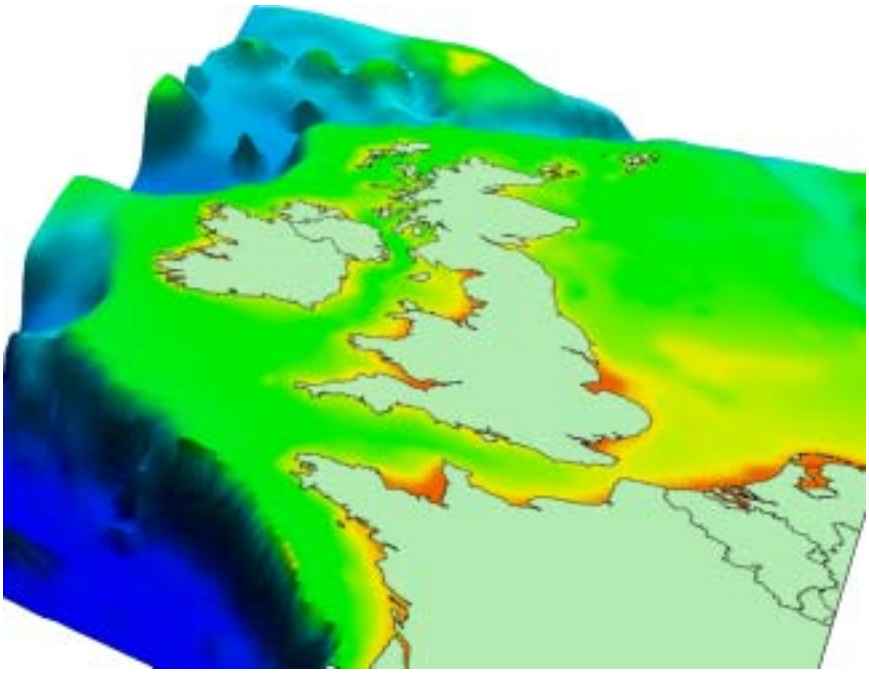
Natura 2000 in UK Offshore Waters: Advice to support the implementation of the EC Habitats and Birds Directives in UK offshore waters

JNCC Report 325

by

Charlotte M Johnston, Caroline G Turnbull & Mark L Tasker



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This report represents the outcome of the research project 'Advice to support the identification of offshore marine Special Areas for Conservation and Special Protection Areas' undertaken by the Joint Nature Conservation Committee for the UK Department for Environment, Food and Rural Affairs (formerly DETR) and the UK Department of Trade and Industry. The report has been prepared by officers of the JNCC in accordance with the requirements of the Agreement and guidance provided by the Steering Group, and with the assistance of the Technical Operational Group, but has not been formally considered or endorsed by the Joint Committee.

Preface

This report is the conclusion of nearly two years of assessment necessary to inform the selection of Natura 2000 sites in UK sovereign waters beyond territorial seas. The work has been undertaken as part of UK action to implement both the Wild Birds Directive (79/409/EC) and the Habitats Directive (92/43/EC).

The two Directives are already applied on land and to the limit of territorial waters. The UK Government has committed itself to implementing both Directives beyond territorial waters where it exercises sovereign rights. To achieve this the following steps are expected:

a. UK legislation introduced to extend the implementation of the Habitats and Birds Directives to UK offshore waters (in progress, due late 2002).

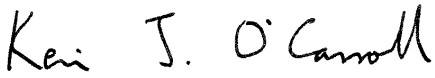
b. The Joint Nature Conservation Committee (JNCC) will advise the UK Government of proposed list(s) of possible Natura 2000 sites.

c. Department for Environment, Food and Rural Affairs (DEFRA) will consult on proposed sites.

d. DEFRA will submit proposed Special Areas of Conservation and Special Protection Areas to the EC.

The work undertaken to prepare this report was commissioned in June 2000 jointly by, the then, Department of the Environment, Transport and the Regions (now DEFRA) and the Department of Trade and Industry to inform the first two steps identified above. The timescale for completion of step b) and steps c) and d) above will depend on progress following issue of this report.

The report and the conclusions that it contains are the first step in the process of site identification and further work will be required within the UK and with other Member States to enable the identification of Natura 2000 sites across European Union waters. This report is being made widely available to stimulate this process and to assist those with an interest in participating in an open and transparent site selection process. It is anticipated that its conclusions will be discussed in the European area at a seminar to be held in June 2002.



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This document is available as a .pdf file on JNCC's website for download if required.

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List of Abbreviations

AFEN	Atlantic Frontier Environmental Network
BGS	British Geological Survey
BTO	British Trust for Ornithology
BIOMOR	Benthic Biodiversity in the Southern Irish Sea Project (bioleg - biology and môr - sea)
CCW	Countryside Council for Wales
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CPUE	Catch per unit effort
cSAC	candidate Special Area of Conservation (i.e. submitted to European Commission)
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department for the Environment, Transport and the Regions (dissolved 7.6.01 and succeeded by DEFRA and DTLR).
DOE(NI)	Department of the Environment (Northern Ireland)
DTI	Department of Trade and Industry
DTLR	Department of Transport, Local government and the Regions
EC	European Commission
EN	English Nature
ESAS	European Seabirds at Sea
ENAW	Eastern North Atlantic Water
EUNIS	European Nature Information System
GIS	Geographical Information System
IBA	Important Bird Area
ISSIA	Irish Sea Seabed Image Archive
JNCC	Joint Nature Conservation Committee
LOIS	Land-Ocean Interaction Study
MCC	Marine Classification Criterion (Skov *et al.* 1995)
MNCR	Marine Nature Conservation Review
MOD	Ministry of Defence
NAW	National Assembly for Wales
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SE	Scottish Executive
SEA2	Strategic Environmental Assessment 2 (2001)

SMRU	Sea Mammal Research Unit
SNH	Scottish Natural Heritage
SOC	Southampton Oceanography Centre
SPA	Special Protection Area
SWISS	South West Irish Sea Survey
UKCS	United Kingdom Continental Shelf
WASP	Wide Angle Seabed Photography
WeBS	Wetland Bird Survey
WWT	Wildfowl and Wetlands Trust

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Summary

Selection of SACs and SPAs in the UK has so far been confined to terrestrial sites and within UK territorial seas. As a result of a UK court judgement in 1999, the UK Government is taking steps to implement the Habitats Directive in offshore waters and has also agreed to take parallel steps to apply the requirements of the Birds Directive to all relevant marine waters. The UK offshore area in the context of this report refers to the area from the 12 nautical mile territorial seas limit out to the UK Continental Shelf designated areas limits.

This report represents the outcome of work carried out by JNCC, on behalf of UK Government, to provide information necessary to identify those areas in UK offshore waters that may contain species or habitats for which sites are required to be considered as possible SACs or SPAs. This work has not been directed at consideration of inshore marine sites, and it is not intended that it should directly result in any amendments to existing inshore candidate SACs. However, the report presents some information relevant to the selection of inshore SACs and SPAs.

Habitats Directive Annex I habitats in the UK offshore area

Four habitat types listed on Annex I to the Habitats Directive are known to or potentially occur in UK offshore waters:

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

The habitat definitions used for inshore marine SAC selection are applicable, with minor clarification of national interpretation, to habitats found in UK offshore waters. Submarine structures made by leaking gases are not found in UK inshore waters, and further work will be required to determine if some UK examples of 'pockmarks' in offshore waters fit within the definition of this habitat type. The criteria and principles used for inshore and terrestrial SAC selection in the UK have been reviewed in relation to the possible occurrence of Annex I habitats in UK offshore waters and the identification of possible sites. These have been found to be applicable to habitats in UK offshore waters, and will be used during the site selection process.

The location and extent of areas of possible Annex I habitat in offshore waters have been mapped using existing BGS geological seabed map interpretations. Biological and other data available for potential Annex I habitat in UK offshore waters have been collated. Limited biological data are available for a number of areas of potential Annex I habitat. For a number of areas of potential Annex I habitat there are no biological data available.

Shallow sandbanks are found in UK offshore waters off north and north-east Norfolk, in the outer Thames Estuary, off the south-east coast of Kent and off the north-east coast of the Isle of Man. Reef habitat occurs in the English Channel, Celtic Sea, Irish Sea and west and north of Scotland extending far out into the North Atlantic; reef is scarce in the North Sea. In the northern North Sea, 'pockmarks' containing carbonate structures deposited by methane-oxidising bacteria occur, these structures may fit within the definition of the

Annex I habitat of 'submarine structures made by leaking gases'. No sea caves have yet been identified in UK offshore waters. Several areas of potential Annex I sandbank and reef habitat in the UK offshore area extend into the offshore areas of other EU Member States, and inshore into UK territorial waters.

Habitats Directive Annex II species

There are four species listed on Annex II of the Habitats Directive known to occur in UK offshore waters for which selection of SACs will be considered:

- Grey seal (*Halichoerus grypus*)
- Common seal (*Phoca vitulina*)
- Bottlenose dolphin (*Tursiops truncatus*)
- Harbour porpoise (*Phocoena phocoena*)

For the two seal species, coastal SACs have already been proposed in the UK to protect their selected breeding colonies and moulting and haul-out sites, and three SACs have been proposed for bottlenose dolphin within UK territorial waters. The UK currently has no proposed SACs for harbour porpoise.

The criteria and principles used for SAC selection for Annex II species in UK inshore waters are reviewed, and issues which may be encountered during consideration of areas as possible SACs are identified. The above four species are typically wide ranging, thus making it difficult to identify specific areas which may be deemed essential to their life and reproduction, and which may, therefore, be considered for proposal as SACs.

Relevant information on the distribution of Annex II species in UK offshore waters is limited. Further analysis of data, and further survey in some cases, will be required to identify any areas in UK waters away from the coast which may qualify as SACs for these species.

Birds Directive Annex I and migratory species

The consideration of marine SPAs in this report is set within the wider context of the JNCC's current work to identify marine SPAs from the coast to the limit of UK offshore waters. Three types of marine SPAs are being developed in the UK (for both inshore and offshore waters):

- Extensions to SPA breeding colonies;
- inshore areas used by birds in the non-breeding seasons (divers, grebes & seaduck);
- marine feeding areas.

Marine SPAs are being considered for 56 bird species which are either on Annex I of the Birds Directive or are migratory species which regularly occur in UK waters. This report primarily offers recommendations concerned with the identification of SPAs as marine feeding areas.

The Birds Directive does not specify criteria for the selection of SPAs. Guidelines on selection of SPAs previously issued by the JNCC are aimed at the selection of terrestrial and coastal sites. These guidelines will act as a good starting point for development or may need modification to be relevant for selection of SPAs in the marine environment.

Possible methods for selection of Natura 2000 sites for wide ranging mobile marine species

A number of the scientific difficulties encountered when attempting to identify areas suitable for consideration as SACs for wide ranging marine mammals are very similar to those encountered when attempting to identify areas for consideration as SPAs for wide ranging birds in the marine environment. The main difficulty in identifying potentially important areas which may qualify as SACs or SPAs for both groups, is in applying existing site selection criteria in an environment with no or few obvious natural boundaries, and to species which are widely dispersed, highly mobile and may be difficult to observe.

A brief review of three published methods that could be used to identify marine areas for both birds and Annex II species is presented. These involve identification of specific areas by: defining generic radii around existing land-based breeding colonies based on predicted foraging ranges; spatial analysis of data on distribution of the species at sea to identify areas of greater density of records for each species; and identification of particular habitat important to the species (e.g. sand areas used by sandeels, shelf break, ocean fronts).

'Special measures', to manage particular activities for particular species, could be applied either in addition to site identification, or where sites cannot be identified. Examples of special measures already in place are given and their applicability to Annex II species and Annex I and migratory bird species is discussed. Different groups of species will need to be addressed in different ways due to differences in data availability and differences in their distribution and behaviour at sea.

Conclusions

Annex I habitats in UK offshore waters

Before a list of possible offshore SACs can be proposed to the UK Government, decisions on the level of information necessary for an offshore area to be proposed as a SAC need to be made, including whether interpolated geological seabed data will provide sufficient information for SAC proposal. A number of habitat-specific site identification problems also require resolution:

- Distinction between areas of boulders and cobbles (i.e. stony reef) and of other gravel.
- Determination of site boundaries around suitable areas of widely distributed reef (e.g. iceberg ploughmark areas) in the absence of suitable data on their distribution.
- Determination of the location and extent of biogenic reefs.
- Determination of the full extent of shallow sandbanks and their associated sandy habitats (as opposed to the extent of sandy sediments in less than 20 m water depth) in UK offshore waters.
- Decision as to whether some UK examples of 'pockmarks' containing carbonate accretions fit the Annex I habitat definition of 'submarine structures made by leaking gases'.

A number of these decisions would benefit from further consultation with other EU Member States, especially because some areas of potential Annex I sandbank and reef habitat extend across Member State boundaries. Any list of SACs proposed for UK offshore waters needs to complement the existing inshore site series. SAC site selection ought to follow a similar process to that used previously for inshore, coastal and terrestrial sites.

Habitats Directive Annex II species

Data on distribution of seals (particularly common seals *Phoca vitulina*) at sea in UK waters are very sparse. From examination of the limited data currently available, it may be possible to identify preferred feeding areas for seals in UK inshore and offshore waters. If such areas can be identified, it remains to be established whether they would be considered areas 'essential to the life and reproduction' of the species, and consequently whether they should be considered as possible SACs. Where sites cannot be identified, or in addition to site identification, further special measures may be required to ensure the conservation of the species.

A recent map showing distribution of bottlenose dolphin in NW European waters indicates that this species is not widely distributed in UK waters. However, spatial analysis of distribution data for bottlenose dolphin in UK offshore waters may indicate areas of elevated population density in addition to those already identified as SACs in UK inshore waters. If such areas can be identified, they may then be considered against the criteria for SAC selection. Where sites in UK offshore waters cannot be identified, or in addition to site identification, further special measures may be required to ensure the conservation of the species.

UK is currently examining data for all UK waters to try to identify specific areas where harbour porpoise may have:

- Continuous or regular presence;
- elevated population density; or
- areas with good adult to young ratio.

If such specific areas can be identified, and where they are deemed essential to the life and reproduction of the species, they should be considered as SACs. Where sites cannot be identified, or in addition to site identification, further special measures may be required to ensure the conservation of the species.

Birds Directive Annex I and migratory species

The list of Birds Directive Annex I and regularly occurring migratory species which occur in UK marine waters consists of groups of birds with very different dispersion patterns, some of which breed in the UK, and some of which are only found in UK waters at certain times of year. Therefore, in order to identify areas that may qualify as SPAs, the bird species must be sub-divided into groups that follow similar distribution patterns. Work is already in progress to identify seaward extensions to existing breeding colony SPAs for those species that breed at coastal sites in the UK. Progress is also being made on identification of important inshore marine areas in the UK for aggregations of birds in the non-breeding seasons, including for divers, grebes and seaduck.

Consideration of possible methods of identification of the most suitable areas for feeding seabird species in UK waters has been initiated, including a preliminary analysis of data from the European Seabirds at Sea database. The preliminary analysis indicates that the list of Annex I and migratory birds splits logically into four groups, according firstly to the data available for each species, and secondly, to their distribution at sea. The first group consists of those species that are adequately represented in the European Seabirds at Sea database, and for which spatial analyses could be performed to identify areas of high density. The second consists of those species with few records in the database, for which spatial analyses of these data would not be appropriate. These two groups then naturally each split into those species which occur primarily inshore (from the coast to 15 km or approximately 8 nautical miles), and those species which occur primarily offshore (greater than 15 km from the coast).

Further data analysis and consideration is required to determine whether SPAs for feeding areas for these four groups of species can be identified. If this is possible, such areas should be considered against the JNCC SPA selection guidelines. Modification of JNCC SPA selection guidelines or development of marine SPA guidelines will proceed in parallel to the work on identifying areas as possible marine SPAs.

1. Introduction

1.1. Joint Nature Conservation Committee and country conservation agencies

The Joint Nature Conservation Committee (JNCC) is the forum through which the three country nature conservation agencies – the Countryside Council for Wales (CCW), English Nature (EN) and Scottish Natural Heritage (SNH) – deliver their statutory responsibilities for Great Britain as a whole and internationally. These responsibilities, known as the special functions, contribute to sustaining and enriching biological diversity, enhancing geological features and sustaining natural systems.

These special functions are principally:

- To advise ministers on the development of policies for, or affecting, nature conservation in Great Britain and internationally.
- To provide advice and knowledge to anyone on nature conservation issues affecting Great Britain and internationally.
- To establish common standards throughout Great Britain for the monitoring of nature conservation and for research into nature conservation and the analysis of results.
- To commission or support research which the Committee deems relevant to the special functions.

1.2. EC Habitats and Birds Directives

In 1979 the European Community adopted *Council Directive 79/409/EC on the conservation of wild birds* (EEC 1979), known as the Birds Directive. The Birds Directive provides for protection, management and control of naturally occurring wild birds with the European Union through a range of mechanisms. One of the key provisions is the establishment of an internationally co-ordinated network of protected areas. Member States are required to identify and classify in particular the most suitable territories in size and number for rare or vulnerable species listed in Annex I to the Directive (Article 4.1) and for regularly occurring migratory species under Article 4.2. These sites are known as special protection areas, referred to as SPAs in the UK.

In 1992 the Community adopted *Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora* (EEC 1994), known as the Habitats Directive. The Habitats Directive includes a requirement to establish a European network of important high quality conservation sites that will make a significant contribution to conserving the habitat types and species identified in Annexes I and II of the Directive. The listed habitat types and species are those considered to be most in need of conservation at a European level. Each Member State is required to prepare and propose to the EC a national list of sites, which will be evaluated in order to form a European network of Sites of Community Importance (SCIs). These will eventually be designated by Member States as Special Areas for Conservation (SACs). SACs and SPAs will together be known as the Natura 2000 Network.

Obligations of the Birds Directive were initially transposed into UK law by the Wildlife and Countryside Act 1981. The Habitats Directive and certain aspects of the Birds Directive were further transposed into UK law by two Regulations; one for England, Scotland and Wales *The Conservation (Natural Habitats, &c.) Regulations 1994* (HMSO 1994), and another for Northern Ireland *The Conservation (Natural Habitats, &c.) Regulations (Northern Ireland) 1995* (HMSO 1995). These Regulations currently apply only within UK territorial waters, which extend from the baseline out to 12 nautical miles. The baseline consists of the low water mark and various defined lines across bays and inlets and around some of the Scottish Islands.

Selection of SACs for habitats and species in terrestrial and inshore areas of the UK is described in JNCC Report 270 (Brown *et al.* 1997), which is currently being updated (McLeod *et al.* in press). Selection of marine SACs under the Habitats Directive in the UK thus far has, however, been exclusively in inshore waters within UK territorial seas. Advice on the selection of sites within 12 nm of the coast is provided by each of the country conservation agencies CCW, SNH and EN, together with the Environment and Heritage Service for Northern Ireland, for each country in the UK, and is co-ordinated and reported to UK government through the JNCC.

In November 1999 the UK High Court judged that the Habitats Directive applied in UK waters beyond the 12 nautical mile (nm) limit of territorial waters (CO/1336/99). The judgement declared that "the Habitats Directive applies to the UK Continental Shelf and to the superadjacent [sic] waters up to a limit of 200 nautical miles from the baseline from which the territorial sea is measured".

As a result of the UK court judgement in 1999, the UK Government has indicated it would amend the existing Regulations and introduce new Regulations to transpose both the Birds and Habitats Directives into UK law in offshore waters. The UK offshore area is described in Section 1.4. One new set of Regulations *The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (HMSO 2001) applying to UK offshore waters has already been laid before parliament, to apply the site selection provisions of the Directives and to provide coverage beyond oil and gas activities. Further Regulations are in preparation.

In contrast to the position from mean low water mark to 12 nm, control of activities from 12 to 200 nm is not a devolved matter and relates to Great Britain as a whole. Therefore the responsibility for advising UK Government on selection of sites under the Habitats and Birds Directives within this offshore area rests with the JNCC.

1.3. Offshore Natura 2000 project

The UK Government is currently taking steps to implement the Habitats Directive in offshore waters in response to the 1999 High Court judgement and has also agreed to take parallel steps to apply the requirements of the Birds Directive. As part of this implementation the JNCC have been asked by UK government to provide advice necessary to identify areas that may qualify as possible offshore SACs and SPAs – the 'Offshore Natura 2000 Project'. This project is conducted by JNCC under a steering group consisting of representatives from sponsoring government departments (Department for Environment, Food and Rural Affairs (DEFRA) and Department of Trade and Industry (DTI)) other government departments and devolved administrations. To ensure that this work carried out for offshore areas integrates with that already done for inshore waters, representatives of each of the country conservation agencies are also on the Steering

Group, and are closely involved in the technical aspects of the project. The project is broken down into several steps:

1. Identify and agree relevant habitats and species under the Habitats and Birds Directives in the UK offshore area;

2. consider habitat definitions for Annex I habitats found in the UK offshore area;

3. consider site selection criteria for Annex I habitats and Annex II species under the Habitats Directive in relation to selection of sites in the offshore area;

4. consider site selection for Birds Directive Annex I and migratory species in relation to selection of sites in the offshore area[1];

5. collate existing data on relevant habitats and species in the UK offshore area;

6. indicate at a generic level the type of conservation objectives that would apply to any Annex I or II features or relevant bird species.

The JNCC 'Offshore Natura 2000 Project' also involved consultation on the scientific aspects of implementation of the Directives with scientists from other Member States. In September 2001 a document based on Sections1, 2.1, 2.2 and 3.1 of this report was circulated for comment to scientists and scientific policy advisors from all Member States. These sections deal with identification of habitats to be considered for selection of offshore SACs, and selection criteria and principles for these habitats and for Annex II species under the Habitats Directive. Consultation with scientific colleagues on aspects of the report dealing with options for methods of site selection for wide ranging mobile species (Annex II species under the Habitats Directive and birds under the Birds Directive) will proceed via a European Seminar to be organised by DEFRA during 2002.

