity in this Marine Natural Area these are not discussed in detail (see other Marine Natural Area profiles for such text, eg The Southern North Sea profile).

6.3 Aggregate extraction

Whilst there appears to be large areas of sand and gravel within this Natural Area, it is believed that the industry does not yet have a marked interest in this area. Such interest may be restricted due to the depth of the seabed and the prevailing weather conditions which affect this area for much of the year.

6.4 Shipping

6.4.1 Commercial

A large amount of international commercial shipping passes through this Natural Area. Destinations include Ireland; western and northern ports of the UK and beyond to Iceland and Scandinavia; the Iberian peninsula and beyond to the Mediterranean and west Africa; Canada, USA, the Caribbean and South America (Figure 6.2). Many different types of vessel operate in this area, according to the nature of the cargo they are carrying (Table 6.1).

Since the mid-nineteenth century the volume of goods transported by sea has grown enormously. The growth of the petroleum industry had a very significant effect on shipping with the advent of the oil tanker, which is the largest carrier of cargo. The carriage of goods by sea inevitably places marine and coastal environments at some risk. Almost any vessel anywhere has the potential to cause a degree of environmental damage, either through routine operations or accidents. Despite this, shipping is responsible for a relatively small proportion of all marine pollution in the UK, compared to that from land-based sources. Much of the marine pollution be traced back to centres of population and to industrial and agricultural operations.

There are four potential areas of concern with commercial shipping:

- **Historical pollution** - for example, the application of TBT has now been banned on vessels of all sizes by the International Maritime Organisation, with a global ban due to come into force in 2008.
- **Operational pollution** – this consists of oil and oily wastes, noxious liquid substances, sewage, garbage and anti-fouling paints.
- **Accidental pollution** – as a result of collision or grounding, which can result in large quantities of pollutant being released into the marine environment. The types of pollutants are similar to those associated with operational discharge.
- **Physical damage** – resulting from the grounding of vessels, anchors dragging along the seabed and disturbance from propellers.

The extent of environmental damage following any accident depends on a range of factors, in particular, the cargo of the vessel, where the accident occurs, the depth of water, the state of the tides and at what time of year. Within this Natural Area the predominant types of shipping vessels are cargo carriers (see Figure 6.2 and Table 6.1).

The COAST database indicates that there were no oil spills reported within this Natural Area between 1989 and 1998 (ANATEC 2000).

In an attempt to address some of the problems caused by shipping, the Donaldson Inquiry was initiated to 'identify what can reasonably be done to protect the UK coastline from pollution from merchant shipping' (Donaldson 1994). The Inquiry, initiated after the *Braer* disaster, provided an overview of the use of routeing measures aimed at accident prevention and subsequently dangers of pollution and loss of life. Routeing measures ensure that ships are kept outside areas where pollution would cause particular damage to the environment. One of the major recommendations of the inquiry was the establishment of Marine Environmental High Risk Areas (MEHRAs). These are comparatively limited areas of high environmental sensitivity that are at risk from shipping. The idea was that identifying MEHRAs would give ship masters additional information relevant to passage planning, which would result in the usage of the recommended routeing and so reduce pollution risk at these sites.

The process of identifying MEHRAs is well advanced, though the timescale for their introduction has not been decided.

Table 6.1 Annual total of number of vessels passing through the Western Approaches Natural Area in 1999. (Data taken from COAST database.)

Vessel type	Annual total of number of vessels passing through the Natural Area
Bulk	2,172
Cargo	10,295
Ferry	156
Gas carrier	543
Ro-Ro	1,881
Standby	0
Supply	0
Chemical tanker	779
Oil tanker	1,083
Shuttle tanker	0
All	16,909

6.4.2 Ferries

The only ferry routes which pass through this Natural Area are those from Cork (south east Eire) to France and the Channel Islands (Figure 6.3). There are occasional trans-Atlantic cruise liners which may also pass through the Marine Natural Area.

6.5 Litter

Being a considerable distance away from land-borne sources, litter is a relatively minor problem within this Natural Area. However, litter is still present, whether it has been discarded illegally from vessels within the Natural Area or whether it has been carried into the Natural Area by winds or currents. Fishing debris (such as nets and buoys) is likely to be one of the main contributors to the litter found within this Natural Area. One of the consequences of fishing-related debris in the marine environment is ghost fishing, whereby

the discarded gear continues to 'fish' (see section 6.1.3). Floating debris may also entangle marine life close to the surface, such as seals, cetaceans, turtles and seabirds.
At a recent OSPAR commission ministerial meeting, the contracting parties agreed to "do their utmost to take measures to eliminate the problem of litter" including through OSPAR's Marine Litter Monitoring Work Programme (OSPAR 2003).

6.6 Submarine cables

A number of submarine communication cables traverse the Western Approaches Natural Area (see Figure 6.4). Many run over 3,000 miles across the Atlantic to the Americas, while others link with France, Ireland, the Iberian peninsula and Africa. Submarine cables have been laid on the seabed since before the turn of the last century. Cables installed since 1983 are buried beneath the seabed (wherever possible) to a depth of 40-90 centimetres, although they can often be scoured out by tide and current or can be dragged out by anchors and fishing gear. Even though attempts are made to bury new cables, they can still interfere with fishing operations or cause damage if they become snagged in fishing gear. However, the environmental impacts of cable-laying are limited (DoE 1993).