1.4. UK offshore area

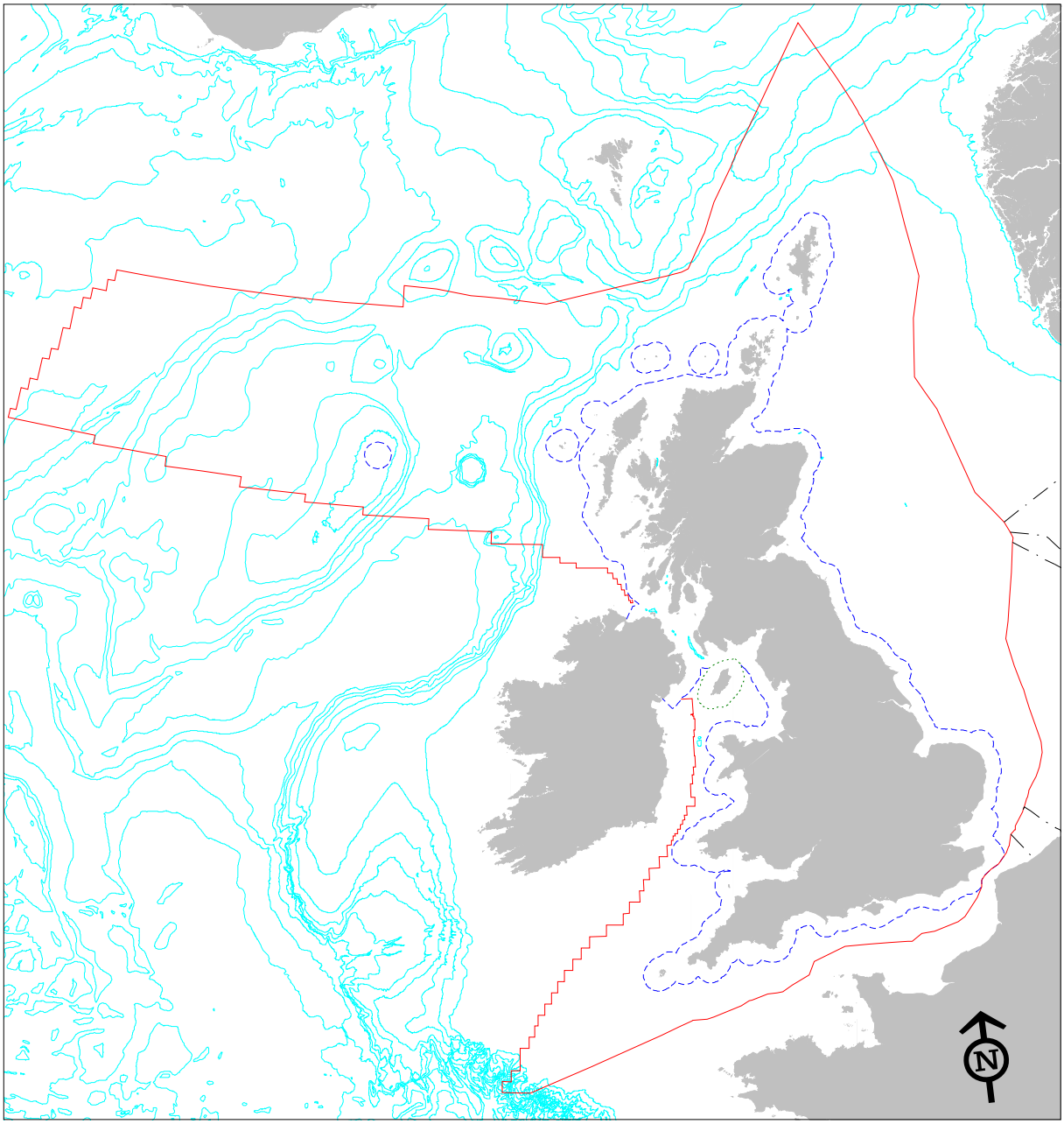
Figure 1.1 shows the maximum extent of the UK offshore area, based on the currently agreed UK Continental Shelf designations. The UK Continental Shelf (UKCS) comprises those areas of the seabed and subsoil beyond the territorial sea over which the UK exercises sovereign rights of exploration and exploitation of natural resources. The exact limits of the UKCS are set out in orders made under section 1(7) of the Continental Shelf Act 1964 (DTI 2000). Some of the boundaries between Iceland, Ireland, France and the UK are yet to be agreed. It is this area within which data have been collated with a view to identifying possible SACs and SPAs under JNCC's Offshore Natura 2000 Project, as the 1999 UK High Court judgement was brought in reference to oil and gas developments on the seabed. There are also British Fishery limits (not shown on Figure 1.1) established under the Fishery Limits Act 1976 (as amended by the Fishery Limits Orders 1997 and 1999) which include the seas around Rockall, but extend only approximately 37 miles west of Rockall (calculated as 200 nm from St Kilda). This area is sometimes referred to as the UK offshore area, but is not used as such within this report as it relates to fisheries activities above the sea bed. The UK territorial sea (12 nm) is measured from the baseline

[1] Where appropriate (for birds and Annex II species) the contract has considered all UK marine waters, not only within the UK offshore area.

and is shown on Figure 1.1. The area from 12 nm out to the Continental Shelf limit is referred to in this document as the UK offshore area, or UK offshore waters.

Figure 1.1 The UK offshore area

Scale 1:11000000



Land
UK Continental Shelf Designated Areas
UK 12 nm Territorial Seas
Isle of Man 12 nm Territorial Sea
Median line
Bathymetric contour >200m

2. Habitats directive Annex I habitats in the UK offshore area

Annex I of the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (as amended by Directive 97/62/EC) lists those habitats of Community Interest whose conservation requires the designation of SACs. The Annex is split into groups and sub-groups of habitats. The only sub-groups to occur in the marine environment (below low water) are Coastal and Halophytic Habitats: open sea and tidal areas; and Rocky Habitats and Caves: other rocky habitats. The Interpretation Manual of European Habitats (HAB 96/2 Final – EN version 15/2 October 1999), aids the interpretation of the habitat types listed in Annex I. The habitats in the open sea and tidal areas sub-group are listed in Table 2.1.

Table 2.1 Marine habitats listed in Annex I of Council Directive 92/43/EEC as amended by Directive 97/62/EC.

EU code	*Habitat name*
Open sea and tidal areas	
1110	Sandbanks which are slightly covered by sea water all the time
1120	*Posidonia* beds
1130	Estuaries
1140	Mudflats and sandflats not covered by seawater at low tide
1150	Coastal lagoons
1160	Large shallow inlets and bays
1170	Reefs
1180	Submarine structures made by leaking gases
Other rocky habitats	
8330	Submerged or partially submerged sea caves

Estuaries, mudflats and sandflats not covered by seawater at low tide, large shallow inlets and bays and coastal lagoons are all coastal and do not occur outside territorial waters. *Posidonia* beds are a Mediterranean habitat and not present in UK waters. The remaining four habitats (reefs, sandbanks, structures made by leaking gases and submerged caves) are either known to occur in UK offshore waters or may occur. These habitats are considered further below.

2.1. Habitat definitions and interpretations

In order to assess offshore areas to identify habitats that might be suitable for selection as SACs, and in order to determine the extent of these habitats in UK waters, working interpretations of these habitats need to be refined. There are three layers of definition/interpretation:

a) EC Habitats Directive (EEC 1992) (as amended by Directive 97/62/EC (EC 1997)).

b) EC Interpretation Manual v. Eur 15/2 (EC 1999) (official EC guidance on the definition of the habitats).

c) National/local interpretation (in the UK, partially covered by Brown *et al.* 1997[1] and subsequently throughout the text).

[1] Brown *et al.* 1997 describes implementation of the Habitats Directive in the UK.

Level c) is likely to vary slightly between Member States, reflecting national and local differences in the character of each habitat.

In the UK, a national interpretation for three of the habitats which may occur in offshore waters was developed with regard to inshore waters at the time of SAC site selection within territorial waters (the fourth, submarine structures made by leaking gases, does not occur in UK inshore waters). The correspondence between these Annex I habitats and the marine biotopes described in the MNCR BioMar classification was established (JNCC 1999a). The national definitions were re-examined and clarified for application in the UK offshore environment, whilst ensuring that existing inshore sites fit within the 'envelope' of definition developed for use by the offshore project.

2.1.1. Sandbanks which are slightly covered by sea water all the time

The Interpretation Manual of European Habitats (EC 1999) defines sandbanks as:

> "Sublittoral sandbanks, permanently submerged. Water depth is seldom more than 20 m below Chart Datum. Non-vegetated sandbanks or sandbanks with vegetation belonging to the *Zosteretum marinae* and *Cymodoceion nodosae*.
>
> Plants: *Zostera marina*, free living species of the *Corallinaceae* family. In the Baltic Sea also *Potamogeton pectinatus*, *Ruppia cirrhosa* and *Tolypella nidifica*. Around Tenerife, *Halophila decipiens* communities.
>
> Animals: Important wintering habitat for many bird species, in particular *Melanitta nigra* but also *Gavia stellata* and *Gavia arctica*. Resting places for seals. Invertebrate communities of sandy sublittoral (e.g. polychaetes)."

At a national level, for the purpose of SAC selection for both inshore and offshore sites, the definition of *sandbanks which are slightly covered by sea water all the time* has been further interpreted and clarified:

Substratum: This habitat comprises a range of sandy sediments. In terms of Wentworth's classification it includes all types of sand (particle size range 0.0625-2 mm). In terms of Folk's classification used for BGS geological maps, this habitat may include all sands, muddy sands and gravelly sands, and some forms of sandy gravels (i.e. all sandy sediments in lower right quartile of modified Folk triangle used by BGS, see Figure 2.1). Free-living *Corallinaceae* (i.e. maerl) are explicitly included in the EC definition. Eelgrass *Zostera marina* beds are also referable to this habitat type.

Height boundary: Chart Datum (Lowest Astronomical Tide may technically be more correct, but is in practice less easy to define on a map or chart).

Depth: Predominantly <20 m in depth (but may include channels or other areas >20 m).

Topography: Topography is variable but includes distinct banks (i.e. elongated, rounded or irregular 'mound' shapes) which may arise from horizontal or sloping plains of sandy sediment. Where the areas of horizontal or sloping sandy habitat are associated with the banks, they are included within the Annex I type.

Size: No lower limit, subject to the sandbank being large enough to maintain its structure and functions.

2.1.2. Reefs

The Interpretation Manual of European Habitats (EC 1999) defines reefs as:

> "Submarine, or exposed at low tide, rocky substrates and biogenic concretions, which arise from the sea floor in the sublittoral zone but may extend into the littoral zone where there is an uninterrupted zonation of plant and animal communities. These reefs generally support a zonation of benthic communities of algae and animal species including concretions, encrustations and corallogenic concretions.
>
> Plants: brown algae (species of the *Fucus*, *Laminaria* and *Cystoseira* genus, *Pilayella littoralis*), red algae (e.g. species of the *Corallinaceae*, *Ceramiceae* and *Rhodomelaceae* families), green algae. Other plant species: *Dictyota dichotoma*, *Padina pavonica*, *Halopteris scoparia*, *Laurencia obtusa*, *Hypnea musciformis*, *Dasycladus claveformis*, *Acetabularia mediterranea*.
>
> Animals: mussel beds (on rocky substrates), invertebrate specialists of hard marine substrates (sponges, *Bryozoa* and cirripedian *Crustacea* for example)."

At a national level, for the purpose of SAC selection for both inshore and offshore sites, the definition of *reefs* has been further interpreted and clarified:

Substratum: Bedrock, boulders and cobbles (cobbles generally >64 mm in diameter), including those composed of soft rock, such as chalk. Biogenic concretions, i.e. aggregations of a species to form a hard substratum, thus enabling an epibiota community to develop. Biogenic reef-forming species include *Serpula vermicularis*, *Sabellaria* spp., *Lophelia pertusa*[2], *Mytilus edulis* and *Modiolus modiolus*.

Height boundary: Highest Astronomical Tide (or in practice Ordnance Survey High water) where the intertidal zone is included in the site. (Note that intertidal areas are only included where they are connected to subtidal reefs).

Depth: No depth limit.

Topography: A variety of topographic features in the subtidal zone, including vertical rock walls, horizontal ledges, overhangs, pinnacles, gullies, ridges, sloping or flat bed rock, broken rock, and boulder and cobble fields. Caves and cave-like features are excluded (these are referable to the Annex I category 'Submerged or partially submerged sea caves). 'Arising from the sea floor' is taken in the sense that the reef is topographically distinct. Rocky structures that are covered by a thin and mobile veneer of sediment are classed as reefs if the associated biota are dependent on the rock rather than the overlying sediment.

Size: No lower limit, subject to the reef being large enough to maintain its structure and functions. Note that some biogenic reefs are inherently patchy and may contain relatively small individual colonies of, for example, *Serpula*.

2.1.3. Submarine structures made by leaking gases

The Interpretation Manual of European Habitats (EC 1999) defines this habitat as:

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[2] At the meeting of the EC Habitats Scientific Working Group on 9 September 1999 there was a discussion as to whether *Lophelia* structures should be treated as reefs in the context of Annex I of the Habitats Directive. The discussions were inconclusive, but the UK view remains clear – *Lophelia* does form reefs which are referable to this Annex I type.

"Spectacular submarine complex structures, consisting of rocks, pavements and pillars up to 4m high. These formations are due to the aggregation of sandstone by a carbonate cement resulting from microbial oxidation of gas emissions, mainly methane. The methane most likely originated from the microbial decomposition of fossil plant materials. The formations are interspersed with gas vents that intermittently release gas. These formations shelter a highly diversified ecosystem with brightly coloured species.

Animals: Porifera – *Clione celata*; Anthozoa – *Metridium senile, Tealia felina, Alcyonium digitatum*; Polychaeta – *Pomatoceros triqueter, Dodocaceria concharum*; Gastropoda – *Cingula striata, Alvania punctura, Rissoa albella, R. parva*; Decapoda – *Porcellana longicornis, Cancer pagurus*; Echinodermata – *Ophiothrix fragilis*."

Implementation of the Habitats Directive in UK inshore waters did not identify any examples of this habitat, so no national level interpretation or clarification was developed. Further work is required to investigate the possible occurrence of *submarine structures made by leaking gases* in UK offshore waters. Initial investigations suggest that a variation of this habitat type may exist in UK offshore waters:

Substratum: Must consist of a carbonate cement structure resulting from microbial oxidation of gas emissions.

Height boundary: No further national interpretation.

Depth: No depth limit.

Topography: No further national interpretation

Size: No lower limit, subject to the submarine structure being large enough to maintain its structure and functions.

2.1.4. Submerged or partially submerged sea caves

The Interpretation Manual of European Habitats (EC 1999) defines this habitat as:

"Caves situated under the sea or opened to it, at least at high tide, including partially submerged sea caves. Their bottom and sides harbour communities of marine invertebrates and algae."

At a national level, for the purpose of SAC selection for both inshore and offshore sites, the definition of *submerged or partially submerged sea caves* has been further interpreted and clarified:

Substratum: No further interpretation.

Height boundary: No further interpretation.

Depth: No depth limit.

Topography: Needs at least to have some overhanging feature.

Size: No lower limit, subject to the cave being large enough to maintain its structure and functions.

2.2. Site assessment criteria and additional principles used for site selection for Annex I habitats in the UK

The Habitats Directive (92/43/EC) includes, in Annex III, criteria for selecting sites eligible for identification as Sites of Community Importance and designation as Special Areas for Conservation (SACs). It also includes in the text of the Directive, reference to selection of sites using the selection criteria and relevant scientific information. In preparing the UK national list of candidate SACs (for terrestrial and inshore habitats), as well as the Annex III selection criteria, additional principles for site selection have been developed, which interpret and supplement the Annex III selection criteria. These additional principles have been developed in the light of discussions between Member States and the European Commission at the Atlantic Biogeographical meeting in Edinburgh (UK) in 1994 (Hopkins & Buck 1995). The selection criteria and additional principles are listed in Table 2.2 below. The process of applying the selection criteria and additional principles to terrestrial and inshore sites in the UK is described in JNCC Report 270 (Brown *et al.* 1997). Brown *et al.* (1997) is currently being updated to take account of work carried out in the UK in the light of conclusions from the Kilkee and Paris Atlantic Biogeographical Region meetings in 1999 (McLeod *et al.* in press).

Table 2.2 Summary of site assessment criteria and additional principles used for site selection in the UK (from McLeod *et al*. (in press)

Site assessment criteria (Annex I habitats)	***Reference***
Representativity	Annex III Stage 1A(a); Article 1e; Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 4).
Area of habitat (Relative surface)	Annex III Stage 1A(b); Article 1e; Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 4).
Conservation of structure and functions	Annex III Stage 1A(c); Article 1e.
Global assessment	Annex III Stage 1A(d).
Additional principles	
Priority/non-priority status	Article 1d; Annex III Stage 1D; Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 3).
Geographical range	Articles 1e and 3.1.
Special UK responsibilities	Article 3.2; Conclusions of 1994 Atlantic Biogeographical Region (para. 6).
Multiple interest	Annex III Stage 2.2(d); Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 2).
Rarity	Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 5).

This section outlines how these site assessment criteria and additional principles (which were used to guide site selection for inshore and terrestrial habitats) should be applied to habitats in the UK offshore area. Relevant extracts of text from the Directive and Annexes, from the Atlantic Biogeographical Meeting in Edinburgh in 1994 (Hopkins & Buck 1995) are referred to in the following sections. The selection criteria and additional principles outlined above are unlikely to change, and there are currently no indications of imminent changes to the list of relevant habitats in Annex I to the Directive or to their definitions in the Interpretation Manual (EC 1999). The more detailed scientific information on habitats included in the following sections of this report, however, is based on currently available knowledge, which for the offshore environment is continually developing. It is provided here only as an *indication* of the aspects of the relevant habitats that are likely to be used to assist in site selection.

Four Annex I habitats are currently being considered for selection of SACs in the UK offshore area and are shown in Table 2.3.

Table 2.1 Habitats considered for SAC selection in UK offshore waters (from Directive 97/62/EC amending Annexes I and II to Directive 92/43/EEC).

EU code	*Habitat name*
1110	Sandbanks which are slightly covered by seawater all the time
1170	Reefs
1180	Submarine structures made by leaking gases
8330	Submerged or partially submerged sea caves

The following Sections (2.2.1. and 2.2.2.) of this report describe application of the criteria and principles set out in Table 2.1, to these four habitat types.

2.2.1. Application of Habitats Directive Annex III Stage 1A criteria

2.2.1.1. Representativity

Habitats Directive Annex III Stage 1A (a): "Degree of representativity of the natural habitat type on the site."

Atlantic Biogeographical Region Meeting Conclusions, paragraph 4: "In considering the degree of representativity of Annex I habitat types on individual sites, Member States will take account of the best examples in extent and quality of the main type, (which is most characteristic of the Member State) and its main variants, having regard to geographical range." (Hopkins & Buck 1995).

The Explanatory Notes to the Natura 2000 Standard Data Form (EC 1995) specifically state that this criterion should be linked to the Interpretation Manual of Annex I habitats (EC 1999) as it provides a definition, a list of characteristic species and other relevant elements for each habitat. This criterion is a measure of how typical a site is for a particular habitat.

Sandbanks which are slightly covered by seawater all the time

Section 2.1.1 gives the full EC habitat definition. Inshore sites were selected to cover the geographical and ecological range of variation of the following categories (Brown *et al.* 1997):

- Gravelly and clean sands;
- muddy sands;
- eelgrass *Zostera marina* beds; and
- maerl (*Corallinaceae*) beds.

Vegetated sandbanks and maerl are not known to occur in the UK offshore area and the three bird species mentioned in the Interpretation Manual (EC 1999) occur primarily within territorial waters.

Offshore sites should be selected to represent the main variants of the habitat occurring offshore, in water depths of less than 20 m, having regard to geographical range (Hopkins & Buck 1995). They should complement the sandbank habitats already represented within the SAC series inshore. On current information, sites selected should include:

- Sandy mounds; and
- the following tidal current sandbank types (from Dyer & Huntley 1999):

Type 1 open shelf ridge sandbanks;

Type 2 estuary mouth sandbanks;

Type 3 headland associated banks.

Sites are also likely to be selected to represent both 'active' and 'relict' banks (indicated by sandwave presence and shape), as their flora and fauna are likely to differ. Within the above categories, sites may also be selected to represent the biological communities of the range of relevant sediment types (see Section 2.1.1).

Reefs

Section 2.1.2 gives the full EC habitat definition. A number of different types of reef with a range of biological communities occur in UK offshore waters. Offshore sites should be selected to represent the main variants of the habitat occurring offshore, having regard to geographical range (Hopkins & Buck 1995). They should complement the reef habitats already represented within the cSAC series inshore. On current information, sites selected are likely to include the following reef types:

1. Different main bedrock types and topographical forms e.g. pinnacles, offshore banks.
2. Stony reefs - cobble and boulder reefs, iceberg ploughmarks (see Section 2.3.3.5 for description).
3. Biogenic reefs - made by cold water corals (e.g. *Lophelia pertusa*) and *Sabellaria spinulosa* (*Modiolus modiolus* reef occurs primarily within 12 nm of the coast).

Within the above categories different biological communities are likely to be represented, e.g. those resulting from differences in water masses, water depths and water currents (cold water reef communities influenced by arctic waters, warmer water reefs influenced by Atlantic waters, transitional areas of reef etc.).

Submarine structures made by leaking gases

Section 2.1.3 gives the full EC habitat definition. Marine columns (the name of this habitat in the original Habitats Directive Annex I), such as those found in Danish waters, are not known to occur in UK waters. However, gas seep depressions (commonly referred to as 'pockmarks'), some of which have carbonate structures within them, do occur in UK waters. It is arguable whether 'pockmarks' with carbonate structures fit within the habitat definition for submarine structures made by leaking gases. If, on further investigation, it is decided that these structures do fit the description, sites should be selected to represent this variant of submarine structures made by leaking gases. If on further investigation the 'pockmarks' with carbonate structures are not deemed to be 'spectacular submarine complex structures', then this habitat will not be represented in UK offshore waters.

Submerged or partially submerged sea caves

Section 2.1.4 gives the full EC habitat definition. Inshore cave sites were selected to encompass the range of structural and ecological variation of sea caves. Selection was confined to well-developed cave systems, with extensive areas of vertical and overhanging rock and those that extend deeply into the rock. Regard was given to rock type and emphasis was given to the selection of habitat in coastal chalk (Brown *et al.* 1997). Offshore cave sites (if found) should have regard to the inshore series and be selected to include a range of rock types, depths and hydrodynamic conditions.

2.2.1.2. Area of habitat (or Relative Surface, EC 1995)

Habitats Directive Annex III Stage 1A (b): "Area of the site covered by the natural habitat type in relation to the total area covered by that natural habitat type within national territory".

Atlantic Biogeographical Region Meeting Conclusions, paragraph 4: "In considering the degree of representativity of Annex I habitat types on individual sites, Member States will take account of the best examples in extent and quality of the main type, (which is most characteristic of the Member State) and its main variants, having regard to geographical range." (Hopkins & Buck 1995).

The Explanatory Notes to the Natura 2000 Standard Data Form (EC 1995) explain that, in theory, one needs to measure the surface covered by the habitat type on the site, and the total surface of the national territory that is covered by the same habitat type, to be able to select a suitable proportion of the habitat type as cSAC. Although this is evident, it can be extremely difficult to make these measurements, especially those concerning the reference national surface. An estimate of the total surface of the relevant habitats in UK offshore waters is being obtained using existing geological map interpretations, supplemented by other data sources.

Consideration of area of habitat for site selection is related to other principles used for site selection, for example, structure and functions (see below) are most often best conserved in sites that are extensive (Brown *et al.* 1997).

2.2.1.3. Conservation of structure and functions

Habitats Directive Annex III Stage 1A (c): "Degree of conservation of the structure and functions of the natural habitat type concerned and restoration possibilities."

Habitats Directive Article 1 (e) "*conservation status of a natural habitat* means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2.

The conservation status of a natural habitat will be taken as 'favourable' when:

- its natural range and areas it covers within that range are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable as defined in (i)."

The Explanatory Notes to the Natura 2000 Standard Data Form (EC 1995) explain that this criterion comprises three sub-criteria:

1. Degree of conservation of structure
2. Degree of conservation of functions
3. Restoration possibilities

Although these sub-criteria could be evaluated separately, they should nonetheless be combined for the requirements of selection of sites as they have a complex and interdependent influence on the evaluation process (EC 1995). Sites selected (and their boundaries) should reflect the structure and function requirements of the particular habitat.

With regard to the third sub-criterion the position has been taken by the UK that, "where a sufficient number of examples of habitat types in good condition can be identified, it is considered unnecessary to select sites that are damaged or in relatively poor condition" (Brown *et al.* 1997). In the case of damaged habitat offshore, consideration should be given as to whether activities have profoundly and irreversibly affected the structure and functions of the habitat (as may be the case, for example, for bottom trawl damage to cold water coral biogenic reef) and, therefore, whether restoration would be possible.

2.2.1.4. Global assessment

Habitats Directive Annex III Stage 1A (d): "Global assessment of the value of the site for conservation of the natural habitat type concerned".

The Explanatory Notes to the Natura 2000 Standard Data Form (EC 1995) state that this should be used to assess the previous three criteria in an integrated way and to take into account the different weights they may have for the habitat under consideration.

2.2.2. Additional principles which should be taken into account in site selection for Annex I habitats

2.2.2.1. Priority/Non-priority habitats

Habitats Directive Article 1 (d) "*Priority natural habitat types* means natural habitat types in danger of disappearance, which are present on the territory referred to in Article 2 and for the conservation of which the Community has particular responsibility in view of the proportion of their natural range which falls within the territory referred to in Article 2".

Atlantic Biogeographical Region Meeting Conclusions, paragraph 3: "Member States will give significant additional emphasis in number and area to sites containing priority habitat types and species." (Hopkins & Buck 1995).

None of the habitats that are being considered in the UK offshore area have priority status.

2.2.2.2. Geographical range

Habitats Directive Article 3 (1): "A coherent European ecological network of special areas of conservation shall be set up under the title Natura 2000. This network, composed of sites hosting the natural habitat types listed in Annex I …, shall enable the natural habitat types … concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range".

Favourable conservation status is dependent upon the maintenance of the geographical range of the habitat type or species, amongst other things. The terrestrial and inshore site series for each habitat type has been chosen to reflect its distribution in the UK (Brown *et al.* 1997). This will also apply in the selection of sites to represent habitats in the UK offshore area. However, habitat types vary considerably in their patterns of distribution. In the offshore area of the UK, due to the physical regime, sandbanks are clustered in the south and east of the UK, submarine structures made by leaking gases ('pockmarks') in the North Sea, and reefs in the west (both north and south). No sea cave habitat is currently known in offshore waters.

2.2.2.3. Special UK responsibility/proportion of European habitat

Habitats Directive Article 3 (2): Selection of sites for relevant habitats within a Member State should be made in proportion to the representation of that habitat within the territory of the Member State.

Atlantic Biogeographical Region Meeting Conclusions, paragraph 6: "It is acknowledged that certain habitat types and species listed in Annexes I and II are relatively common and extensive in certain Member States. These Member States will have particular responsibility for proposing a proportion of the resource which is sufficient to contribute significantly to the maintenance of the habitat types and species at a favourable conservation status." (Hopkins & Buck 1995).

Certain habitat types are relatively common and extensive in certain Member States. These Member States will have "particular responsibility for proposing a proportion of the resource that is sufficient to contribute significantly to the maintenance of the habitat types … at a favourable conservation status" (Hopkins & Buck 1995). However, proposed sites will still be subject to the other selection criteria and additional principles so that selection is consistent and the sites of high quality (Brown *et al.* 1997).

The UK does not have special responsibility within the EU for reef, sandbank and sea cave habitats, as, although large areas of these habitats are represented in the UK, they also occur over large areas of the territories of other Member States. The proportion of these three habitats in the UK is unlikely to change significantly by the inclusion of the UK offshore area in the UK territory. If it is determined that some UK examples of 'pockmarks' fit within the definition of 'submarine structures made by leaking gases', then it is possible that the UK may have special responsibility for this habitat, as it is otherwise known in the EU only from Denmark and Italy.

2.2.2.4. Multiple interest

Atlantic Biogeographical Region Meeting Conclusions, paragraph 2: "Acknowledging that outstanding single interest sites in terms of quality, extent or range make an important contribution to the Natura 2000 network, special emphasis will be given to identifying and delimiting sites containing complexes of interests on Annexes I and II as valuable ecological functional units." (Hopkins & Buck 1995).

It is considered unlikely that any of the sites proposed for selection will have multiple habitat interest features due to the nature and scale of the habitats being considered for the offshore area. However, sites proposed for offshore habitats may also contain Annex II species or SPA interest features.

2.2.2.5. Rarity

Directive text: None

Atlantic Biogeographical Region Meeting Conclusions, paragraph 5: "Acknowledging that sites containing Annex I habitat types and Annex II species at the centre of their range will make an important contribution to Natura 2000, Member States will take responsibility for proposing sites containing habitats and species that are particularly rare in that Member State, with a view to preserving the range." (Hopkins & Buck 1995).

Brown *et al.* (1997) lists specific habitats considered to be rare, "because they cover less than 1,000 ha or because there is a significant representation of the habitat type at three or fewer sites". None of the Annex I habitats that are being considered in the offshore area

occur on the list given in Brown *et al.* (1997). Thought will need to be given to adding 'submarine structures made by leaking gases' if it is determined that the habitat exists in the UK, and its extent is calculated as below this threshold.

2.3. Information on Annex I habitats in the UK offshore area

2.3.1. Habitat identification

Identification of the distribution and extent of Annex I habitats in offshore waters was undertaken through a contract with the British Geological Survey (BGS), Edinburgh. The location and extent of reefs (excluding biogenic reefs), sandbanks and submarine structures made by leaking gases were extracted from existing BGS map interpretations of sample and geophysical data (1:250,000 scale seabed sediment map series). These locations were mapped within a Geographical Information System (GIS) and a database was created in MS Access 97 for accompanying data. Each BGS 1:250,000 map covers one degree of latitude and two degrees of longitude, and is based largely on BGS survey data (sampling and seismic, refer to Figure 2.2 for survey coverage). These maps have an average data density of 5-10 km, and therefore depict regional geology, which can in places be very generalised. The published maps cover the entire UK offshore area east of about 10° west. The survey work, interpretation, compilation and publishing of these maps was done mainly from the late 1970's until about 1990 (Graham *et al.* 2001a). Where possible, refinement of the existing map interpretations followed in subsequent phases, using additional information where available, in order to further distinguish between habitat and sub-habitat types.

The habitat maps presented (Figure 2.3 to Figure 2.20) show bathymetric contours for depths greater than 200 m from the GEBCO '97 Digital Atlas (IOC, IHO and BODC 1997). Unfortunately bathymetric contours at less than 200 m depth (mostly relevant to the English Channel and North Sea) are not yet available in a suitable form for the whole of UK offshore waters and are not included on these maps.

Limitations on using existing geological map interpretations to map the location and extent of Habitats Directive Annex I habitats in UK offshore waters were encountered in terms of the depth of sandy sediments to include, and in terms of the Habitats Directive definition of 'reef'.

Sandbanks in terms of the Habitats Directive are in water depth "seldom more than 20 m below Chart Datum", and in terms of UK interpretation of the types of sediments represented, may include any sandy sediments. Existing BGS geological maps use a modified form of the Folk classification (see Figure 2.1), therefore any sandy sediments (those forming the lower right quartile of the Folk triangle) occurring in less than 20 m water depth were included in the GIS as potential sandbank habitat. It is important to note that the maps in this report show only these areas of sandy sediments in 20 m water depth or shallower. Complete sandbanks of which these areas form the summits, extend into water deeper than 20 m. The actual area considered for designation as Annex I habitat may, therefore, need to be increased to incorporate complete sandbank flanks, associated horizontal or sloping sandy habitats and/or channels between banks, to maintain the structure and functions of a sandbank or sandbank system. In the UK offshore area there are also distinct sandbanks in waters much deeper than 20 m, which have not been mapped as part of this project as they do not fit the Annex I habitat definition.

Reef habitat in terms of the Habitats Directive includes bedrock, rocky substrates and biogenic concretions arising from the seafloor (see Section 2.1.2). Areas of bedrock and

rocky substrata are relatively easy to extract from BGS seabed map interpretations. However, areas of 'gravel' according to the BGS modified Folk classification include any solid particles from 2 mm diameter to greater than 256 mm diameter (see Sediment Size table in Figure 2.1). In terms of the Wentworth classification, this category includes 'cobbles' and 'boulders', which would be included within the UK interpretation of the definition of reef, but also includes 'pebbles' and 'granules', which do not fall within the definition of reef. Therefore, during the work to map areas of reef, all those areas on existing BGS maps categorised as 'gravel' were included as potential Annex I reef habitat. More detailed survey work may in future indicate that some of these areas do not fall within the definition of reef. In this report, where the term 'gravel' is used, we have included reference to Folk where appropriate. However, during the literature review as part of this project, the term 'gravel' is not always used in this specific context; we have specified the context in which the term has been used where such information is available.

Individual submarine structures made by leaking gas could not be mapped from existing seabed maps. However, gas seep areas were shown as areas where examples of this Annex I habitat may be found to occur.

It is important to note that the maps only show potential Annex I habitat for UK offshore waters. Where areas of such habitat extend into UK inshore waters, the inshore element is also shown on the maps, and is shaded differently. The same applies to areas of habitat which extend outside UK offshore waters into the offshore areas of other EU states. Therefore, the extent of such habitats in UK inshore waters (0-12 nm) is **not** fully represented – only those areas of habitat which extend further than 12 nm from shore are shown.

Additional information has been acquired from commercial and non-commercial sources in order to determine the nature of habitat in areas identified by the BGS contract. This information has also been used to identify any areas of reef (in particular, biogenic reef) which were not identified through the BGS contract, e.g. *Sabellaria spinulosa* reef. A full list of individuals and organisations which have contributed information is provided in the acknowledgements and where information has been used, a reference is provided.

2.3.2. Sandbanks which are slightly covered by sea water all the time

Sandbanks may originate through different processes which can lead to topographical differences. The two main sandbank types in UK offshore waters are:

a. Sandy mounds

   Sandy mounds may form where the underlying bedrock is uplifted or glacial till has been left and sand has been deposited in an overlying layer.

b. Tidal current sandbanks

   Tidal current sandbanks may form around headlands (banner banks and alternating ridges), in estuary mouths (estuary mouth ridges or tidal deltas), or on the open shelf (open shelf ridges).

In addition to topographic structure, salinity and sediment type are important factors influencing the nature of biological communities in sandbanks, as are temperature and water mass differences in different parts of the UK offshore area. All sandbanks in offshore waters are assumed to be subject to full salinity, as freshwater influences at 12 nm from shore are likely to be negligible.

Figure 2.3 shows the occurrence of sandy sediments (according to the BGS modified Folk classification, see Figure 2.1) in UK offshore waters in less than 20 m water depth. The main aggregations of offshore sandbanks occur around the north and north-east coast of Norfolk, in the outer Thames Estuary, off the south-east coast of Kent and off the north-east coast of the Isle of Man. This section will address the main aggregations of offshore sandbanks in turn with a view to characterising them by sediment type, topographical structure and indicating whether further information is available for them.

2.3.2.1. Dogger Bank (South-West Patch)

The Dogger Bank is an extensive sandy mound in the central North Sea located in both UK, Dutch and German waters. The majority of the bank in UK waters is between 20 and 40 m deep but an area of sandy sediment in the south-west is shallower than 20 m (shown on Figure 2.4), referred to here as the south-west patch. The Dogger Bank is composed of sediment which was deposited during the last glaciation and has subsequently been modified and smoothed by surrounding prevailing currents and storm influences to give its current formation. Sediment varies across the bank from clay to medium-grained sand to pebbles (Veenstra 1965). The seabed sediment in the south-west patch is primarily well-sorted medium to fine sand and some gravelly sand (Graham *et al.* 2001a). Few surveys have been undertaken on the south-west patch and consequently little is known about the biological communities that occur in this area of the bank. An environmental survey for Marathon Oil UK Ltd in 1989 (Aberdeen University Marine Science 1990) on the northern margin of the south-west patch, found that faunal diversity was relatively low in comparison to other regions of the North Sea which lie in deeper water. The low diversity of fauna was regarded as being due to the high degree of turbidity which the south-west patch experiences due to its shallow nature (Aberdeen University Marine Science 1990). The most abundant species throughout the area surveyed were *Bathyporeia elegans* (an amphipod), *Iphinoe trispinosa* (a cumaecean), *Nephtys cirrosa* (a polychaete worm), *Lunatia alderi* and *Fabulina fabula* (molluscs). The 2001 DTI-led Strategic Environmental Assessment 2 (SEA2) survey was conducted a little to the west of the south-west patch and found the predominant species to be *Echinocardium cordatum* (sea urchin), *Fabulina fabula* (bivalve), *Lanice conchilega* and *Owenia fusiformis* (polychaete worms) (DTI 2001) in a community that was generally considered to be richer than those found on the sandbanks off North Norfolk.

2.3.2.2. Norfolk Banks

The sandbanks off the Norfolk coast are a combination of tidal current sandbanks and sandy mounds, with the sandy mounds dominating the western half, north of The Wash. The location and general topographical shape can be seen in Figure 2.4. The water predominantly comes from the north and is southern North Sea water but to the eastern edge of the area there is some mixing with English Channel water.

Norfolk Sandy mounds

The sandy mounds generally occur in the western half of the region and in all but one case are formed of gravelly sands. The western mounds generally are formed of a thin (<1m) layer of sediment over till or clay (Graham *et al.* 2001a). The mounds which lie further east between the linear ridges of Swarte Bank and Haddock Bank are similar in character but the underlying sediment is unknown. In all cases, significant sandwaves are uncommon with only two mounds having a possibility of sandwave presence (Graham *et al.* 2001a). Detailed information for the sandy mounds is minimal. Two mounds in the eastern group were surveyed during the SEA2, which will provide

biological data, images and sediment analysis in 2002. Preliminary results show the area to have a stony and coarse shelf sediment with extensive epifauna (DTI 2001). In the western group there has been some surveying undertaken by oil and gas companies which gives some detailed sediment analysis but very limited biological data.

North Norfolk sandbanks

These sandbanks are the most extensive example in UK waters of offshore linear ridges. The series includes over ten sandbank ridges which are formed of sand and exhibit varying degrees of sandwaves (Graham *et al.* 2001a). The North Norfolk sandbanks were initially formed as Alternating Ridges around the headland and as the Norfolk coast has receded they have been restructured by tidal currents to form their present shape. The tidal currents diminish from nearly 1.5 to 1 metre per second as distance from shore increases (Graham *et al.* 2001a). The inner banks have sandwaves between 4 and 6 m high associated with them which equates to a habitat which is fairly disturbed. The outer sandbanks in the Indefatigable group have small sandwaves or no sandwaves associated with them and hence are likely to support a differing biological community to the sandbanks further inshore (Graham *et al.* 2001a). The SEA2 survey ran transects across the majority of the sandbanks in this group and will yield biological, sediment and image data in 2002. Preliminary results show a fauna typified by *Echinocardium cordatum* (a sea urchin) and *Fabulina fabula* (a bivalve) with two species of sandeels common (DTI 2001). In addition to this, a number of environmental surveys have been conducted for oil and gas companies in this area. However, it is likely that many of the survey points will lie in the troughs between the ridges.

Haisborough Tail, Hewett Ridges & Smith's Knoll

This series of sandbanks is distinct from the sandbanks outlined above as they are undergoing further formative processes that are likely to split the sinuous complex of banks into a series of offshore linear ridges. These banks are currently morphologically classified as Alternating Ridges and are composed of sand. The tidal currents around these sandbanks are greater in magnitude than those of the North Norfolk banks (1.5 metres per second) and have resulted in larger sandwaves occurring on the banks (c. 8 m high on the outer banks) (Graham *et al.* 2001a). The SEA2 survey includes a transect across Smith's Knoll which should supply biological, image and sediment data for that ridge. It is likely that the other ridges in the group will have similar communities to those on Smith's Knoll.

2.3.2.3. Outer Thames Estuary sandbanks

This group of sandbanks is entirely formed of tidal current ridges and can be seen in Figure 2.5. They were formed by the tidal current flow through the Thames Estuary but have been modified by open shelf currents as the coastline has receded. They are different from the Norfolk sandbank groups as the surrounding sediment in the troughs is more mixed and has a higher proportion of gravel as opposed to the predominance of sand in the Norfolk group. The ridges are all predominantly sand with the exception of Outer Gabbard which is predominantly gravelly sand. All the sandbanks have sandwaves on them and in the case of South Falls these may reach as high as 16 m towards the southern end of the bank (which protrudes into territorial waters) (Graham *et al.* 2001a). The water in this area is very turbid and is a combination of English Channel water and southern North Sea water. The different water bodies may have an influence on the communities that occur in this region in comparison to those off the Norfolk coast or the south Kent coast. To the knowledge of the offshore project, no surveys have been conducted on the areas of potential Annex I sandbank habitat which occur in this region.

However, there are likely to be similarities with the communities found on the Haisborough Tail etc. sandbank group.

2.3.2.4. Eastern English Channel

Only one offshore sandbank (Bassurelle) occurs in this region, and it is formed predominantly of sand. Its location can be seen in Figure 2.5 and it is an open shelf ridge. Sandwaves are abundant on the bank and are up to 15 m in height (Graham *et al.* 2001a). The water mass is Channel Water. No surveys are known to have been conducted on the bank.

2.3.2.5. North-east coast of the Isle of Man

Two habitat occurrences are found in this region, their locations can be seen in Figure 2.6.

Sandy mound east of Isle of Man

This mound is glacigenic in origin and is predominantly sand which is around 2 m thick and overlies stony gravelly, glacigenic deposits and bedrock (Graham *et al.* 2001a). It is unknown whether sandwaves occur. No surveys are known to have been conducted on the bank but it is likely that any community would be similar to that occurring on the inshore sand sheet off the west coast of England.

King William Bank

This tidal current ridge is likely to have been formed as a banner bank off the headland of the Isle of Man and has been modified over time and become an open shelf ridge. It is predominantly formed of gravelly sand and is part of a sequence of banks off the Isle of Man (Graham *et al.* 2001a). No surveys are known to have been conducted on the bank.

2.3.3. Reefs

This habitat type encompasses three main types of reefs:

a. Bedrock reefs

   These are made from continuous outcroppings of bedrock which may be of various topographical shapes e.g. pinnacle, pavement, ridge or bank etc. Some bedrock reefs may have a non-continuous, mobile veneer of sediment.

b. Stony reefs

   These consist of aggregations of boulders and cobbles which may have some finer sediments in interstitial spaces.

c. Biogenic reefs

   In offshore waters these may be formed by cold water corals (e.g. *Lophelia pertusa*), by Ross worm *Sabellaria spinulosa*, and possibly by horse mussel *Modiolus modiolus*.

All reefs in offshore waters are assumed to be at full salinity as freshwater influences at 12 nm from shore are likely to be negligible and no freshwater springs are known. Some

examples of the fauna found on different types of reefs in UK offshore waters are given in Plate 2.1 to Plate 2.4.

Figure 2.7 shows the potential extent and location of bedrock and stony reef habitat in northern UK offshore waters. Figure 2.8 and Figure 2.9 show the same for south-east and south-west UK offshore waters. Potential reef habitat is much more common in western UK offshore waters, and is virtually absent from UK offshore waters in the North Sea. Occurrences of reef habitat are described on a regional basis in the following section of the report, with an explanation of the type of reef which is thought or known to be present and any further information on the fauna. Areas on the maps are those reef areas identified from geological maps under the contract with BGS (see Section 2.3.1), with some information from surveys conducted by Southampton Oceanographic Centre for AFEN and the UK Department of Trade and Industry, and from surveys conducted by an aggregate extraction company as part of a licence application.

Biogenic reefs are not fully represented on these maps, as they could not be identified from existing geological map interpretations, and there is no comprehensive information on their location in UK waters. Where they are known to occur, they are mentioned in the text for each area. Figure 2.10 shows an interpretation of potential distribution of *Lophelia pertusa* in the NE Atlantic (Brian Bett, SOC) based on known locations of the species, its temperature requirements and water depth. It therefore gives an indication of areas where biogenic reefs formed by cold water corals may be found to exist in UK offshore waters. The reef forming worm *Sabellaria spinulosa* is widespread in UK offshore waters, particularly in the North Sea, Irish Sea and English Channel, but the full extent and locations of reefs formed by this organism are not known.

2.3.3.1. North Sea

The regions described in the following sections are shown in Figure 2.11.

Dogger Bank Gravel

To the north-west of the patches of Dogger Bank sandy sediments in less than 20 m water depth (see Section 2.3.2.1 and Figure 2.4), there are superficial mounds of gravel (defined according to modified Folk classification, i.e. of particles from 2 mm to greater than 256 mm diameter), which could be potential Annex I reef habitat (Graham *et al.* 2001a). Further detail on the particle size of the gravel is not known, but other information on the Dogger Bank indicates that it is unlikely that it is composed of particles predominantly greater than 64 mm in diameter, and therefore within the definition of Annex I reef habitat.