Another impact of cables (of which little is known to date) is the production of electromagnetic frequencies (EMF) generated by 'active' cables. With the recent development of offshore wind power, the Collaborative Offshore Wind Research Into the Environment (COWRIE, which is funded by the interest on deposits developers put down to secure a development site) has commissioned two research projects investigating the effects of noise, vibration and EMF. Although the environmental effects of EMF are unknown at present, it is thought that elasmobranchs may be particularly sensitive to them (pers. comm., Victoria Copley, English Nature).

6.7 Recreational uses

The main recreational activities that take place within this Natural Area are ocean sailing (occasionally) and ocean powerboat racing (rarely).

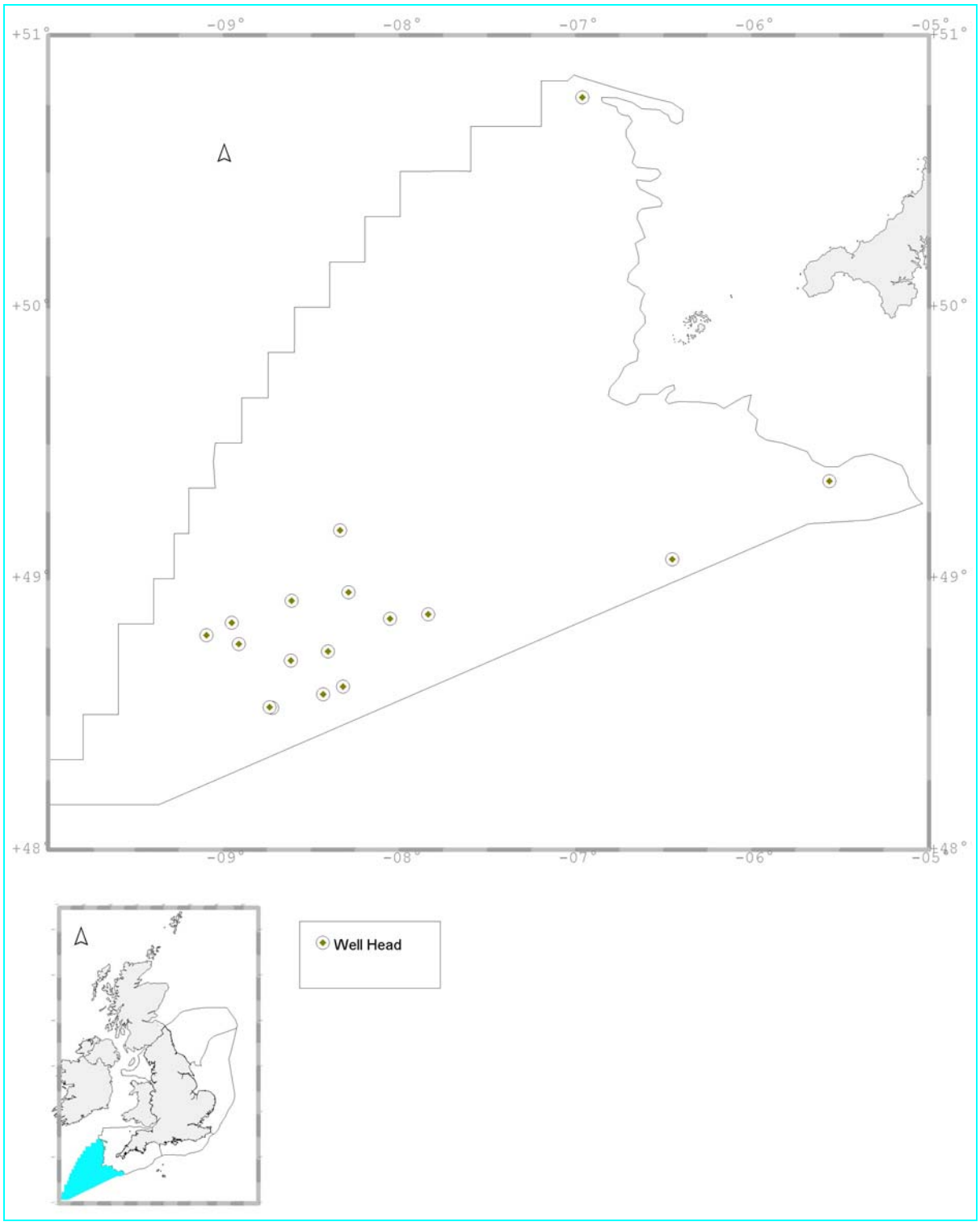


Figure 6.1 Oil well heads remaining from exploration drilling in the Western Approaches Natural Area.