Offshore of Humber

This region of potential Annex I reef habitat comprises a series of irregular gravel mounds with superficial gravel overlying other sediments and bedrock (Graham *et al.* 2001a). The majority of the area is under licence for aggregate extraction and environmental survey data, which may establish which areas, if any, have a predominant particle size greater than 64 mm, may be available.

***Sabellaria* Reefs (Licence Area 401/2)**

Sabellaria spinulosa reef has been found in 2000 in the aggregate licence area 401/2, which is approximately 13 nautical miles east of Great Yarmouth (Newell *et al.* 2001). The majority of the licence area lies within territorial waters but the eastern edge lies

within UK offshore waters. The area surrounding the *Sabellaria* reef occurrence is characterised by stable coarse, gravelly sand and it is likely that this habitat is present in the surrounding offshore waters. Therefore, it is likely that with further survey, patches of *S. spinulosa* reef may be found in this region. The actual location of *S. spinulosa* reefs is liable to change over time as cycles of aggregation and degeneration in *Sabellaria* sp. colonies have been reported over periods of 5-7 years (Wilson 1971) and severe storms are likely to disturb the substratum and break up colonies (Holt *et al.* 1998). Fishing also affects the structure and presence of *S. spinulosa* reefs (Vorberg 2000).

2.3.3.2. English Channel

The regions described in the following section are shown in Figure 2.12.

Median Deep

This is a large spread of gravel (according to the Folk classification) which includes cobbles along with other sediment fractions. The northern part of the area is currently under application for an extraction licence and the southern part is under a prospecting licence for aggregates extraction. Surveys undertaken in the area have frequently recorded cobbles but not as the dominant sediment size (Environmental Resources Management 2000). There may be some bedrock outcrop or boulder fields on the western side (close to the median line) (Environmental Resources Management 2000). Sessile epifauna included a wide variety of encrusting bryozoans and smaller quantities of hydroids and soft corals. *Pomatoceros triqueter* (a calcareous tube worm) was very common on cobbles and crevice fauna such as squat lobsters (Galatheidae), syllid worms and small bivalves were abundant (Environmental Resources Management 2000). The particle size analysis of samples taken across the area under licence shows that cobbles and boulders do not dominate the majority of the area and, therefore, it is likely that the majority of this area would not fall within the definition of Annex I reef habitat.

Eastern English Channel Basin

This region is dominated by a large expanse of potential reef habitat which stretches 142 km in length and is 32 km wide. The water depths over the patch are generally 50-75 m with an exception for a linear deep that reaches around 100 m deep. The region has been surveyed by side-scan sonar and is extremely heterogeneous in nature (Graham *et al.* 2001a) with gravel (according to modified Folk classification) and bedrock outcrops present. This is due to the complex geology of the region where folded bedrock is overlain patchily by coarse glacigenic lag sediments (gravel, pebbles, cobbles and boulders) and both may be covered in more mobile sandy sediments. The current strengths are sufficient to mobilise fine gravel which results in a highly disturbed environment. The bedrock outcrops tend to occur in the form of ridges which have resulted from folds in the sedimentary rock and softer layers having been eroded (Graham *et al.* 2001b). Further spatial analysis of the potential reef may identify some regions of gravel furrows, sand ripples and sand waves.

Epibenthic fauna such as barnacles and bryozoans have been found encrusting sampled cobbles within the patch of potential reef habitat (Graham *et al.* 2001b). Holme and Wilson (1985) conducted side-scan sonar and video sledge surveys just to the north of the main patch identified by BGS and found very similar mixes of habitat. Of the faunal assemblages identified by Holme and Wilson, two are likely to occur within reef habitat identified by Graham *et al.* (2001a). The first is a stable faunal assemblage with diverse sponge cover which was identified as occurring on the surface of non-mobile hard seabeds such as pebbles, cobbles, boulders and rock outcrops which are not subject to

scour by sand or gravel or periodic cover by sand or gravel. Cobble bottoms tended to be bound together by the growth of sponges, bryozoans and ascidians. *Pentapora foliacea* (Ross coral bryozoan) was also characteristic. The second type of faunal assemblage was one which is present on hard surfaces of rock, cobbles or pebbles that were subject to sand scour and/or periodic submergence by sand. Three sub-types were identified:

a. Well-developed faunal assemblage with *Polycarpa violacea*.

b. Impoverished *Polycarpa violacea-Flustra foliacea* assemblage.

c. Impoverished *Balanus-Pomatoceros* assemblage (Holme & Wilson 1985).

Other occurrences of potential reef habitat in this region are thought to be of similar character to that described above. Recent work off Selsey, east of the Isle of Wight (detailed in Brown *et al.* 2001) describes the seabed in the deeper areas, that coincides with the potential reef occurrence mapped by Graham *et al.* (2001a), as a mixture of coarse material and out-cropping bedrock overlain with areas of sand veneers. The epibenthic fauna could not be sampled with a beam trawl due to the rocky and uneven nature of the seabed but Hamon grab samples showed the polychaete worm *Ophelia borealis* as biologically dominant and the barnacle *Balanus crenatus* to be a numerous species (Brown *et al.* 2001).

2.3.3.3. South-west Approaches

The regions described in the following section can be seen in Figure 2.13.

Western English Channel

A further series of gravel patches (according to modified Folk classification) occur c. 15 nm south west of the Isle of Portland which appear to be very similar in character to those described above as they are described as shelly gravel with occasional rock outcrops (Graham *et al.* 2001a). They occur in around 65 m of water and the current strengths are moderate. Very little is known about these patches and no biological surveys are known within this region.

South of Cornwall are a series of small (c. 3-7 km^2) gravel patches with BGS samples describing the seabed type as sandy gravel or shelly gravel. The underlying rock is chalk/limestone but there is no indication that this outcrops (Graham *et al.* 2001a).

Haig Fras

This habitat occurrence is an isolated bedrock reef 150 km offshore in the Celtic Sea with a steep peak rising to 38 m from 100-110 m depth. Overall the granite exposure measures about 45 by 15 km but the pinnacle measures less than 1 km across. The remaining exposure has been planed down to a rock platform protruding only a little above the sediment (Rees 2000). A camera survey (Rees 2000) demonstrated that the bedrock on the peak has three distinct deep water reef biotopes 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. Photographs of the first three reef biotopes can be seen in Plate 2.1 a, b and c. The biotopes are:

a. Biotope dominated by jewel anemone *Corynactis viridis.*

b. Biotope dominated by Devonshire cup coral *Caryophyllia smithii.*

c. Biotope characterised by cup sponges and erect branching sponges.

d. Complex biotope with red encrusting sponge, *Caryophyllia smithii* and featherstars (crinoids) on boulders and bryozoan *Pentapora membranacea*, squat lobster *Munida* sp. and brittlestars (ophiuroids) also common.

The Rees (2000) survey yielded tentative biotope classifications and descriptions and some images. Further work has produced side-scan images of the outcrop.

South-west Approaches Shelf Break

The bathymetry of the shelf break area in the south-west approaches to UK waters indicates that the shelf break is heavily canyoned. Currents are generally moderate in this region (MAFF 1981) and will have exposed bedrock and kept fine sediments suspended. However, in canyons, the water currents are likely to be greater and a different fauna may occur. In addition to the bedrock reef in this area it is likely that cold water corals are abundant and may well have formed reefs. In similar conditions to the west and east of UK waters, Le Danois (1948) discovered large quantities of *Lophelia pertusa* reef on the shelf break. Fauna associated with *Lophelia pertusa* reef in this region have been found to be different to those on the Faeroe Shelf (Jensen & Frederiksen 1992) and may be different to that found in north-west UK waters. To the knowledge of the Offshore Natura 2000 project, no surveys have been carried out in this section of UK waters and very little is known about the specific nature of the habitat and the biota it supports.

2.3.3.4. Irish Sea

Figure 2.14 shows the distribution of potential Annex I reef habitat occurrences in the Irish Sea. These fall into four main regions which are discussed in turn below. The Irish Sea is distinct from other regions of the UK when considering hydrographic regime and seabed type with the possible exception of the eastern English Channel where there are also moderate currents and mobile sediment lags within a similar salinity regime.

Mid Irish Sea

This area consists of numerous outcrops of rock and sediment with one very large patch occurring centrally. These patches are highly variable in sediment type but have occurrences of cobble fields within a matrix of sand and gravel (Graham *et al.* 2001a). Within the large area of potential reef habitat are a series of bedrock outcrops which may have some mobile sediment cover and have a bold hummocky topography. All the potential reef habitat occurrences in this region are likely to be sediment-influenced and to have sediment-tolerant fauna associated with them. The region is approximately 120 m deep in the north and slopes upwards to 70 m in localised areas and reaches depths of c. 100 m in the north of the region. Many of the occurrences of potential reef habitat occur on slopes and rims of depressions (Graham *et al.* 2001a).

A few surveys from the SWISS project were carried out within the large patch of quaternary sediment which dominates this set of habitat occurrences. Sandy gravel was found in the west of the patch and shelly sediment in the north-east, which confirms the variable nature of the patch (Wilson *et al.* 2001). CEFAS beam trawl surveys were conducted on two potential reef habitat occurrences on the north side of the region and found 5.6 kg/hr and 12.9 kg/hr of *Sabellaria spinulosa* (CEFAS pers. comm.). Full species lists with catch per unit effort (CPUE) figures are available for these sites. These indicate the possibility of *Sabellaria spinulosa* biogenic reef within the region. In general, for the area, very little information is held and further survey work is needed to determine where areas of cobble, boulder and bedrock may occur.

Cardigan Bay

In this region there are a number of small gravel (as defined in the modified Folk classification) patches in water depths from 30 to 60 m. Seabed samples have recovered a range of sediment types from cobble, shelly cobble gravel to shelly gravel and sandy gravel, again demonstrating the variability of the seabed (Graham *et al.* 2001a). One CEFAS beam trawl monitoring site is within the region and a full species list with CPUE figures is available. No significant quantities of biogenic reef-forming species were trawled (CEFAS pers. comm.). Other surveys have been conducted in the area for geophysical purposes and these records could be investigated for further information if required.

North of Anglesey

This area extends from the shoreline to beyond territorial waters on the north side of Anglesey. The main occurrence of potential reef habitat is an extensive area of gravel (as defined in the modified Folk classification) which contains patches of gravelly sand and scattered rock outcrops. Within this area, patches of *Modiolus modiolus* reef have been found although the precise location of these is not known (Ivor Rees pers. comm.) and they may be within territorial waters. The surrounding, smaller, areas of potential reef habitat are either gravel patches or outcrops of quaternary material or rock. Cover of mobile sediments is patchy and of variable depth and any reef community is likely to be sediment-influenced (Graham *et al.* 2001a). The water depth is approximately 50 m and tidal currents are strong in the area north of Anglesey (CEFAS 2000). No BIOMOR or SWISS surveys have been undertaken within these patches. One survey was undertaken by CEFAS just within territorial waters and found compact rippled muddy sand with some shell material (Allen & Rees 1999). Other geophysical surveys have been undertaken within the areas of potential habitat and these may be accessed through the BGS if necessary.

West of Isle of Man

The potential Annex I reef habitat identified in this region is generally in the form of rock outcrops which are associated with slopes and small highs in the bedrock at between 70 and 90 m deep. The outcrops have a variable cover of mobile and non-mobile lag sediment and any reef community is likely to be sediment-influenced although tidal currents in this region are moderate to weak (MAFF 1981). A submersible survey on one of these outcrops found rock pavement with boulders and cobbles and a community which included bryozoans, *Flustra* sp., sunstar *Solaster* sp., occasional spiny lobsters, anemones and sponges (Graham *et al.* 2001a). The ISSIA, SWISS and BIOMOR projects in the Irish Sea do not provide any further information for this area, except in the case of one towed sledge survey which showed mud habitat with *Nephrops norvegicus* burrows which is consistent for the mud habitat which is believed to surround the rock outcrops (Allen & Rees 1999). No CEFAS surveys have been conducted over the habitat occurrences in this region. Other geophysical surveys have been undertaken within the areas of potential habitat and these may be accessed through BGS if necessary.

2.3.3.5. West of Scotland

Refer to Figure 2.15 for the location of the following areas of potential Annex I reef habitat.

Blackstones Banks

Blackstones Banks is a complex area of many rock outcrops and intervening sediment-filled hollows in water depths between 40 and 70 m. The rock outcrops are a combination of igneous and sedimentary rock. Surveys by submersible as well as geophysical samples have been taken in the area and photographs show boulders and cobble pavements as well as a vertical rock wall. The epifauna is well developed and includes sponges and anemones (Eden *et al.* 1971). The potential reef occurrences extend into Scottish territorial waters.

Stanton Banks

The Stanton Banks are a group of rock outcrops that protrude above the surrounding sediment seabed. They have steep slopes and the actual banks have a rugged topography with numerous sediment-filled hollows (Graham *et al.* 2001a). Geophysical surveys have been carried out on some of the banks and these may be accessed through BGS if necessary. No biological surveys are known to have been carried out on the Stanton Banks but a photograph from a submersible survey shows brittlestars and other encrusting fauna on clean current-swept bedrock (Eden *et al.* 1971) (Plate 2.2).

Hebrides Shelf

This area of potential Annex I reef habitat is a large patch of bedrock to the west of the Uists and extending upwards towards Lewis and out towards St Kilda. It is elevated from the surrounding sediment seabed but does have patchy sediment cover of a variable thickness and made up of various sediment fractions (Graham *et al.* 2001a). Incorporated into this area is the Flannan Ridge which is a linear feature with frequent pinnacles. The entire platform area has very complex bathymetry (Graham *et al.* 2001a). No biological information is currently available for this region but many geophysical surveys have been undertaken (especially in the southern half) and this information could be accessed through the BGS. Samples of cobbles have been encrusted with bryozoans and tube worms (Graham *et al.* 2001a).

Iceberg Ploughmarks (Hebrides Slope to West Shetland Slope including Wyville-Thomson Ridge)

Iceberg ploughmarks are ridges of boulders and cobbles which have been formed by the ploughing movement of icebergs through the seabed at the end of the last ice age (Belderson *et al.* 1973). Ploughmarks are very common on the outer shelf and upper slope in water depths between c. 140 and 500 m. They are typically 20 m in width and 2 m deep (Graham *et al.* 2001a). They are characterised by ridges made up of larger fractions of sediment and furrows which are lined with pebbles, gravel and sand (Masson *et al.* 2000). Although only the ridges fit into the habitat definition of reef, the furrows are an integral part of the feature's structure and the overall feature is a matrix of the two types. Since formation, many ploughmarks have been degraded by hydraulic and sedimentary processes and the furrows have been filled to varying extents by sediment (Graham *et al.* 2001a). The locations of areas which have been sedimented over or degraded are not fully known. Iceberg ploughmark zones can be seen in Figure 2.15 and Figure 2.19.

The West Shetland Slope region and a segment of the northern Hebrides Slope were surveyed in 1996 and 1998 as part of the work commissioned by the AFEN consortium. Sidescan sonar, targeted cores and photographic tows were used to characterise the seafloor. Sampling of the iceberg ploughmark areas was problematic as cores were generally only successful when sampling sediments finer than cobble. However, the failure of core samples due to rocks caught in jaws etc. was noted by the survey and these can be taken as an indication that Annex I reef habitat is probably present. Photographic tows along the West Shetland Slope showed that visible fauna on the ridges was dominated by cidarid urchins and a variably developed encrusting epifauna. No large aggregations of cold water corals were observed and only two occurrences of *Lophelia pertusa* (both very small colonies) were noted in the entire survey (Bett 2000a).

The hydrography of the area is a major structuring force on the biological communities due to the different water masses occurring at different depths (Bett 2000b). In the Faeroe-Shetland Channel, cold (<-0.5°C) Faeroe-Shetland Channel Bottom Water flows below 600 m deep in a south-westerly direction. Over the top of this flows warm (>8°C) North Atlantic Water from the Rockall Trough in the continental shelf current. Internal tidal waves in the bottom water cause fluctuations in the water mass at around 500-600 m depth which means that communities within this zone have to endure fluctuations in water temperatures from around 8°C to around -0.5°C. Consequentially, the community at this depth is different from shallower communities and potential reef areas at this depth should be considered as different in nature to those in shallower depths. The iceberg ploughmarks of the northern Hebrides Shelf are in North Atlantic Water and the soft sediment communities found in this region were similar to those of the shallow West Shetland Shelf (<500 m deep) (Bett 2000b). It is likely that reef communities would also be similar to those of the shallow West Shetland Shelf.

The DTI commissioned surveys of the Faeroe-Shetland Channel and Wyville-Thomson Ridge regions in 1999 and 2000. These data have been less comprehensively analysed but have provided sidescan information confirming the presence of iceberg ploughmarks on the Wyville-Thomson Ridge and on another part of the West Shetland Slope. The ploughmarks are extremely dense above 500m and in places extend as far downslope as 700 m on the flank of the Ridge. The photography conducted by the 1999 survey revealed that the seafloor in the ploughed zones is characterised by a lag deposit consisting of a carpet of gravel and cobble, with frequent boulders up to a few metres in size (see Plate 2.3). Over two distinct areas of the ridge, bottom current activity has removed the ploughmark traces on the sonar records. In these regions, seafloor photography reveals a similar cover of cobbles and gravels with some areas of sand (Bett 2000c). The Wyville-Thomson Ridge is subject to large fluctuations in water temperature due to the periodic overflow of Faeroe-Shetland Channel Bottom Water over the Ridge which temporarily displaces the warmer North Atlantic Water which flows from the Rockall Trough. Therefore, faunal communities are likely to be different to those which are found on the shallow parts of the West Shetland Slope and northern Hebrides Slope. Photographic tows showed sponges, mobile invertebrates e.g. squat lobsters, cidarid sea urchins, and some octocorals (Bett 2000c).

The southern part of the Hebrides Shelf was sampled as part of the Shelf Edge Study in the Land-Ocean Interaction Study (LOIS) by a bed-hop camera system. Samples were taken in a transect from 140 m deep to 2000 m. Samples taken at the 140 m and 200 m stations clearly showed the presence of cobbles as a dominant substratum and the expression of iceberg ploughmarks. Cobbles are mostly free of a sediment veneer due to the strong continental shelf current. Thick-spined sea urchins (*Cidaris cidaris*) were common and encrusting bryozoans, cup corals and sponges were abundant (Humphery *et*

al. 1999). Original photographs from these areas are held by J. Humphery at the NERC Proudman Oceanographic Laboratory in Bidston, Merseyside.

2.3.3.6. The Rockall Bank and Rockall Trough region

Rockall Trough is a large basin bounded, in UK waters, by the Hebrides Shelf to the east and the Rockall Bank to the west (refer to Figure 2.16). To the north the trough rises to meet the Wyville-Thomson Ridge and in the north-west it is incompletely bounded by three banks (Lousy, Bill Bailey's and George Bligh). The Rockall Trough is dominated by the influence of Eastern North Atlantic Water (ENAW) which flows at depths less than 1200 m in a clockwise motion and is c. 8°C. Labrador Sea Water (which is slightly cooler at 2-4°C than ENAW) flows in an anti-clockwise direction through the deeper parts of the Rockall Trough (Bett 2000a). Gage (1986) observed differences in faunal assemblages associated with the changes in water masses and these are likely to affect the faunal composition of communities found within potential Annex I reef occurrences.

Hebrides Terrace Seamount

This is the smallest and most southerly of the seamounts which are situated in the UK sector of the Rockall Trough. The seamount rises from c. 2000 m to 1000 m deep and has a narrow summit. Dredge samples have recovered igneous rocks which may indicate that there are exposed areas of rock. It is possible that the flanks may have exposed bedrock areas similar to the other seamounts in the Rockall Trough (Graham *et al.* 2001a). There is currently no biological information for this area of potential reef occurrence but the seamount is within the zone in which cold water corals may be found and, therefore, it is possible that cold water coral may be found on the seamount. Any exposed rock areas are likely to have encrusting fauna growing on them and faunal composition may change below 1200 m due to a change in water masses. Two geophysical survey points are present on the summit of the seamount and the data may be accessed through the BGS if necessary.

Anton Dohrn Seamount

Anton Dohrn Seamount is flat-topped (a guyot) and arises from about 2100 m to a minimum depth of 521 m. The top of the seamount is covered by c. 100 m of sediment but the sediment cover terminates near the outer edges of the summit plateau and basaltic rock is exposed on the steep sides down to a depth of around 1500 m (Jones *et al.* 1994). There is also a small central knoll on the summit where basalt is exposed (Graham *et al.* 2001a). Dredges on the eastern flank have recovered live *Lophelia pertusa* samples of which some fragments measured more than 50 cm (Jones *et al.* 1994). No further biological information is available but a series of geophysical samples were taken across the seamount and these may be accessed through BGS if required. It is likely that Annex I reef habitat on the seamount is patchy and largely confined to the flanks of the seamount but its exact distribution is not possible to define.

Rosemary Bank

The Rosemary Bank is a conical seamount and rises from around 1830 m deep to a domed crest, at around 370 m. The underlying rock is basaltic and very similar to the underlying rock of Anton Dohrn seamount (Dietrich & Jones 1980). Much of the seamount is covered in a layer of sediment which is predominantly sand with some gravel, cobbles and boulders (Britsurvey 1995). On the south-eastern flank of the seamount, surveys have shown little or no sediment cover (Britsurvey 1995; Dietrich & Jones 1980) and rock dredges have brought up corals, bryozoans and sponges from a depth of c. 1000 m

(Dietrich & Jones 1980). Unfortunately, no further work was undertaken on the biological samples and the type of coral found is unknown. Two samples of live *Lophelia pertusa* have been taken from the south flank of the bank (Wilson 1979).

Annex I reef habitat on the Rosemary Bank is likely to be patchy and may be confined to the flanks of the bank. However, at this time, it is not possible to define the exact areas of Annex I reef habitat within the larger location.

Darwin Mounds

The Darwin Mounds are a series of sand volcanoes which are capped with thickets of *Lophelia pertusa* and have "tails" of sediment oriented with the current. There are two main fields of mounds which were discovered by the AFEN surveys in 1998 and 1999 and resurveyed in 2000. These are referred to as the eastern and western groups. The mounds are located at a depth of approximately 1,000 m in the north-east corner of the Rockall Trough, immediately to the south of the Wyville-Thomson Ridge (Bett 2000d) (see Figure 2.17 for location). The data from the 2000 survey have been unavailable thus far but some photographs from it are available (see Plate 2.4).

Around the mounds and tails, the seafloor is a rippled foraminiferous sand, having a fauna typical of similar depths throughout the Rockall Trough. On the tails, the sediment character is apparently the same but there are high densities of the xenophyophore *Syringammina fragilissima*. the appearance of the seafloor on the mounds is variable with some being similar to that of the surrounding seafloor and tails and others showing blocky rubble (possibly cemented sediments and/or coral debris) and living stands of the coral *Lophelia pertusa*. The coral provides a habitat for invertebrates such as sponges and brisingiids (Bett 2000d).

Only one WASP tow was conducted in the eastern area in 1999. The biological zonation around the mounds, i.e. dense xenophyophore populations on the mound tails and coral growths on the mounds themselves, is consistent with the western field. However, rocks on the seabed are more abundant. Coral was not seen to be attached to these rocks (Bett 2000c).

Rockall Bank

This is a large igneous rock feature which rises to the island of Rockall. Sediment cover is patchy with the western and south-western area of the plateau being devoid of sediment. The sediment varies from sandy contourite and mud on the eastern flanks to cobbles and gravels on the western flanks. Seismic surveys on the north-west flank of Rockall Bank have shown bedrock exposed by vigorous bottom current flow (Howe *et al.* 2001). No comprehensive survey of the sediment or benthos has been undertaken on Rockall Bank and therefore, the detailed distribution of reef habitat and the community it supports is unknown.

Wilson (1979) records *Lophelia pertusa* as occurring in discrete patches around the Bank and appearing to be fairly common at depths ranging from 130 to 400 m. They may also be correlated with the occurrence of iceberg ploughmarks (Wilson 1979). Surveys on the south-east slope of Rockall Bank (outside UK waters) have shown frequent occurrences of cold water coral colonies with both *L. pertusa* and *Madrepora oculata* well represented (Kenyon *et al.* 1998). The full extent of cold water coral reefs on Rockall Bank is unknown as a comprehensive survey of the Bank in UK waters has not been undertaken. However, many records of *L. pertusa* have come from trawl nets and it is likely that the abundance of corals has decreased as trawling pressure on the Bank has increased.

Bedrock reef is not confined to the outer regions of the Bank but is also present around the island of Rockall and Helen's Reef (2 miles from Rockall Island) (Graham *et al.* 2001a). These fall within territorial waters but are likely to be contiguous with offshore occurrences of Annex I reef habitat.

To the north-west of Rockall Bank there are three potential reef areas. These are noted by Graham *et al.* (2001a) as superficial gravel mounds, and recent research has shown that these are highly likely to be gravel sediment areas winnowed by strong bottom currents (Howe *et al.* 2001) and, therefore, not Annex I reef habitat.

George Bligh Bank

This area of potential reef habitat is a volcanic mound which is mostly covered in fine sediment with one area of rock outcrop towards the north of the summit. The Bank rises from 1650 m deep to 450 m (Graham *et al.* 2001a). There is one record of live *Lophelia pertusa* from the bank (Wilson 1979). There is currently no further information available for George Bligh Bank.

2.3.3.7. West of Rockall

This region has undergone very little survey work and in general knowledge is restricted to interpretations of seismic surveys. The region can be seen in Figure 2.18. Much of the bottom water of this area is cold water originating from Norwegian Sea 'arctic intermediate water' and Norwegian Sea 'deep water' which has flowed down the Faeroe-Shetland and Faeroe Bank Channels and then turned south to form part of the cold (<-0.5°C) and less saline North Atlantic Deep Water current (Aurora Environmental Ltd & Hartley Anderson Ltd 2001). Therefore, the area west of Rockall is subject to very different conditions compared to the Rockall Trough.

Sandastre

This area is a volcanic, broad, asymmetric dome with a sediment veneer that covers the majority of the mound except in three locations: a double crested cone near the centre of the mound, a 300m high pinnacle in the north-east of the feature and a 2.5 km wide ridge along the south-west side. The sediment veneer is very thin on the south-west slope and there is a possibility of rock outcrops in this region. *Lophelia pertusa* was recovered from a dredge of the south-west flank in 1980, along with sponge, bryozoan and shell debris (Graham *et al.* 2001a).

Swithin

This area of potential reef habitat is a volcanic mound at the north-west edge of Rockall Bank and appears to be an extension of the Rockall Bank. The mound may have a sediment veneer across the entirety of its surface but there have been no samples to establish this (Graham *et al.* 2001a). No further information is currently available on this area.

Lyonesse

This potential Annex I habitat reef occurrence is a volcanic mound which is predominantly covered by a sediment veneer with some bedrock outcroppings in the central and north-east sections of the mound. There are some minor ridges or pinnacles in the east of the area which may outcrop (Graham *et al.* 2001a). No sediment samples

have been taken on Lyonesse and no further information is currently available for this region.

Mammal

Mammal is a volcanic mound with sediment veneer occurring across the majority of the area and some outcroppings of basaltic rock. There are outcrops of rock on a knoll at the top of the bank and on the east-south-east flank. There are steep scarp slopes which may also allow outcropping of bedrock but there are no samples in this area (Graham *et al.* 2001a). No further information is currently available for this region.

Two further areas of potential Annex I reef habitat are present to the south of Mammal. The first occurrence (just to the south of Mammal) is an elliptical mound of volcanic bedrock which may be totally covered by a sediment veneer with the exception of the north side where it is thin or absent and reef habitat may be present (Graham *et al.* 2001a). The second occurrence (south of Mammal and Hatton Bank) is a long sinuous volcanic swell which is probably sediment-covered (Graham *et al.* 2001a). No samples are available for this region and no further information is currently available.

Hatton Bank

This series of potential Annex I reef occurrences is formed from an underlying basaltic mound with an extensive sandy sediment veneer. Surveys have revealed some pinnacles in the western portion of the main southern area which may be basaltic in nature or may be coral bioherms (Graham *et al.* 2001a). The main northern area also has an irregular surface with pinnacles that may be basaltic in nature or coral bioherms. Live *Lophelia pertusa* has been sampled from the northern area (Graham *et al.* 2001a). Very little is known about Hatton Bank but the topography and possible presence of large coral bioherms indicate a need for further survey.

2.3.3.8. North of Scotland

The regions described in the following section can be seen in Figure 2.19.

Judd Deeps

This is a region that was not identified from existing BGS seabed sediment maps but was revealed by 3D exploration seismic survey conducted for the oil industry and benthic survey of the Faeroe-Shetland Channel commissioned by the DTI and conducted in 1999. The Judd Deeps are large troughs, up to 200 m deep, which run along the edge of the Faeroe Plateau at the south end of the Faeroe-Shetland Channel and are kept sediment free by bottom waters flowing south-westwards and cascading over the scarps (Aurora Environmental Ltd & Hartley Anderson Ltd 2001). They mainly fall within the Faeroese sector but protrude into the UKCS in two places. Three photographic surveys along the edge of the Faeroe Plateau at the edge of these formations revealed the seabed as having a dense gravel cover with frequent rock, boulder and cobble occurrences which sometimes become the dominant substratum (Bett 2000d). The surveys were conducted at depths between 1000 and 2000 m and the water at this depth is Faeroe-Shetland Channel Bottom Water which is less than -0.5°C and has a salinity of less than 35‰. Encrusting fauna was abundant with sponges, featherstars and octocorals common (Bett 2000d). A further survey for the DTI in 2000 re-visited the area but the results are currently unavailable. Further information and possibly survey work is needed to fully identify the extent of reef in this region and assess the communities present.

Solan Bank

The potential Annex I reef occurrences in this region can be divided into two categories; bedrock outcrops and gravel patches (according to modified Folk classification). The water depth is as shallow as 60 m on the top of Solan Bank and falls off to c. 100 m deep in the surrounding area. The rock outcrops mainly occur on the top of and to the west of Solan Bank in the channel between Sule Skerry and North Rona. The gravel patches tend to occur more to the north and south of the rock outcrops. BGS surveys indicate that the rock outcrops have some cover of mobile sediment (generally shelly sands and gravels). The gravel patches consist of superficial irregular mounds of gravel of varying grades (Graham *et al.* 2001a). No biological survey information is available for these areas but some geophysical surveys have been conducted in the region and could be sourced from BGS if required.

To the north of the Solan Bank area, AFEN and BGS surveys have sampled cobbles or rocks which may be indicative of further patchy reef habitat (Bett 1996; BGS 2001). However, this was not identified by the BGS during habitat identification and further information is needed to clarify the type of seabed in this area.

Turbot and Otter Banks

The series of potential Annex I reef occurrences in the region of the Turbot and Otter Banks are made up of gravel patches (according to modified Folk classification) and rock outcrops. They lie in water between c. 75 and 125 m deep. Two rock outcrops lie close to the Shetland Islands and have a patchy sediment coverage which varies from sand to cobbles and boulders. The remaining occurrences are gravel (as defined by the Folk classification) patches, and BGS sampling shows that the sediment is frequently made up of boulders, cobbles and gravel (Graham *et al.* 2001a). No biological samples are available for this region and no geophysical surveys apart from BGS surveys are known to have been conducted. It is likely that epifaunal communities in this set of occurrences are sediment-tolerant.

Shetland Islands

The main potential Annex I reef habitat occurrence in this region is a composite of sedimentary rock platform (the East Shetland Shelf) and a basement high (the Pobie Bank). Sediment cover is patchy over the rock surfaces, generally very thin when present and mainly consists of gravelly sand (Graham *et al.* 2001a). The region is between 100 and 200 m deep and is contiguous with similar habitat which runs into the coast of the Shetland Islands. *Lophelia pertusa* samples have been recovered locally but are likely to be at the extreme edge of their range and potentially poorly developed (Wilson 1979). One biological sample was taken in this region by the Institute for Marine Research, Norway as part of a wider epibenthos survey of the North Sea. The species taken in the trawl indicate a sediment-influenced community with a non-mobile substratum present (CEFAS pers. comm.). No further surveys are known in this region.

2.3.4. Submarine structures made by leaking gases

Pockmarks with carbonate structures formed by leaking gases are the only features known to occur in UK offshore waters which may conform to this Annex I habitat. In UK waters ‘pockmarks’ are large depressions in areas of generally fine muddy sediments. Due to the scale of the data available, only two ‘pockmarks’ in UK waters are known to have carbonate structures within them (see Figure 2.20). These carbonate structures form pavements and blocks, or possibly vase shaped structures (the latter only known from

one historical record recovered in fishing gear from St Magnus Bay, in Shetland). Pockmarks are commonly found in the Witch Ground formation in the northern North Sea (shown in Figure 2.20). Pockmark fields are also located in the Irish Sea and, although carbonate structures have been found in some of those located in Irish waters, no structures have been found in those seeps located in UK waters.

Scanner, Block 15/25, North Sea

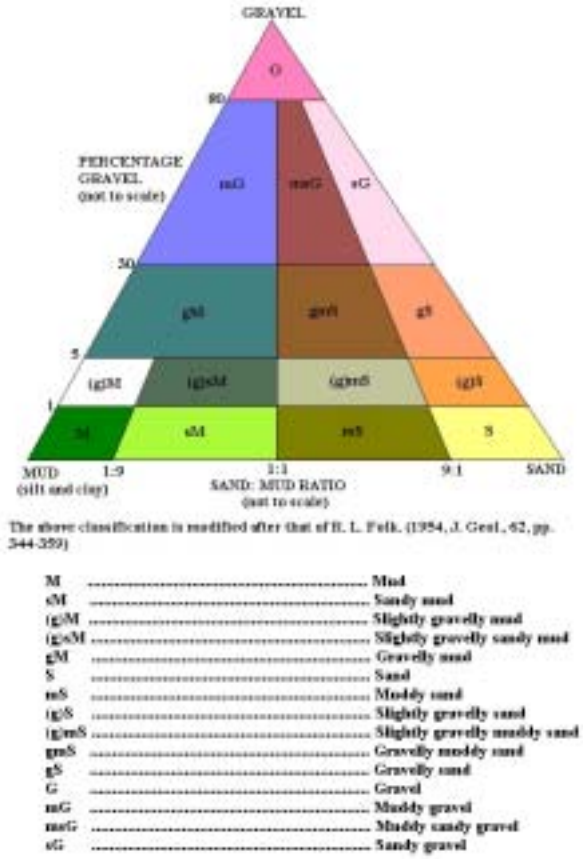
This is a single large pockmark within the Witch Ground field, which may be a composite pockmark with two major craters containing subsidiary depressions. The pockmark itself is 17 m deep and the side-wall angles range from 1-10 degrees. The location of this pockmark can be seen on Figure 2.20. At the base of the pockmark a gravelly lag deposit is exposed (Graham *et al.* 2001a). Slabs of carbonate-cemented sediment (clay, sand and gravel) were found to be present in or near to the edges of the gravelly lag areas and in some cases appeared to be supported centrally by a pillar or pedestal (Hovland & Judd 1988). The cement comprises of aragonite and calcite. The pockmark is open and active with streams of gas bubbles issuing from under the edge of the carbonate cemented sediment that is sometimes concealed by a thin layer of silty clay. Fauna at the base of the pockmark differs from that of the sides. The carbonate-cemented slabs and lag layer are colonised by anthozoans e.g. *Metridium senile*, *Bolocera eques* and *Cerianthis* sp.; Ophiuroids, whelks and hermit crabs were also observed on the hard substratum (Graham *et al.* 2001a). Fish were abundant and frequently seen to be occupying single pockmarks or hiding in hollows underneath slabs of cemented sediment (Hovland & Judd 1988). The meiofauna in the sediments surrounding the carbonate slabs and pockmark were dominated by nematodes, especially *Astonema southwardoorum* (Austen *et al.* 1993). Polychaete worms and crustaceans were also common.

Unnamed pockmark, Block 16/3, North Sea

As part of the Braemar field development the environmental assessment commissioned by Marathon Oil UK Ltd identified the presence of large and small pockmarks in oil and gas licence block 16/3 (see Figure 2.20). Further subsequent investigation by photography and grab sampling has shown the presence of hard substratum interpreted as carbonate cemented material in a number of the pockmarks. In most of the pockmarks most material appears to be old and much of it has been overturned (assumed to be by trawling). In one pockmark, larger blocks of carbonate cemented material were seen with some epifauna present (hydroids, anemones and crabs). Photographs, grab samples and sidescan images may be available in 2002 from the environmental assessment documentation.

2.3.5. Sea caves

Sea caves are not currently known to occur in UK offshore waters.

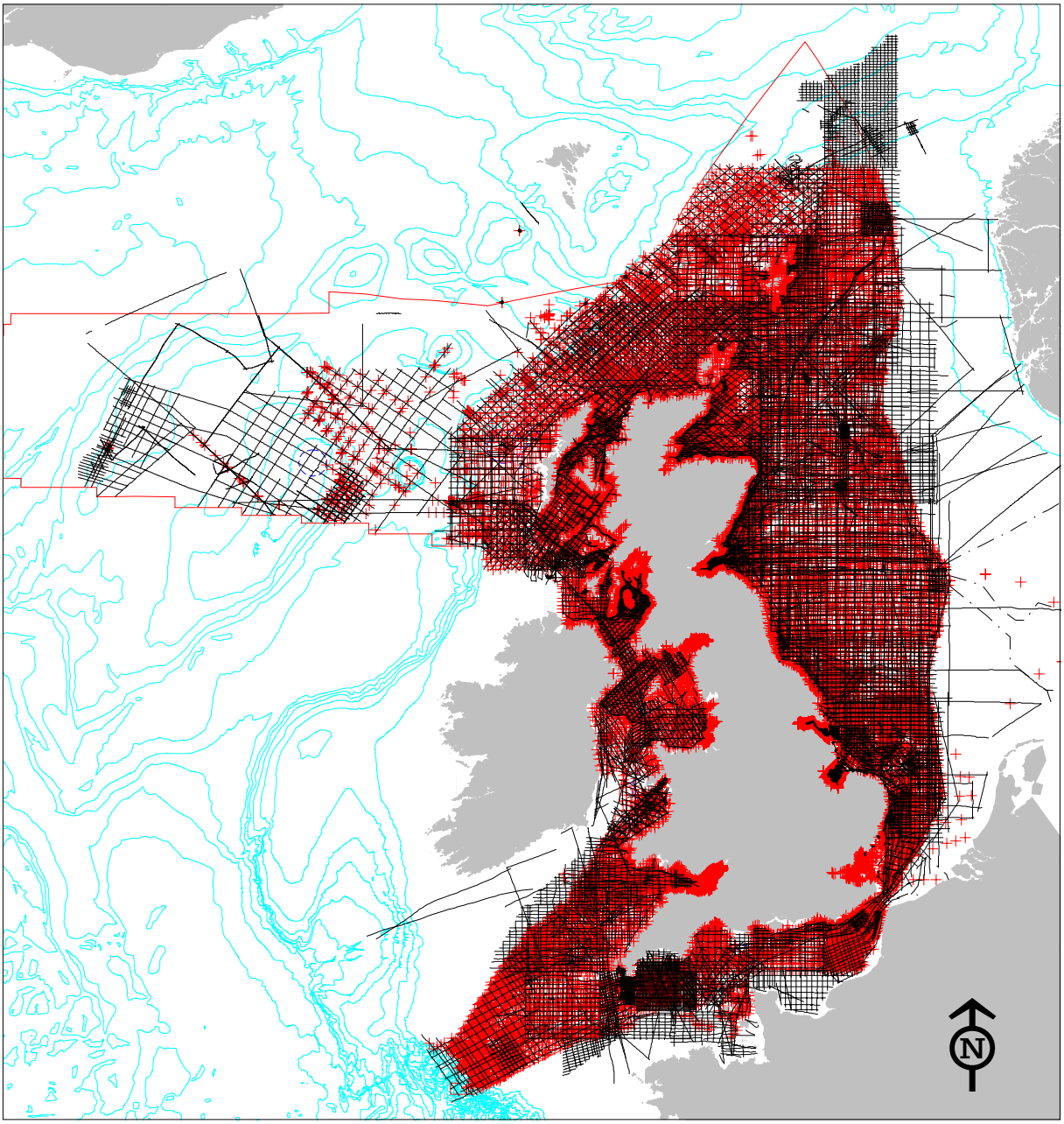


SEDIMENT SIZE				
phi value	milli-metres	SIZE CLASS		
		WENTWORTH		FOLK
-8	256	Boulder		Gravel
-6	64	Cobble		
-2	4	Pebble		
-1	2	Granule		
-0.5	1.41	Very coarse	Sand	Sand
0	1			
0.5	0.71	Coarse		
1	0.5			
1.5	0.35	Medium		
2	0.25			
2.5	0.17	Fine		
3	0.125			
3.5	0.088	Very fine		
4	0.0625			
8	0.0039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

Figure 2.1 Sediment size classification and the relationship between Wentworth and Folk classification systems (Pantin 1991)

Figure 2.2 BGS survey (seabed sampling and seismic) coverage around the UK

Scale 1:11000000



Seismic tracks
BGS seabed samples
Land
UK Continental Shelf Designated Areas
Median line
Bathymetric contour >200m

Figure 2.3 Sandy sediment in less than 20 m water depth in UK offshore waters

Scale 1:3500000

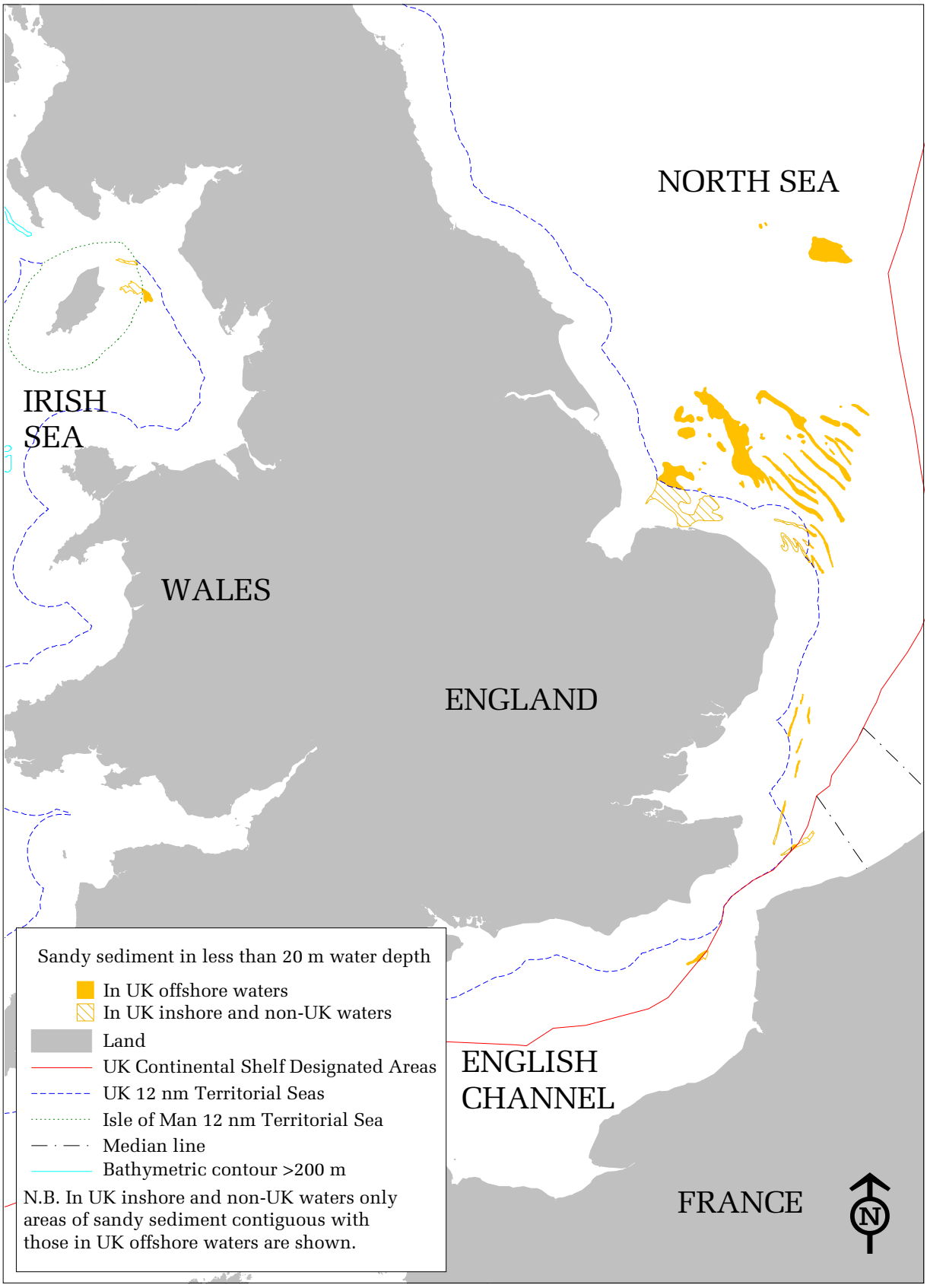


Figure 2.4 Sandy sediment in less than 20 m water depth in UK offshore waters off the Norfolk coast