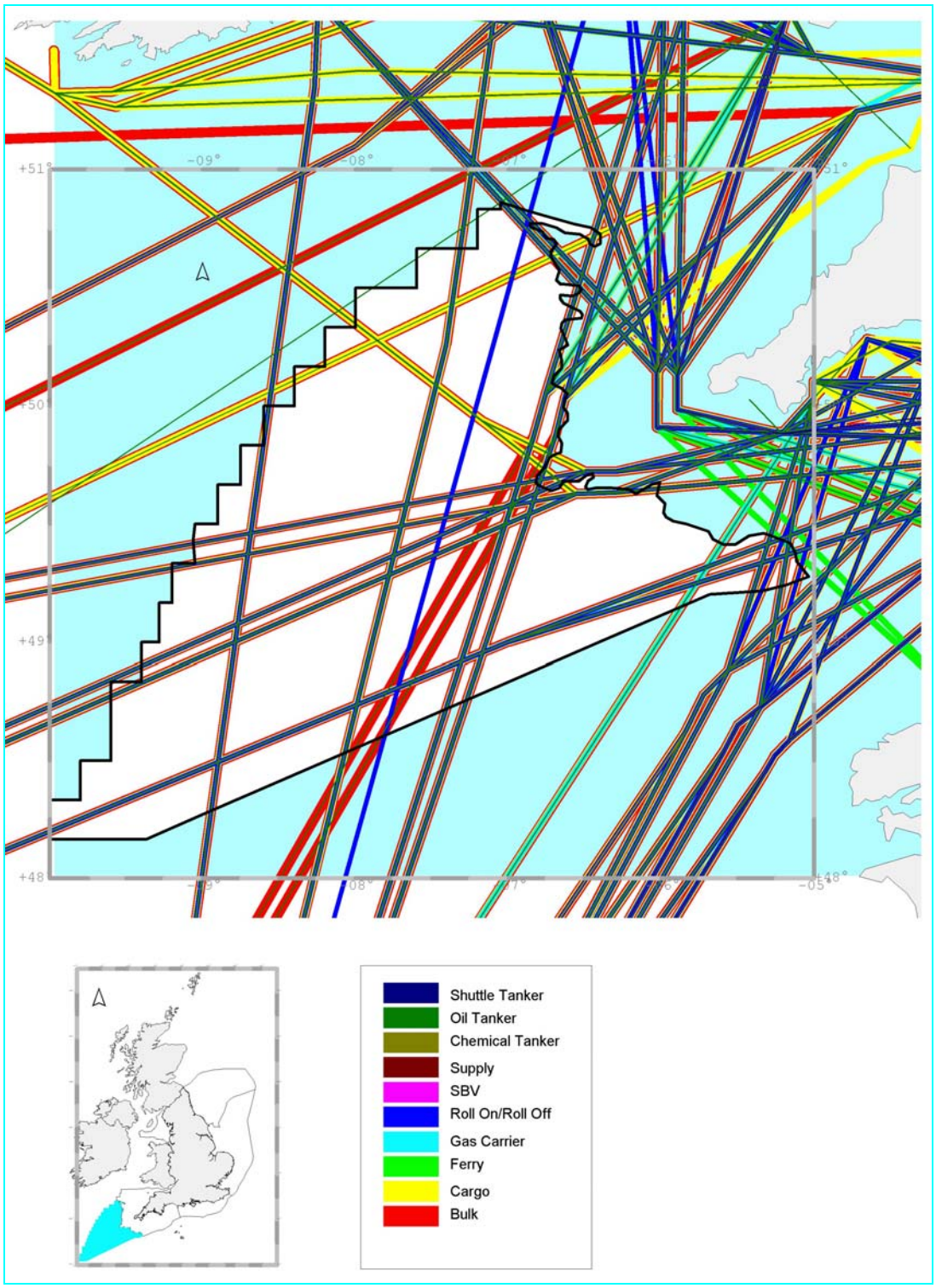


Figure 6.2 Map showing the various types of vessel operating with the Western Approaches Natural Area during 1999. (Data taken from COAST database) (SBV Standby vessel).

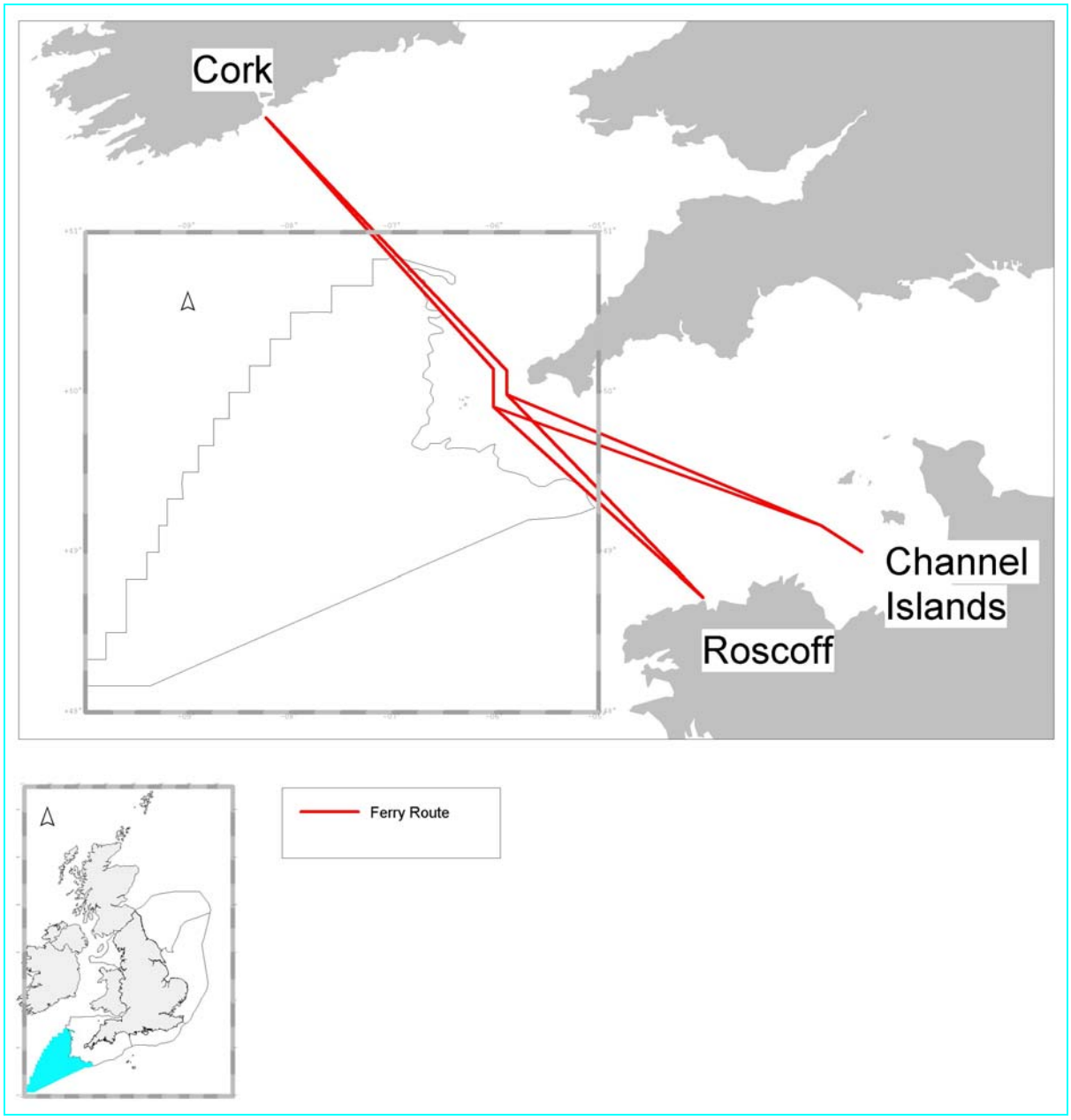


Figure 6.3 Map of ferry routes crossing the Western Approaches Natural Area.

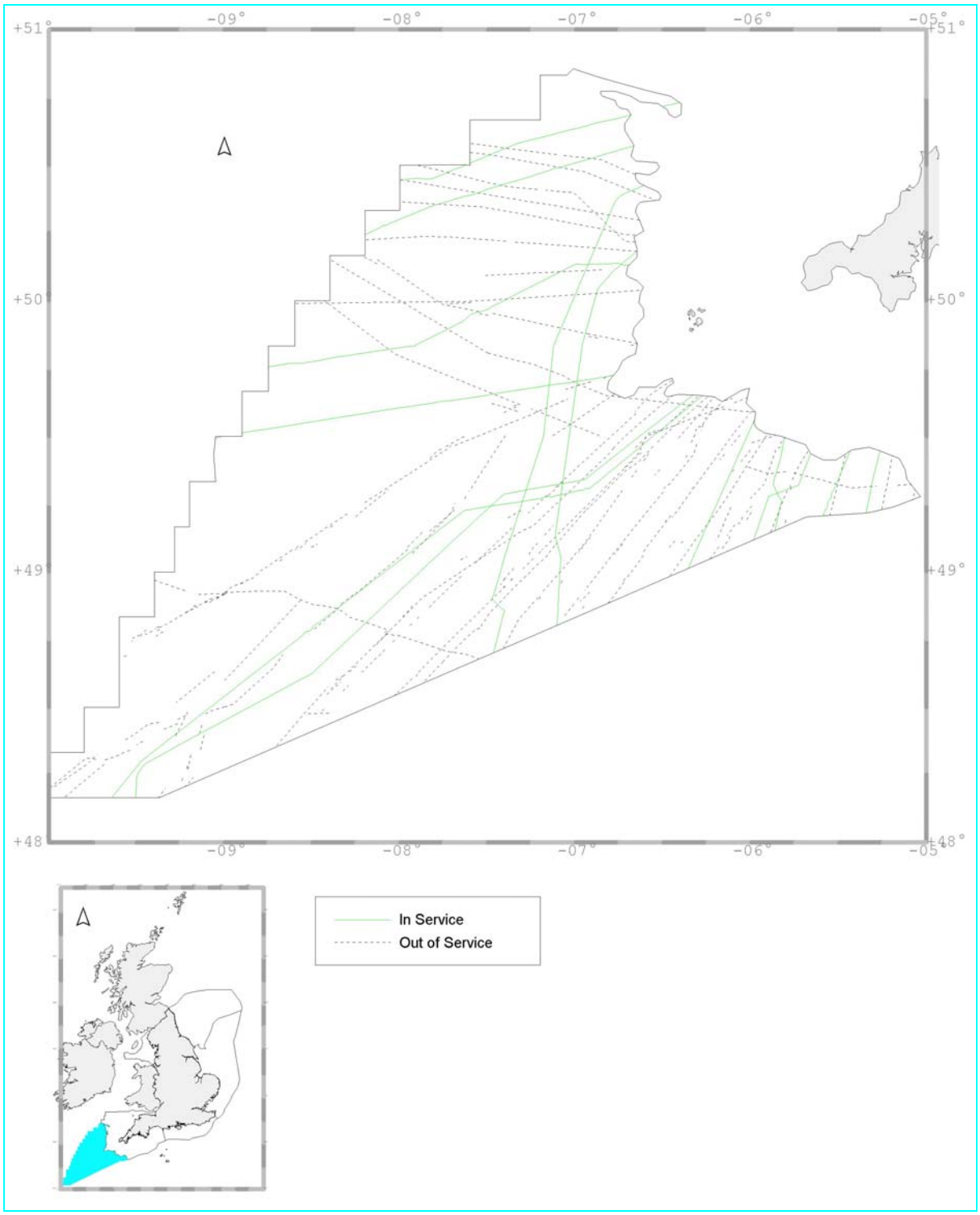


Figure 6.4 Map of submarine cables passing through the Western Approaches Natural Area (data provided by Global Marine Systems).