Scale 1:1500000

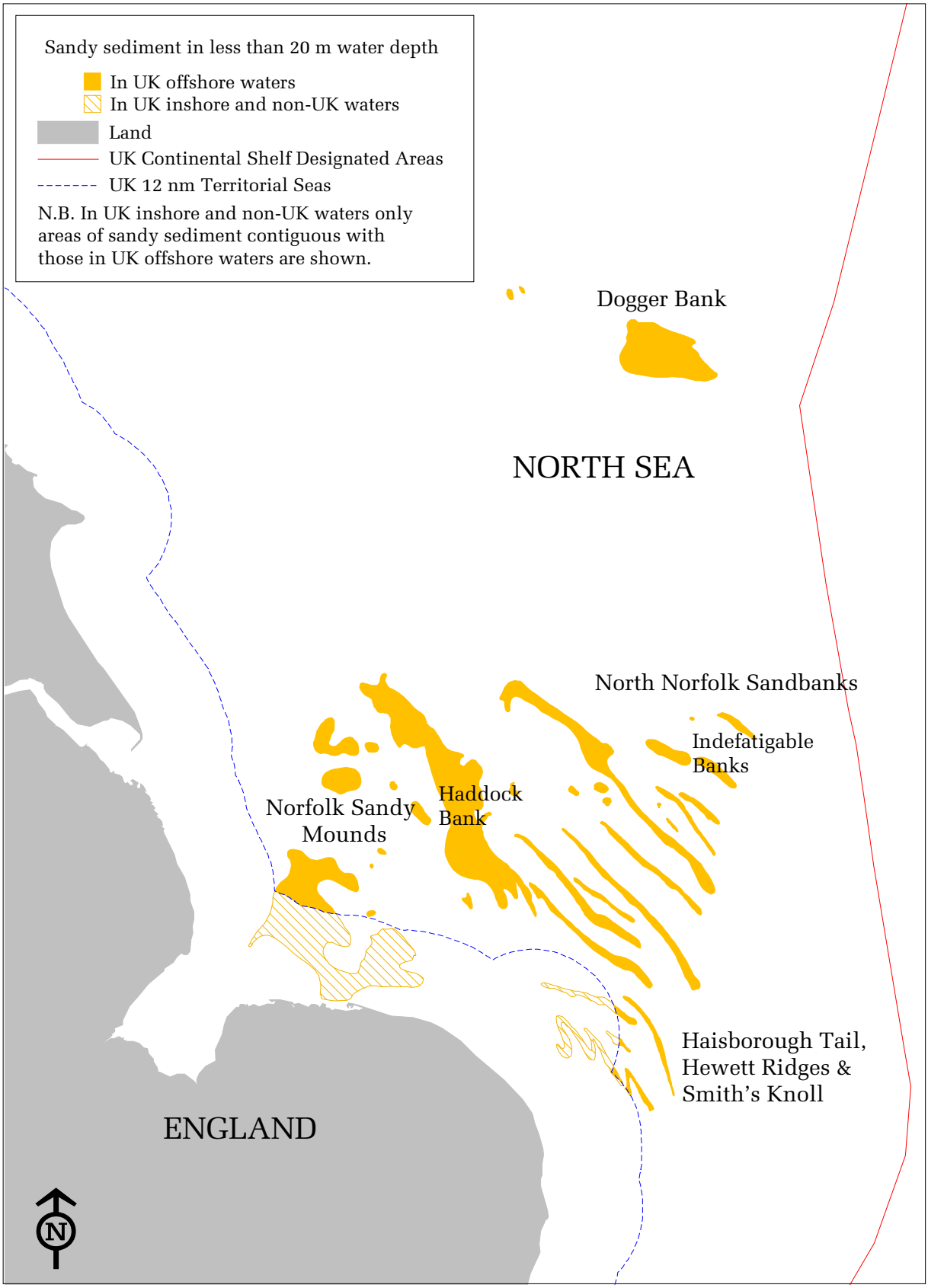
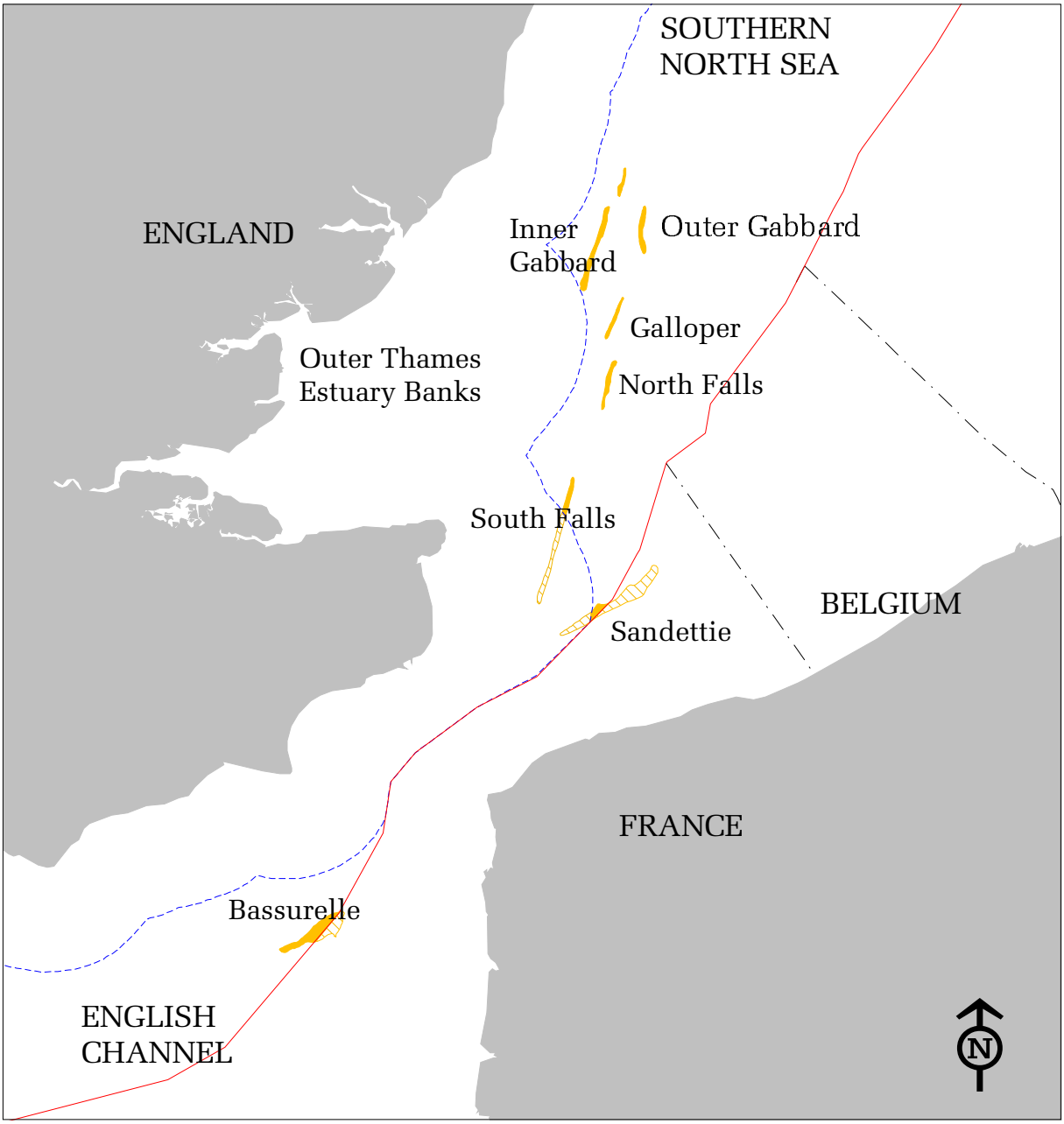


Figure 2.5 Sandy sediment in less than 20 m water depth in the outer Thames Estuary and eastern English Channel

Scale 1:1400000



Sandy sediment in less than 20 m water depth

- In UK offshore waters
- In UK inshore and non-UK waters

Land

UK Continental Shelf Designated Areas

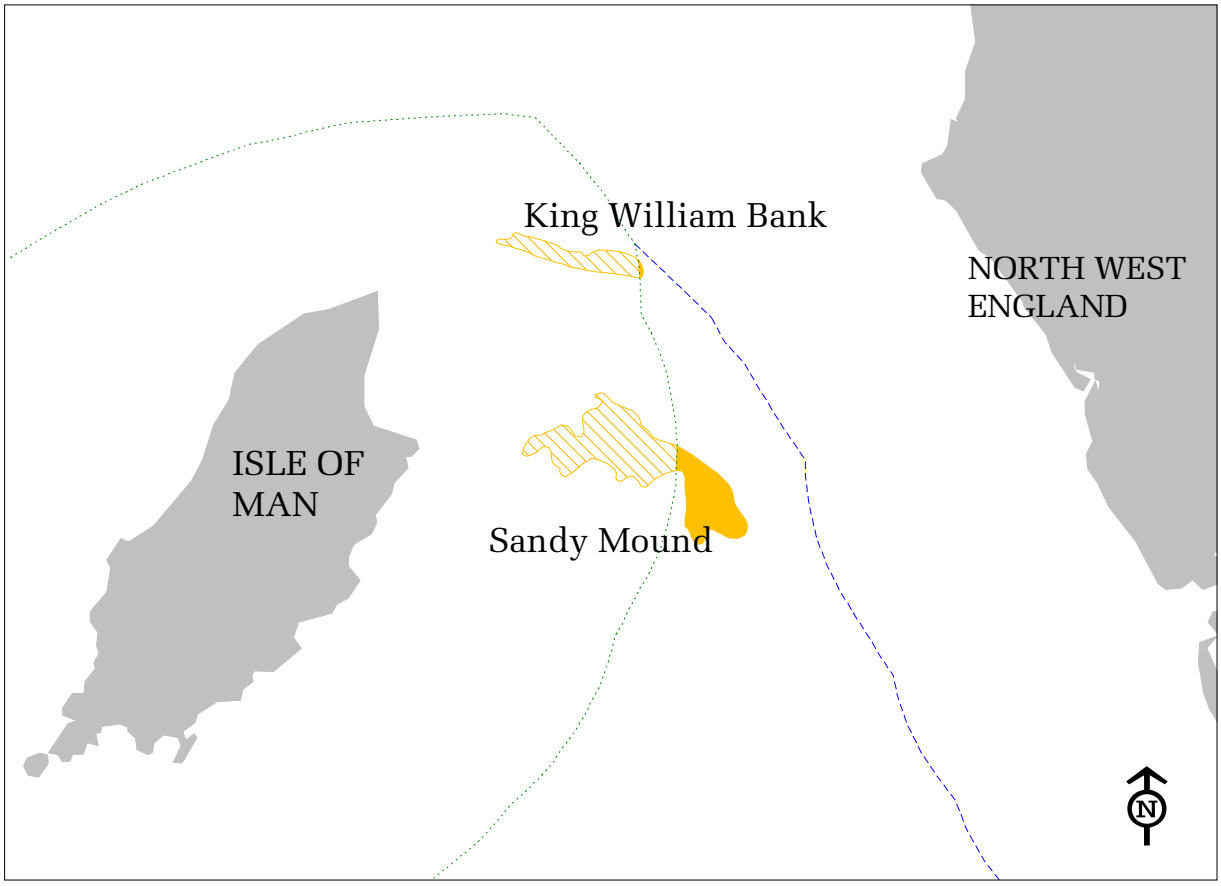
UK 12 nm Territorial Seas

Median line

N.B. In UK inshore and non-UK waters only areas of sandy sediment contiguous with those in UK offshore waters are shown.

Figure 2.6 Sandy sediment in less than 20 m water depth in UK offshore waters north-east of the Isle of Man

Scale 1:650000



Sandy sediment in less than 20 m water depth
- In UK offshore waters
- In UK inshore and non-UK waters

Land

UK Continental Shelf Designated Areas
UK 12 nm Territorial Seas
Isle of Man 12 nm Territorial Sea

N.B. In UK inshore and non-UK waters only areas of sandy sediment contiguous with those in UK offshore waters are shown.

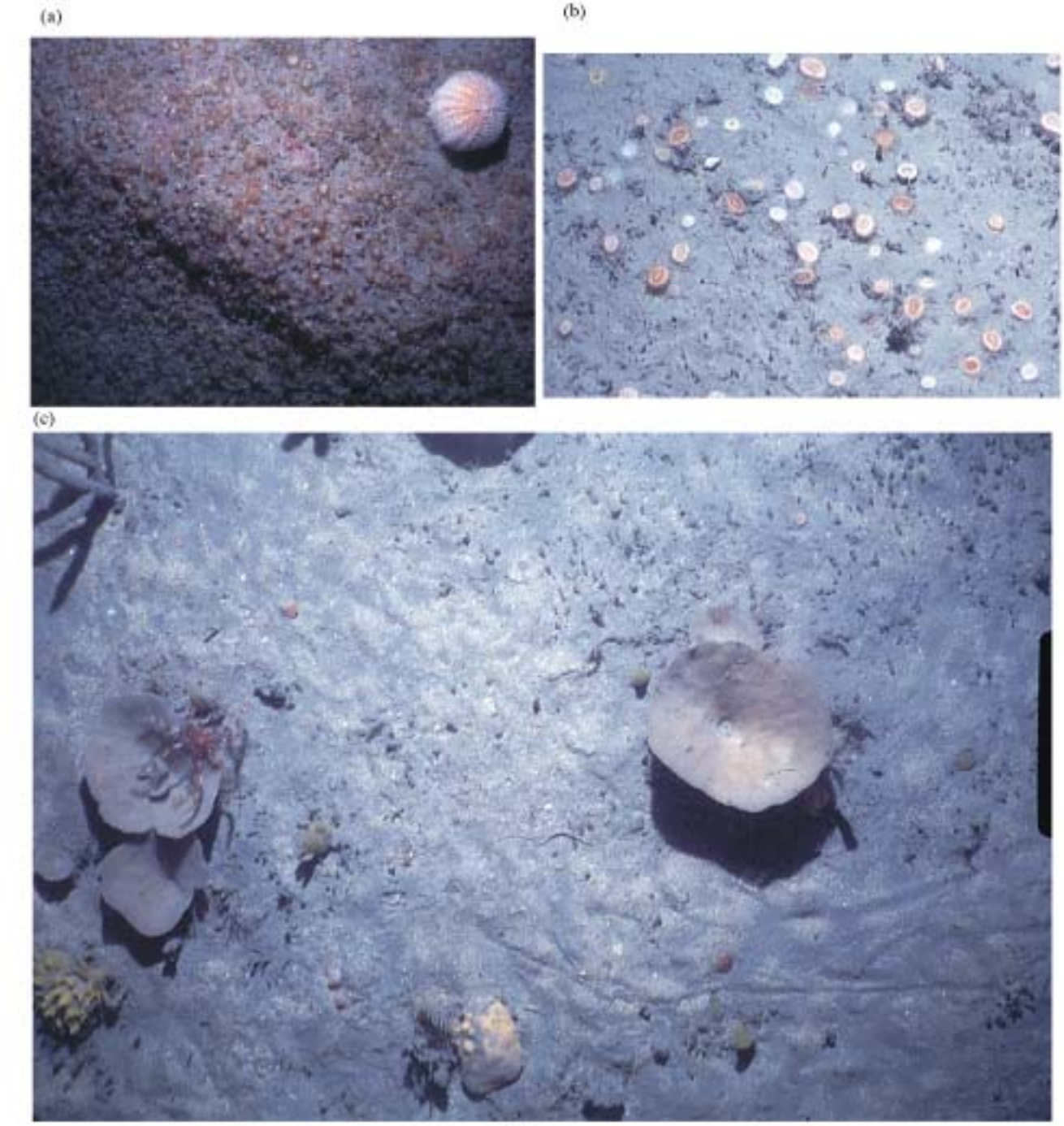


Plate 2.1 Possible Annex I reef habitat from south-western UK offshore waters at Haig Fras (photos: Ivor Rees, Dept. of Ocean Sciences, University of Wales, Bangor). (a) Biotope dominated by jewel anemone (*Corynactis viridis*) (b) Biotope dominated by Devonshire cup coral (*Caryophyllia smithii*) (c) Biotope characterised by cup sponges and erect branching sponges.

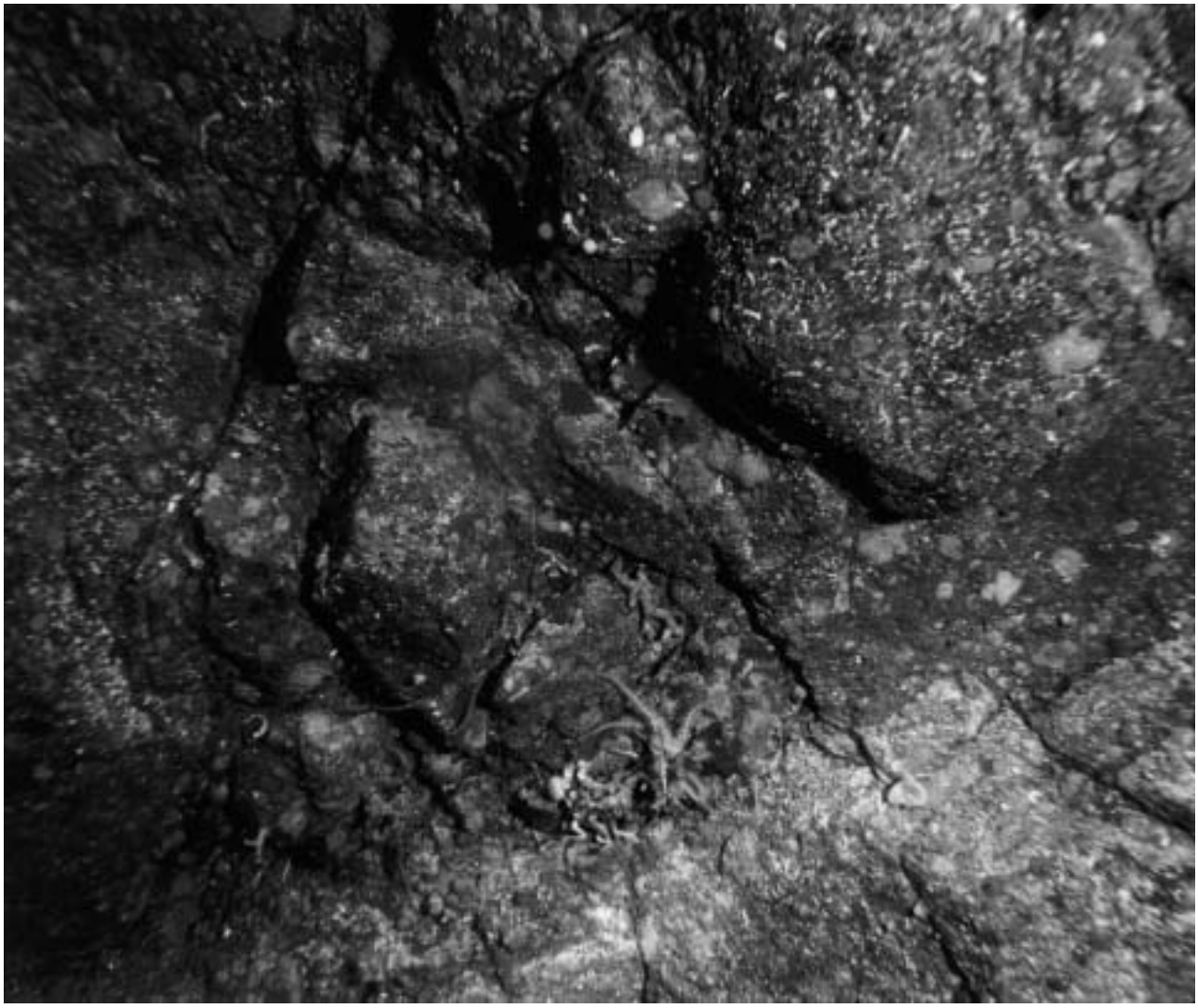


Plate 2.2 Possible Annex I bedrock reef habitat at approximately 130 m depth in north western UK offshore waters at Stanton Banks (Photo: British Geological Survey).

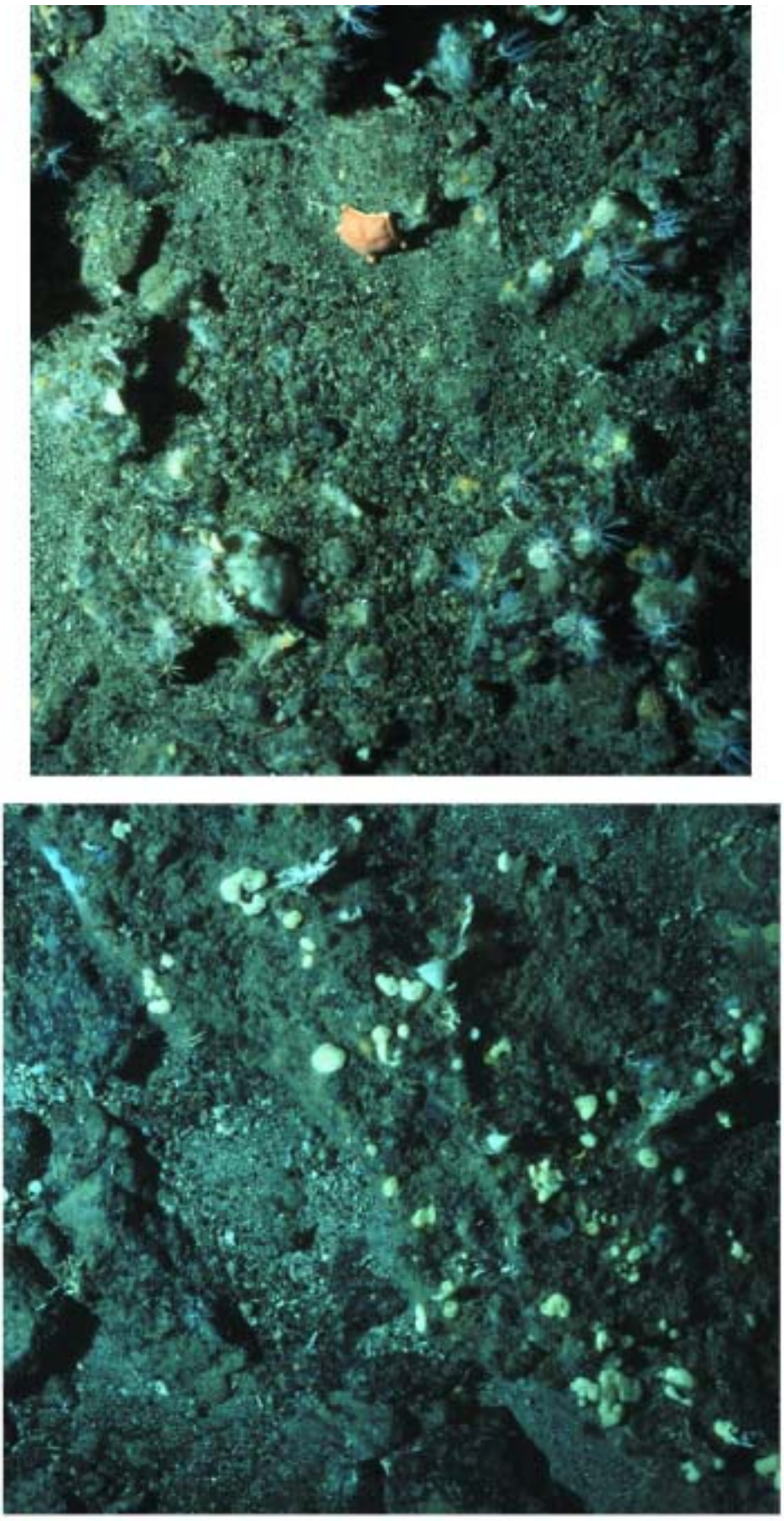
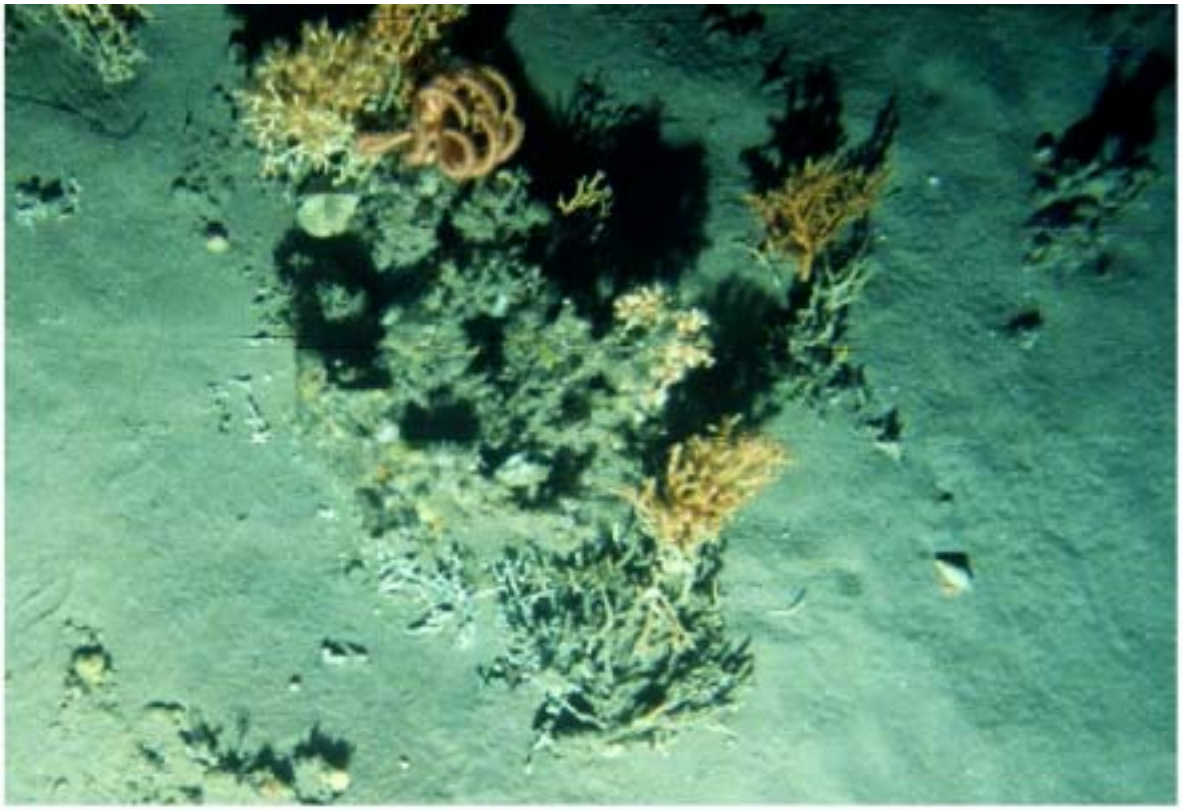


Plate 2.3 Possible iceberg ploughmark Annex I reef habitat at Wyville-Thomson Ridge (Photos: Brian Bett, Southampton Oceanography Centre).



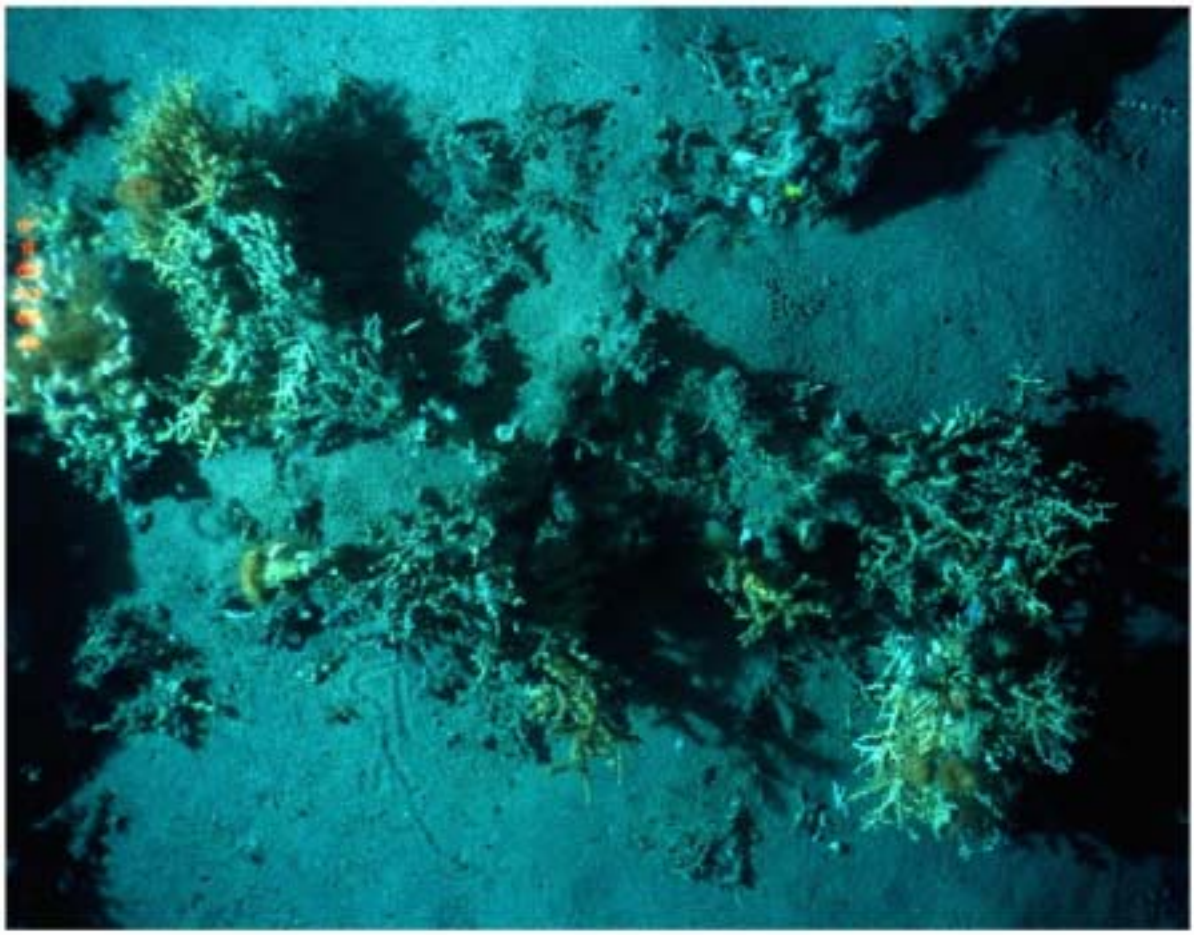
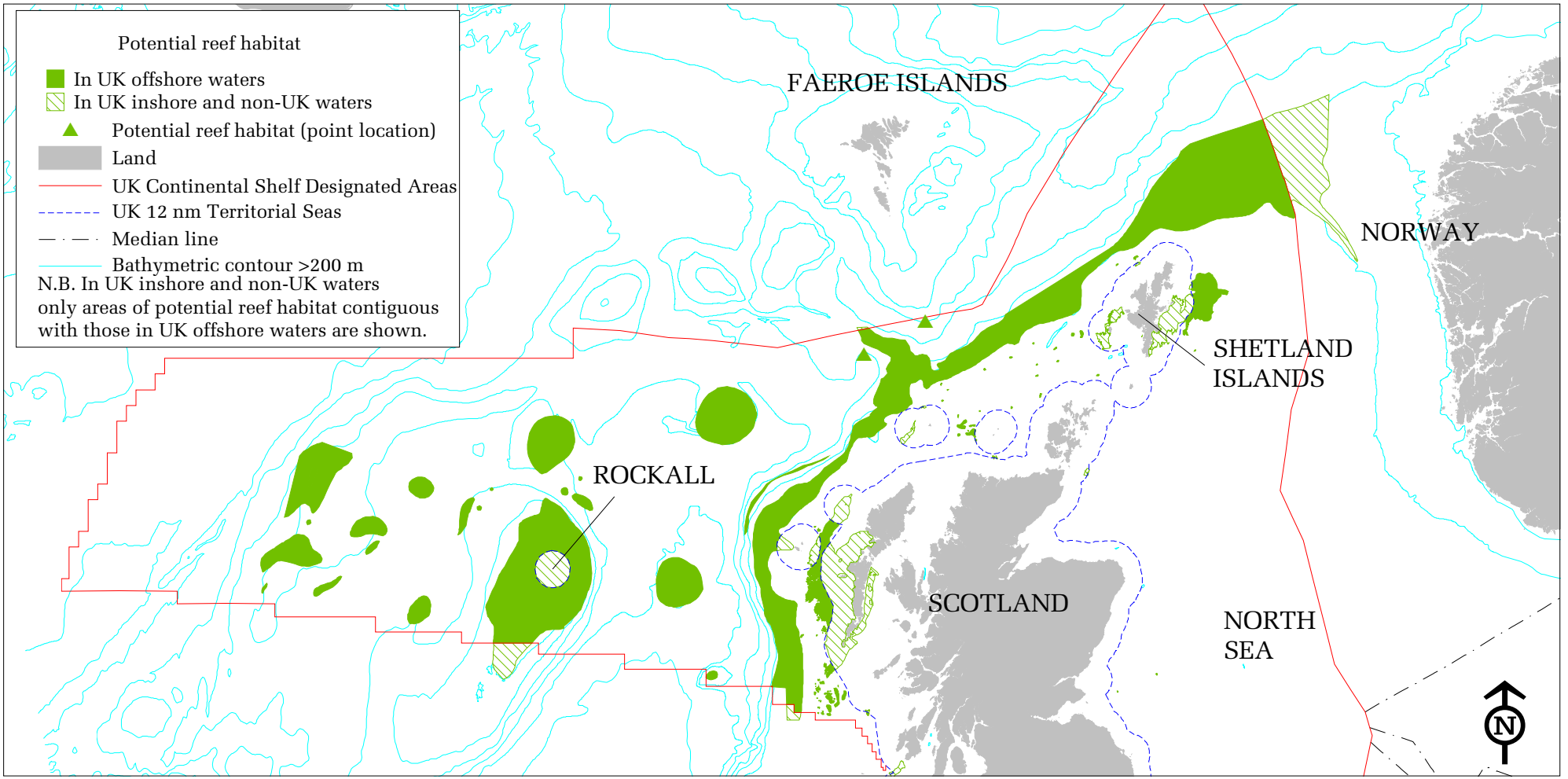


Plate 2.4 Possible cold water coral (*Lophelia pertusa*) Annex I reef habitat at Darwin Mounds (Photos: Brian Bett, Southampton Oceanography Centre).

Figure 2.7 Potential Annex I reef habitat in UK offshore waters (northern section)

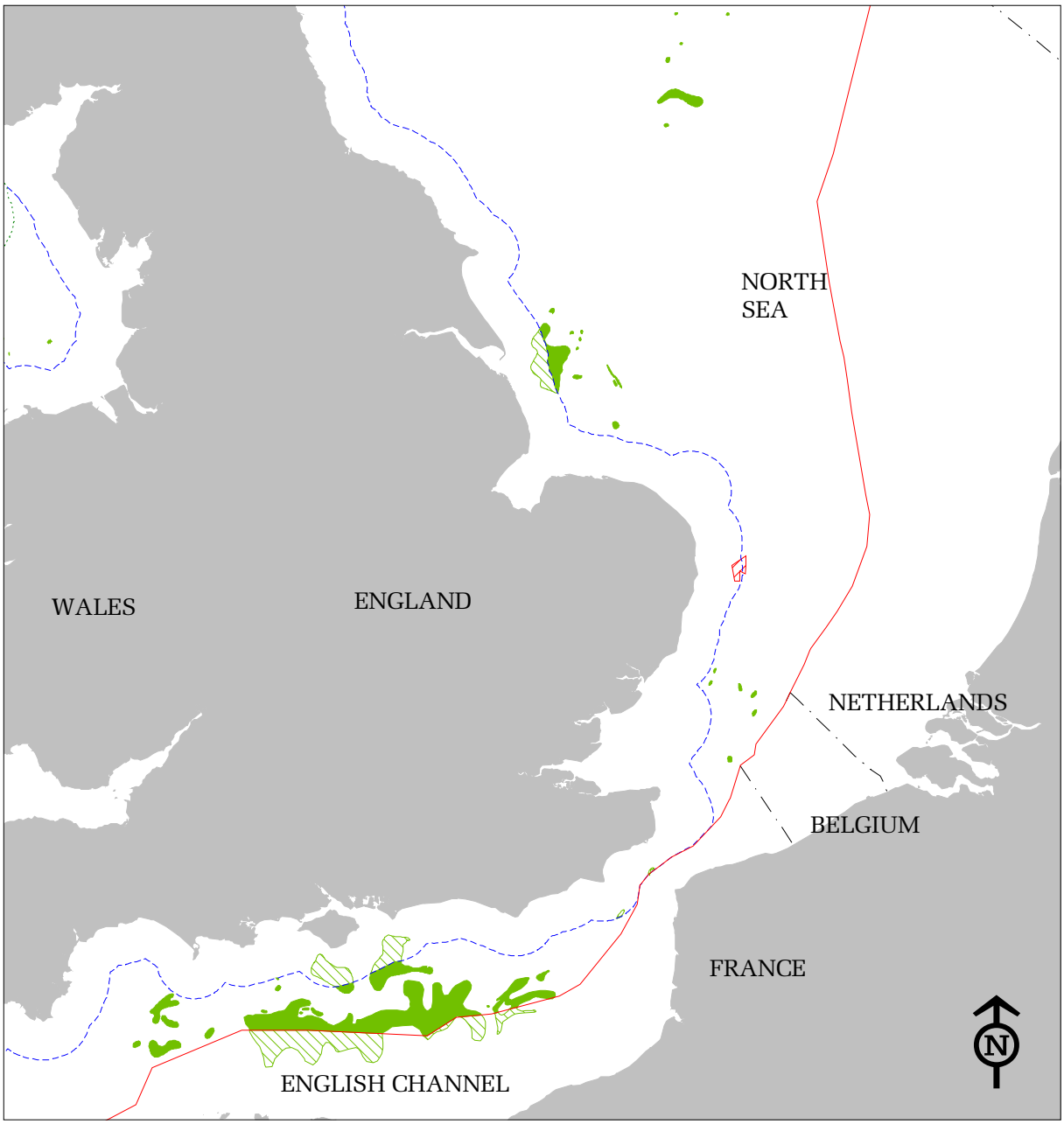
Scale 1:7000000



Seabed habitat derived from BGS 1:250,000 seabed sediment maps © NERC (Licence No. 2002/85).
World Vector Shoreline © US Defense Mapping Agency. Bathymetry © GEBCO Digital Atlas, British Oceanographic Data Centre on behalf of IOC and IHO 1994 & 1997.
The exact limits of the UK Continental Shelf are set out in orders made under section 1(7) of the Continental Shelf Act 1964 (© Crown Copyright).

Figure 2.8 Potential Annex I reef habitat in UK offshore waters (south-east section)

Scale 1:3750000



Potential reef habitat

- In UK offshore waters
- In UK inshore and non-UK waters
- Region which may contain Sabellaria spinulosa reef
- Land

- UK Continental Shelf Designated Areas
- UK 12 nm Territorial Seas
- Median line
- Bathymetric contour >200 m

N.B. In UK inshore and non-UK waters only areas of potential reef habitat contiguous with those in UK offshore waters are shown.

Figure 2.9 Potential reef habitat in UK offshore waters (south-west section)

Scale 1:3500000

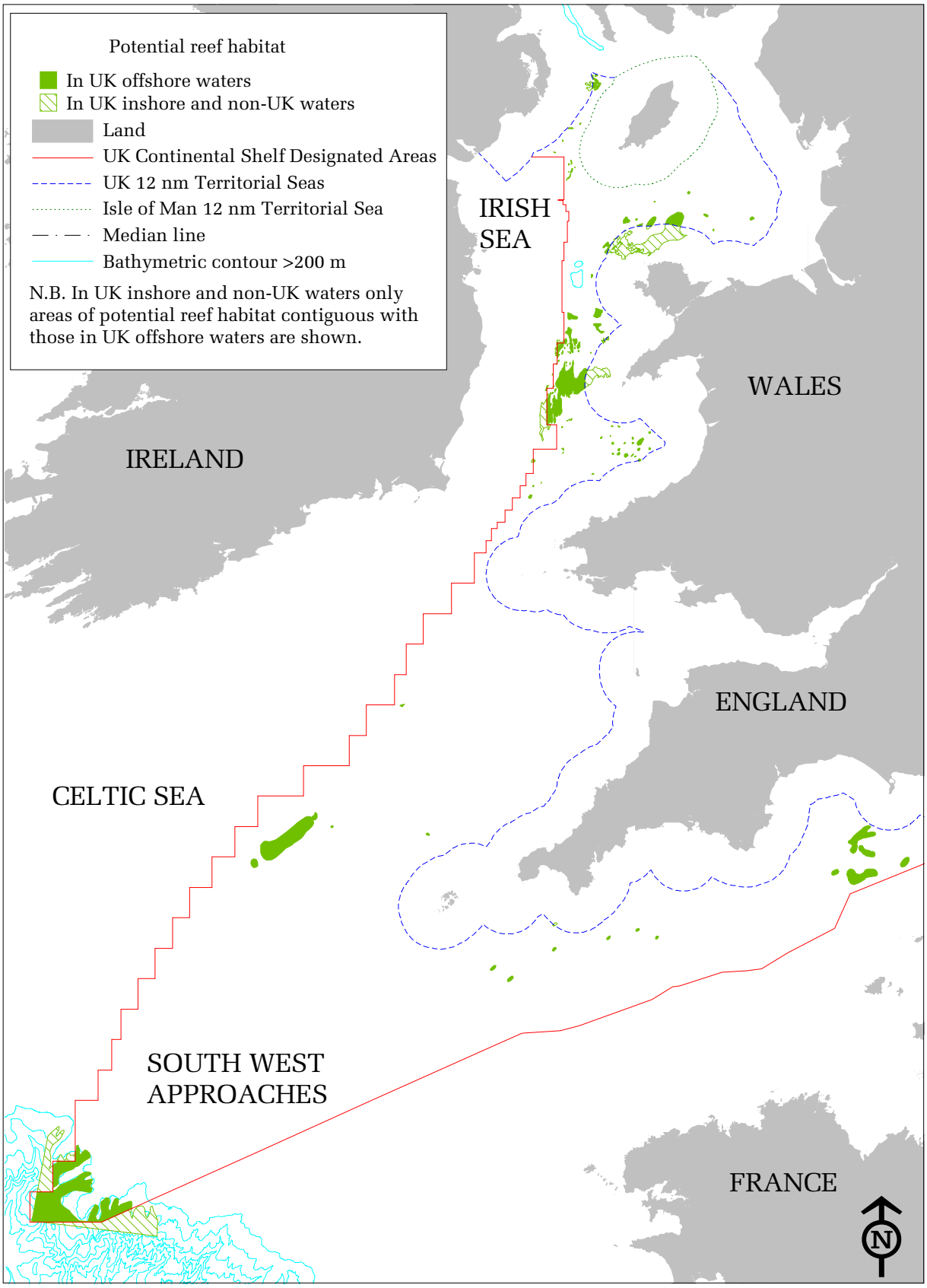
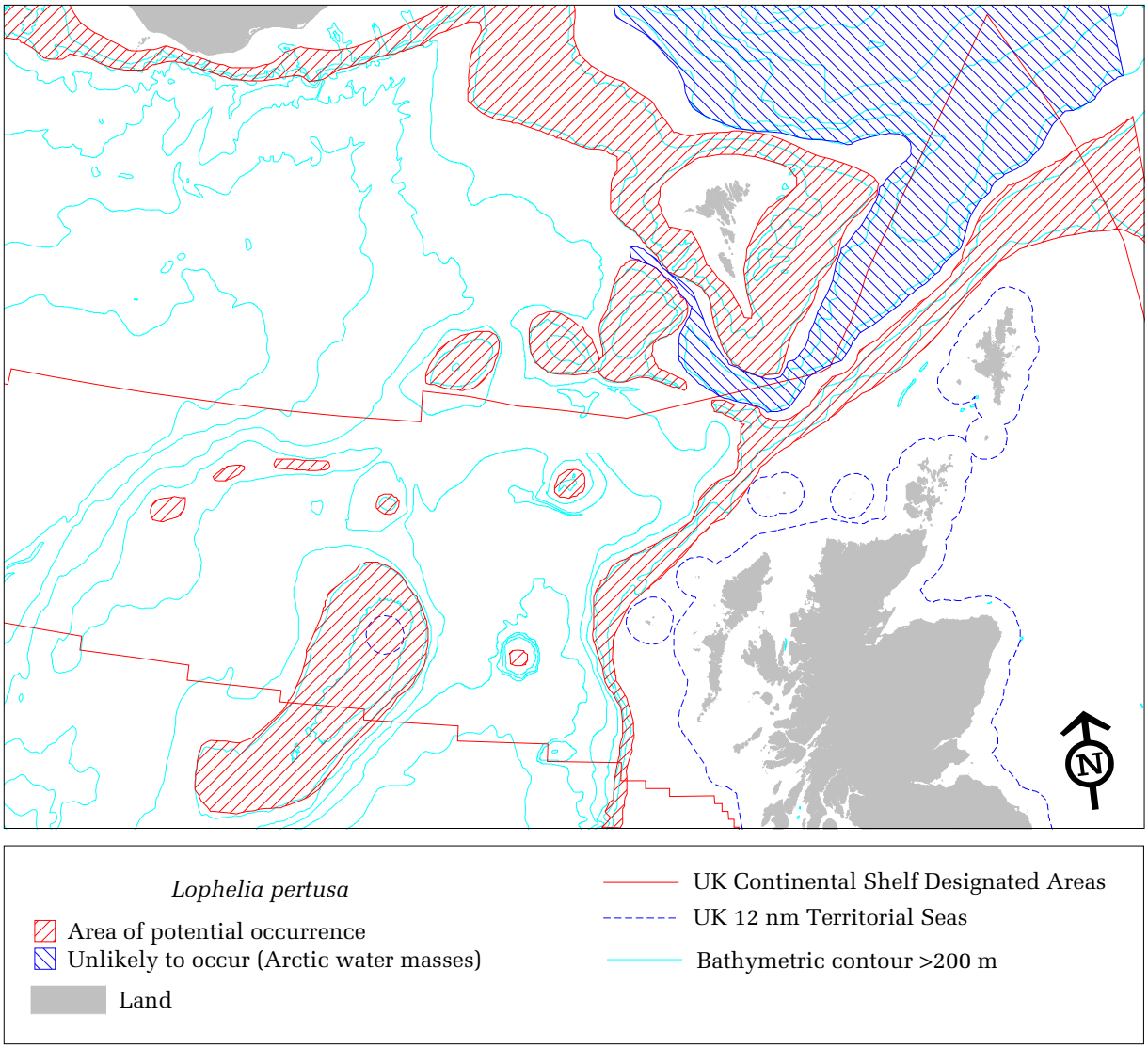