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Appendix 1 Marine Natural Areas and the ecosystem approach

An ecosystem consists of a community of plants, animals and micro-organisms and their physical environment. They are inter-dependent and may be best described as a network or web. In 2000 the Conference of the Parties to the Convention on Biological Diversity (CBD 2000) stated, amongst other things, that:

"The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources."

"An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems."

The following table provides a brief outline of the relevance of Marine Natural Areas to taking forward the ecosystem approach.

12 principles recommended by the Conference of Parties of the Convention on Biological Diversity in 2000 to guide signatory countries in the practical application of the ecosystem approach	**Relevance of Marine Natural Areas**
The objectives of management of land, water and living resources are a matter of societal choice.	English Nature believes that all key stakeholders should be involved in the management of the marine environment. The degree to which the ideas and information presented in these Marine Natural Area profiles are taken forward should be decided through dialogue amongst those stakeholders.
Management should be decentralised to the lowest appropriate level.	The better management of many marine activities around England, such as fisheries, aggregates and energy generation, requires a regional rather than simply a national approach. We feel that the Marine Natural Areas framework is at a scale that is appropriate for managing and governing the seas around England.
The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.	Marine Natural Areas are a broad scale, ecologically meaningful framework. Although some boundaries of individual Marine Natural Areas may need further refinement, we feel that this initial framework provides a good basis for testing and applying the ecosystem approach at an appropriate, ie regional, scale.
Recognising the varying temporal scales and lag-effects that characterise ecosystem process, objectives for ecosystem management should be set for the long-term.	Marine Natural Areas reflect broad scale factors and processes, some of which change only in the long-term, eg current patterns. Consequently objectives to guide management of human activities in Marine Natural Areas should consider a long-term as well as short-term perspective.

12 principles recommended by the Conference of Parties of the Convention on Biological Diversity in 2000 to guide signatory countries in the practical application of the ecosystem approach	Relevance of Marine Natural Areas
Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.	The emphasis on the key processes that help to define the Marine Natural Areas highlights the need to consider the interconnections both within the sea and also between Natural Areas. Consequently there is a need for a more integrated, holistic view of the effects of individual activities, including the cumulative effects over broad areas and adjacent waters.
Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: reduce those market distortions that adversely affect biological diversity; align incentives to promote biodiversity conservation and sustainable use; and internalise costs and benefits in the given ecosystem to the extent feasible.	Although Marine Natural Areas focus on defining ecological units and describing their biodiversity and nature conservation values, the descriptions also recognise key economic activities. Marine Natural Areas provide an ecologically relevant framework for management, including sustainable use, and offer a potentially common framework for aligning economic with environmental concerns. We appreciate the challenges this brings. We also recognise that the basis of 'regional seas' is likely to evolve and boundaries may be refined as interest in a potential regional approach to the marine environment gathers momentum.
Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.	Marine Natural Areas are based on both functional processes and structure and the link between them. Both should be reflected in conservation objectives for Marine Natural Areas.
Ecosystems must be managed within the limits of their functioning.	We must manage human use of the coasts and seas so that they do not damage the way the ecosystem works. For example, we should seek to ensure that particular activities do not affect the productivity of the marine environment. The development and application of conservation objectives for Marine Natural Areas will help towards identifying such limits.
Management must recognise that change is inevitable.	The marine environment is dynamic and responds to both man-made and natural changes. The profiles do not describe changes that have occurred within each Marine Natural Area in detail but change is implicit in an approach which emphasises functional processes and the link between these and structure.The development of conservation objectives and management for Marine Natural Areas should reflect the fact that change is often inevitable.
The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.	Marine Natural Areas provide an ecologically relevant framework at a scale appropriate for managing the use of biological diversity (such as fisheries) in a way that maintains wildlife. This will be addressed further through the development of conservation objectives and management for Marine Natural Areas, in conjunction with key stakeholders and government.
The ecosystem approach should consider all forms of relevant information including scientific and indigenous and local knowledge, innovations and practices.	The definition and description of Marine Natural Areas has drawn on a wide range of information but this has been largely technical in nature. Other relevant information is likely to be drawn on in the process of developing management for regional seas in partnership with other stakeholders, building on Marine Natural Areas as appropriate.

12 principles recommended by the Conference of Parties of the Convention on Biological Diversity in 2000 to guide signatory countries in the practical application of the ecosystem approach	Relevance of Marine Natural Areas
The ecosystem approach should involve all relevant sectors of society and scientific disciplines	A number of organisations have been consulted in defining and describing Marine Natural Areas including relevant regulatory authorities, industry, agencies and scientific institutes. However, this has been limited to those with relevant technical information. It is hoped that Marine Natural Areas will help to inform and structure a wider debate involving all relevant stakeholders in developing management for regional seas.

Appendix 2 Biodiversity Action Plan and Habitats Directive Classifications

Broad habitat types	Priority habitats
Inshore sublittoral rock	Sublittoral chalk *Sabellaria spinulosa* reef *Modiolus modiolus* beds
Inshore sublittoral sediment	Seagrass beds (*Zostera marina*) *Maerl* beds Mud in deep water Sublittoral sands and gravels
Offshore shelf sediment	Sublittoral sands and gravels

After Volume 5 of the *UK Biodiversity Group Tranche 2 Action Plans*

EC Habitats Directive – Annex I Habitats (relevant to Marine Natural Areas)

Physiographic features	Habitats
Large shallow inlets and bays	Sandbanks which are slightly covered by seawater all the time
	Mudflats and sandflats not covered by seawater at low tide
	Reefs
	Submerged or partially submerged seacaves

Appendix 3 Wentworth and Folk sediment classifications

SEDIMENT SIZE				
phi value	milli-metres	SIZE CLASS		
		WENTWORTH		FOLK
-8	256	Boulder		Gravel
		Cobble		
-6	64	Pebble		
-2	4			
-1	2	Granule		
-0.5	1.41	Very Coarse	Sand	Sand
0	1			
0.5	0.71			
1	05	Coarse		
1.5	0.35			
2	0.25	Medium		
2.5	0.17			
3	0.125	Fine		
3.5	0.088			
4	0.0625	Very fine		
8	0.0039			
		Silt		Mud
		Clay		

Appendix 4 Glossary and abbreviations

Definitions based largely on:
Covey & Laffoley (2002), Ellis *et al* (1996) and Hiscock (1996).

Anadromous (of fish)
Upward-running: spending part of their life in the sea and migrating up rivers in order to breed (eg salmon) (cf. "catadromous").

Bathymetry
Measurement of ocean or lake depth and the study of floor topography (Lincoln & Boxhall 1987).

Benthos
Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides as the littoral zone.

Bioaccumulation
The accumulation of a harmful substance such as a radioactive element, a heavy metal, or an organochlorine in a biological organism, especially one that forms part of the food chain.

Biodiversity (biological diversity)
"The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." (UN Convention on Biological Diversity 1992).

Biogeographic region
A region which is separated from adjacent regions by barriers or a change in environmental conditions which limits the movement of species or prevents their establishment outside their natural geographical range.

Biota
Any living organisms, both animals and plants.

Biotope
The physical "habitat" with its biological "community"; a term which refers to the combination of physical environment (habitat) and its distinctive assemblage of conspicuous species. MNCR uses the biotope concept to enable description and comparison.

The smallest geographical unit of the biosphere or of a habitat that can be delimited by convenient boundaries and is characterised by its biota (Lincoln, Boxhall & Clerk 1982).

Boreal
(Biogeographical) Pertaining to cool or cold temperate regions of the northern hemisphere. In marine zoogeographical terms, Ekman (1953) states that the centre of the Boreal region lies in the North Sea. It is bounded by the subarctic transitional zone to the north between Shetland, the Faroe Islands and Iceland, and in the south west of Britain by a transitional zone with the Mediterranean-Atlantic Lusitanean region.

Catadromous (of fish)
Downward-running: spending most of their life in rivers and migrating downstream to the sea in order to breed (eg eels) (cf. "anadromous").

Coastal zone
The space in which terrestrial environments influence marine (or lacustrine) environments and vice versa. The coastal zone is of variable width and may also change in time. Delimitation of zonal boundaries is not normally possible; more often such limits are marked by an environmental gradient or transition. At any one locality, the coastal zone may be characterised according to physical, biological or cultural criteria, which need not, and rarely do, coincide.

Cobble
A rock particle defined in two categories based on Wentworth (1922): large (128-256 mm); small (64-128 mm) (from Hiscock 1990).

Common Fisheries Policy (CFP)
A 20-year programme agreed in 1983 by EC Member States for the management and conservation of fish stocks, the maintenance and improvement of the market structure associated with the fishing industry, and international fisheries agreements.

Continental shelf
The seabed adjacent to a continent to depths of around 200 metres, or where the continental slope drops steeply to the ocean floor. Defined in law as "the seabed and subsoil of the submarine areas adjacent to the coast… to a depth of 200 metres"; the legal landward limit is set at the outer limit of territorial waters (q.v.) (Geneva Conference on the Law of the Sea, Convention on the Continental Shelf, 1958).

Controlled waters
In the UK, for the purposes of pollution control and other regulations, all rivers, streams, lakes, groundwaters, estuaries and coastal waters to a distance of three nautical miles (5.5 km) offshore (12 nautical miles (22 km) for migratory fish). The term is also used to refer to the area extending to 200 km from baselines (or to the midline between countries where less than 200 km) where a country has rights in relation to utilisation of resources and control of pollution but where the area is not described as an "Exclusive Economic Zone" (q.v.).

Current
Horizontal movement of water in response to meteorological, oceanographical and topographical factors (see also "tidal stream") (from Ministry of Defence 1987); a steady flow in a particular direction. "Current" refers to residual flow after any tidal element (ie tidal streams) has been removed.

Demersal
Living at or near the bottom of a sea or lake, but having the capacity for active swimming.

Diadromous
Fish that spend part of their life in freshwater and part in saltwater; eg anadromous salmon and catadromous eels.

Ebb tide
Outgoing or falling tide.

Ecosystem
A community of organisms and their physical environment interacting as an ecological unit (from Lincoln, Boxhall & Clerk 1982). Usage can include reference to large units such as the North Sea down to smaller units such as kelp holdfasts as "an ecosystem".

Ecosystem approach
The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way (Convention on Biological Diversity). There have been various elaborations on the definition, eg in a marine context as "the comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity" (definition being discussed under the developing EU Marine Strategy).

Eddy
Motion of a fluid in directions differing from, and at some points contrary to, the direction of the larger-scale current (from Allaby & Allaby 1990); a circular movement of water, the diameter of which may be anything from several cm to several km, caused by topographical features or sudden changes in tidal or tidal stream characteristics. (Based on Ministry of Defence 1987). Cf. "gyre".

Endocrine disruptor
An endocrine disruptor is an exogenous substance or mixture that alters the function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub) populations.

Eustatic
Local sea-level changes deriving from global changes in sea level, which have been estimated as rising at between 1.5 and 2 mm per year.

Eutrophication
The enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned (UWWTD, 1991).

Exclusive Economic Zone (EEZ)
A legal concept introduced by the United Nations Conference on the Law of the Sea III (UNCLOS III) (1967-82), giving coastal states certain sovereign rights and jurisdictions for economic purposes over an area of sea and seabed extending up to 200 nautical miles (370 km) from a baseline (normally low-water line) (based on Baretta-Becker, Duursma, & Kuipers 1992). Cf. "controlled waters".

Flood-tide
Incoming or rising tide.

Front, frontal system
An interface between two fluid bodies with different properties (based on Baretta-Becker, Duursma, & Kuipers 1992).

Graben
A fault-bounded crustal block, generally elongate, that has been depressed relative to the blocks on either side.

Gravel
Sediment particles 4-16 mm in diameter, based broadly on Wentworth (1922), which may be formed from rock, shell fragments or maerl (based on Hiscock 1990).

Gyre
A circular or spiral motion of fluid.

Gulf Stream
A relatively warm ocean current flowing north-eastwards off the Atlantic coast of North America from the Gulf of Mexico. It reaches north eastern Atlantic waters off Europe as the North Atlantic Drift.

Igneous [rocks]
Rocks formed from molten rock (magma). They usually consist of interlocking crystals, the size of which is dependent on the rate of cooling (slow cooling gives larger crystals; rapid cooling produces smaller crystals).

Irish Sea
The area of sea between Great Britain and Ireland north of a line across St George's Channel from St Annes Head to Carnsore Point in the south, and south of a line across the North Channel from Mull of Kintyre to Fair Head in the north, including all estuaries except the Firth of Clyde (Irish Sea Study Group definition, based on Shaw (1990)).

Isostatic
Changes in sea level deriving from the effect of local crustal movements which result in Scotland rising and southern England sinking, due to the removal of the weight of ice since the last glacial period.

Lusitanean
(Biogeographical) Referring to a biogeographical region centred to the south of the British Isles and influencing the extreme south west of the British Isles.

Maerl
Twig-like unattached (free-living) calcareous red algae, often a mixture of species and including species which form a spiky cover on loose small stones - 'hedgehog stones'.

Marine
Pertaining to the sea.

Marine Nature Conservation Review (MNCR)
A project initiated by the Nature Conservancy Council (NCC) in 1987 to consolidate the information already collected on British marine ecosystems, particularly the extensive data collected from marine survey projects commissioned by the NCC since 1974, and to complete survey work and the interpretation of the data. Since 1991, the MNCR has been undertaken within the UK's Joint Nature Conservation Committee. The area included in the MNCR is the coastline of England, Scotland and Wales (excluding the Isle of Man and the Channel Isles) extending from the lower limit of terrestrial flowering plants out to the limit of British territorial seas, and into estuaries and other saline habitats to the limits of saltwater influence. The MNCR concentrates on the benthos, and is based on descriptions of habitats and the recorded abundance of conspicuous species.

Maritime
Situated, living or found close to, and having a special affinity with, the sea.

Mean Low Water Springs (MLWS)
The average of the heights of two successive low waters during those periods of 24 hours when the range of the tide is greatest (from Ministry of Defence 1980).

Mud
Fine particles of silt and/or clay, <0.0625 mm diameter (from Hiscock 1990, after Wentworth 1922). Sediment consisting of inorganic and/or organic debris with particles in this category.

Natura 2000 site(s)
The European Community-wide network of protected sites established under the Birds Directive and the Habitats Directive.

Natural Areas
A concept, introduced by English Nature, for defining areas based on their landscape features, geology and biota and resulting in the definition of 92 terrestrial and 24 coastal/maritime Natural Areas in England (English Nature 1994). Maritime Natural Areas are based on coastal cell boundaries.

Nautical Mile
A unit of distance used in navigation, equivalent to 1° of latitude. The standard, or international, nautical mile is 1852 metres; the true nautical mile changes with latitude, from 1861.7 metres at the equator to 1842.9 metres at the poles.

North Atlantic Drift
A north easterly continuation of the warm Gulf Stream current into the eastern North Atlantic.

North Sea
As defined for the purposes of the North Sea Conferences it is southwards of 62°N, eastwards of 5°W and northwards of 48° 30'N and includes the Kattegat defined by lines between coastal features (Oslo and Paris Commissions 1994 where it is described as the "Greater North Sea"). For the British coast, these are the seas to the east of Cape Wrath, and of Falmouth. This is the definition used by the JNCC for the *Directory of the North Sea Coastal Margin* (Doody, Johnson & Smith 1993) and elsewhere.

OSPAR
OSPAR (or Oslo and Paris) Commission for the Protection of the Marine Environment of the North East Atlantic. The UK is one of the sixteen contracting parties to the OSPAR convention.

Pebble
Rock particle 16-64 mm in diameter (from Hiscock 1990, after Wentworth 1922).

Pelagic zone
The open sea and ocean, excluding the sea bottom. Pelagic organisms inhabit such open waters.

Phytoplankton
Planktonic plant life: typically comprising suspended or motile microscopic algal cells such as diatoms, dinoflagellates and desmids.

Precautionary principle
A principle underlying the concept of sustainable use of resources, which implies that:
prudent action be taken in the absence of scientific certainty; the balance of the burden of proof should be to show that no irreversible harm will occur rather than to prove that significant damage will occur; environmental well-being will be given legitimate status and best-practice techniques will be developed. (From *WWF Marine Update* No. 14, April 1994.)

SAC (Special Area of Conservation)
A site of [European] Community importance designated by the [EU] Member States through a statutory, administrative and/or contractual act where the necessary conservation measures are applied for the maintenance or restoration, at a favourable conservation status, of the natural habitats and/or the populations of the species for which the site is designated (Commission of the European Communities 1992). This status is achieved by sites adopted by the European Commission.

Sand
Particles defined in three size categories based on Wentworth (1922): very coarse sand and granules (1-4 mm); medium and coarse sand (0.25-1 mm); very fine and fine sand (0.062-0.25 mm) (from Hiscock 1990).

Seagrasses
Higher plants (angiosperms) that are adapted to living submerged in seawater. They are not true grasses, but belong to the order Helobiae, and are related to pondweeds. Two genera are present in British coastal waters: *Zostera* (eelgrass) and *Ruppia*, a brackish-water genus.

SPA (Special Protection Area)
A site of European Community importance designated under the Wild Birds Directive (Commission of the European Communities Council Directive 79/409/EEC of 2 April 1979 on the Conservation of Wild Birds).

Sublittoral
The zone exposed to air only at its upper limit by the lowest spring tides. The sublittoral extends from the upper limit of the large kelps and includes, for practical purposes in nearshore area, all depths below the littoral.

Territorial waters
The seas over which a nation exercises jurisdiction and control, but within which other states have certain rights, notably for innocent passage of vessels. In UK law, the landward limit of UK territorial seas is defined as "the low water line around the coast" (Territorial Waters Order in Council 1964); the seaward limit is 12 nautical miles offshore from the landward limit.

Wentworth Scale
A scale of sediment particle size categories described by Wentworth (1922), based on a doubling above or halving below, a fixed reference diameter of 1 mm, and with descriptive class terms ranging from boulder (> 256 mm) to clay and colloid (<0.004 mm). This scale is used as the basis of the MNCR and most other sediment classifications. The Wentworth Scale is transformed to the phi (Φ) scale for statistical analysis of sediments.

Zooplankton
The animal constituent of plankton consisting mainly of small crustacea and fish larvae.

Abbreviations and acronyms

ACOPS	Advisory Committee on Protection of the Sea
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BMAPA	British Marine Aggregate Producers Association
BOD	Biological Oxygen Demand
c	(as prefix, eg cSAC) candidate
CCW	Countryside Council for Wales
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CFP	Common Fisheries Policy
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CROW	Countryside Rights of Way Act 2001
cSAC	Candidate Special Area of Conservation
Defra	Department of Environment, Food and Rural Affairs
DoE	Department of the Environment (now subsumed by Defra)
DTI	Department of Trade and Industry
EEC	European Economic Community (later the European Community, now the European Union)
EEZ	Exclusive Economic Zone
EQS	Environmental quality standards
EU	European Union
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine environmental Protection (until about 1991, the Joint Group of Experts on the Scientific Aspects of Marine Pollution) (an advisory body to the Heads of eight organisations of the United Nations System).
GIS	Geographic Information System(s)
ICES	International Council for the Exploration of the Sea
IUCN	International Union for the Conservation of Nature and Natural Resources (now IUCN – The Conservation Union)
JNCC	Joint Nature Conservation Committee
MAFF	Ministry of Agriculture, Food and Fisheries (now subsumed by Defra)
MAGP	Multi-annual Guidance Programme

MARPOL	International Convention for the Prevention of Pollution of the Sea from Ships
MCS	Marine Conservation Society
MEHRA	Marine Environmental High Risk Area
MS	Minimum Size
MLW	Mean Low Water
MNA	Marine Natural Area
MNCR	Marine Nature Conservation Review
MSC	Marine Stewardship Council
mSPA	Marine Special Protection Area
m/g	Milligrams per litre
m/s	Metres per second
n/l	Nanograms per litre
µg/l	Micrograms per litre
NMMP	National Marine Monitoring Programme
NVZ	Nitrate Vulnerable Zone
OSPAR	Oslo and Paris Convention (short title for the 1992 International Convention for the Protection of the Marine Environment of the North-East Atlantic).
PAHs	Poly-cyclic Aromatic Hydrocarbons
PCBs	Poly-chlorinated biphenyls
Ro-Ro	Roll on - Roll off ferry
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SFC	Sea Fisheries Committee
SMRU	Sea Mammal Research Unit
SNH	Scottish Natural Heritage
SPA	Special Protection Area
STW	Sewage treatment Works
TAC	Total Allowable Catch
TBT	Tri-butyl tin
UWWTD	Urban Waste Water Treatment Directive
W& C Act	Wildlife and Countryside Act 1981

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Top left: Pair trawling for whiting in the Western Approaches. Phil Lockley
Bottom left: Seawater surface temperature for all Natural Areas in June 1997. © Natural Environment Research Council (NERC) & Plymouth Marine Laboratory (PML) 2004
Main: Wave riding common dolphin. This species is the most frequently sighted cetacean in this Natural Area. Mark Tasker/JNCC

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