Figure 2.10 Potential distribution of Lophelia pertusa in the north-east Atlantic (courtesy of Brian Bett, Southampton Oceanography Centre)

Scale 1:8250000



Lophelia pertusa

Area of potential occurrence

Unlikely to occur (Arctic water masses)

Land

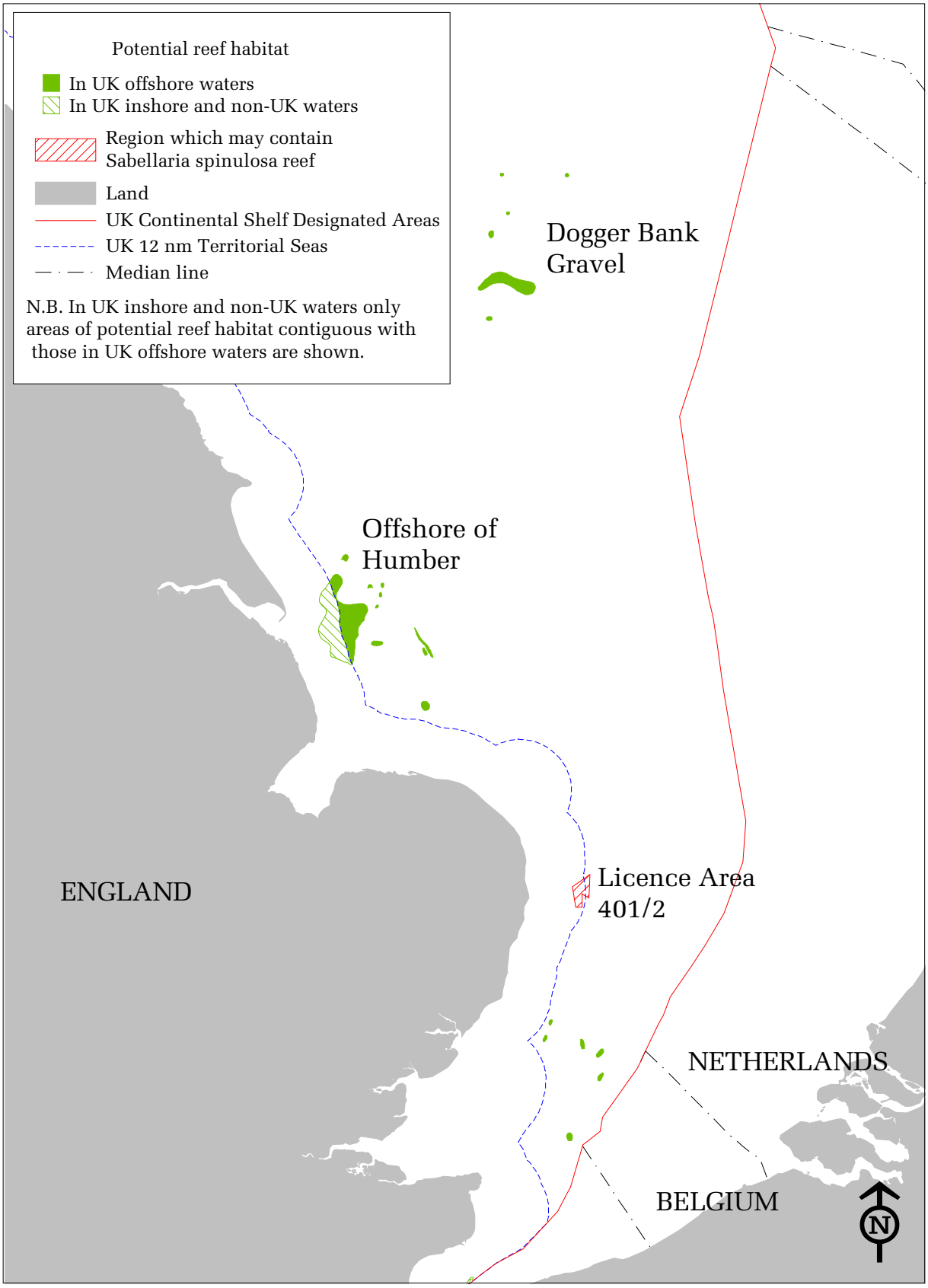
UK Continental Shelf Designated Areas

UK 12 nm Territorial Seas

Bathymetric contour >200 m

Figure 2.11 Potential Annex I reef habitat in UK offshore waters of the North Sea

Scale 1:2500000



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Bathymetry © GEBCO Digital Atlas, British Oceanographic Data Centre on behalf of IOC and IHO 1994 & 1997.
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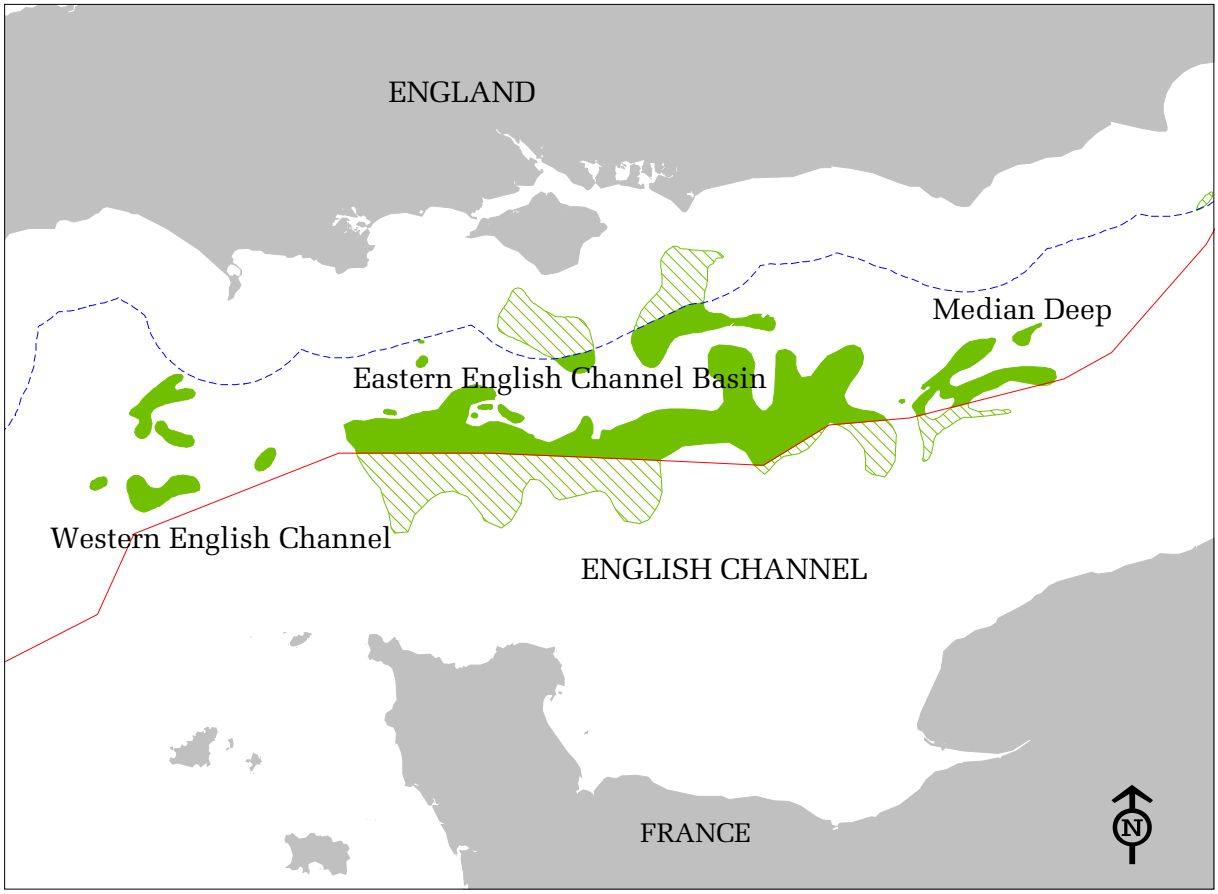
Figure 2.12 Potential Annex I reef habitat in UK offshore waters in the English Channel

Scale 1:2000000



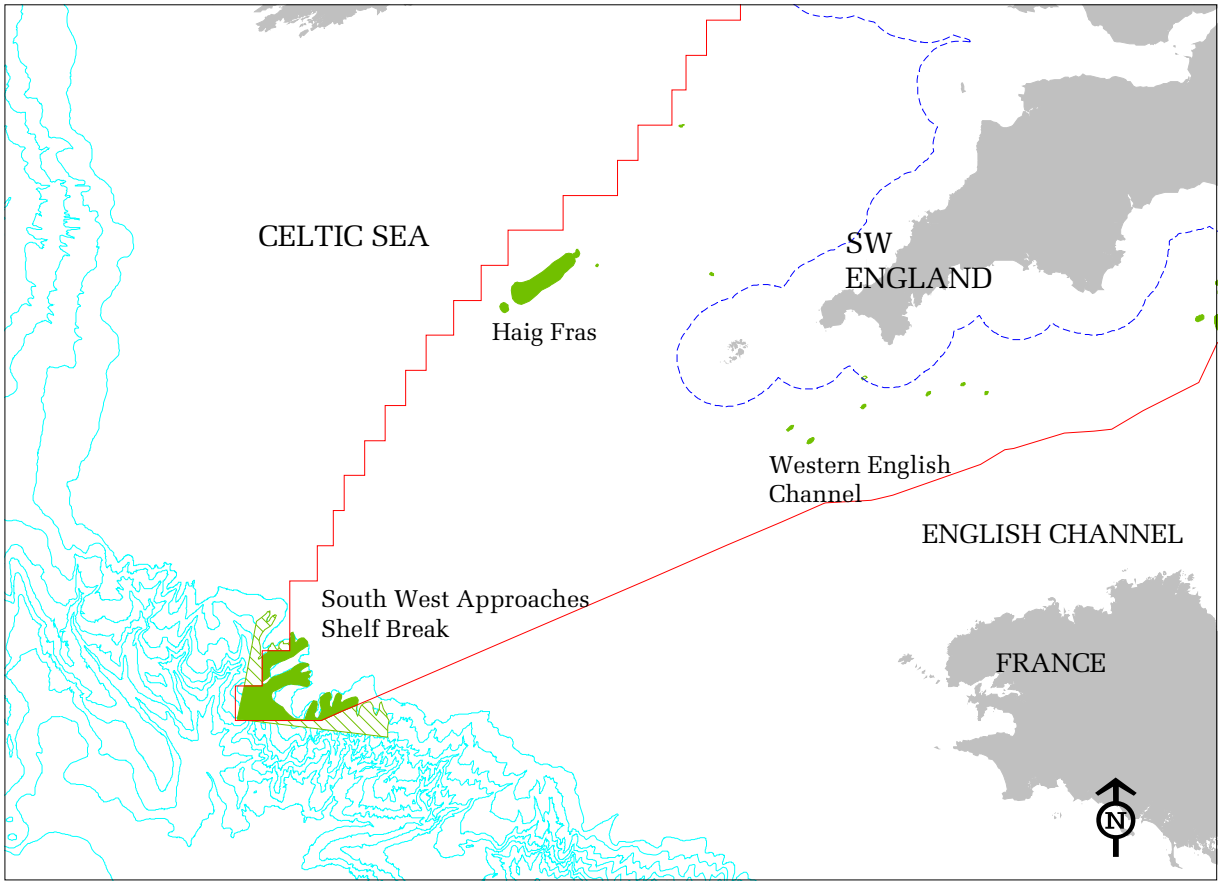
Potential reef habitat
In UK offshore waters
In UK inshore and non-UK waters
Land

UK Continental Shelf Designated Areas
UK 12 nm Territorial Seas

N.B. In UK inshore and non-UK waters only areas of potential reef habitat contiguous with those in UK offshore waters are shown.

Figure 2.13 Potential Annex I reef habitat in UK offshore waters in the Celtic Sea and South-west Approaches

Scale 1:4000000



Potential reef habitat

In UK offshore waters

In UK inshore and non-UK waters

Land

UK Continental Shelf Designated Areas

UK 12 nm Territorial Seas

Bathymetric contour >200 m

N.B. In UK inshore and non-UK waters only areas of potential reef habitat contiguous with those in UK offshore waters are shown.

Figure 2.14 Potential Annex I reef habitat in UK offshore waters in the Irish Sea

Scale 1:1500000

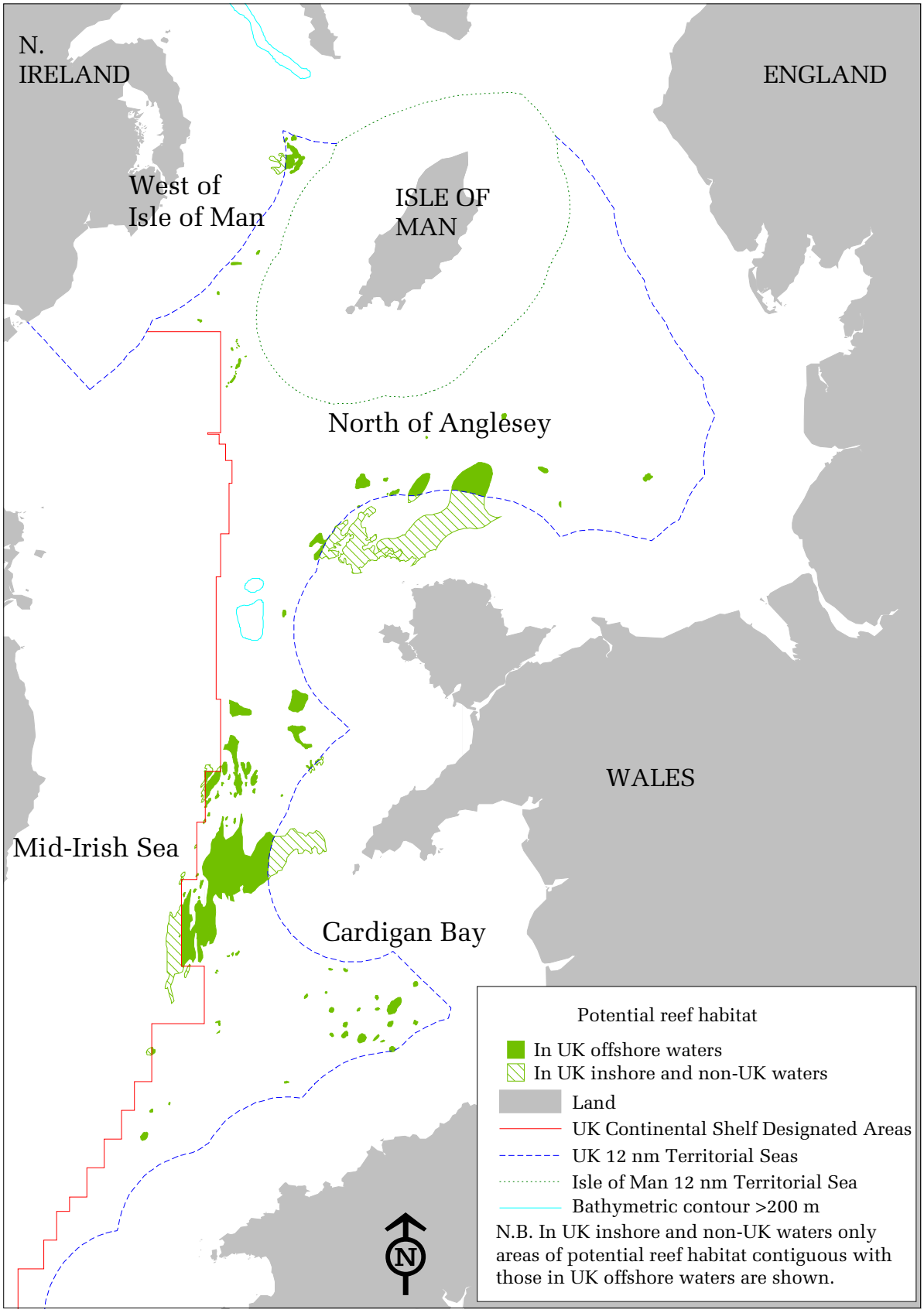
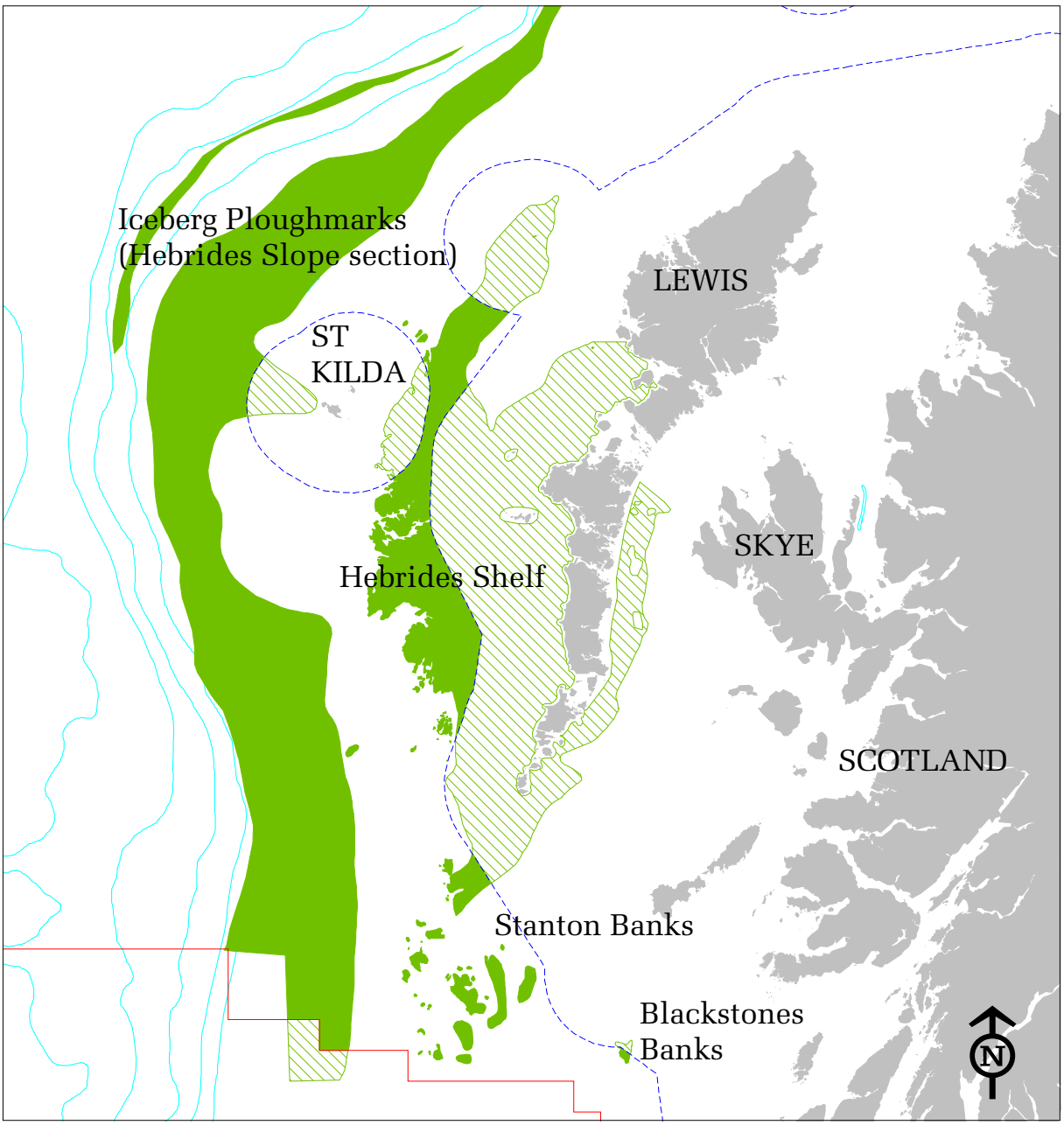


Figure 2.15 Potential Annex I reef habitat in UK offshore waters west of Scotland

Scale 1:2000000



Potential reef habitat

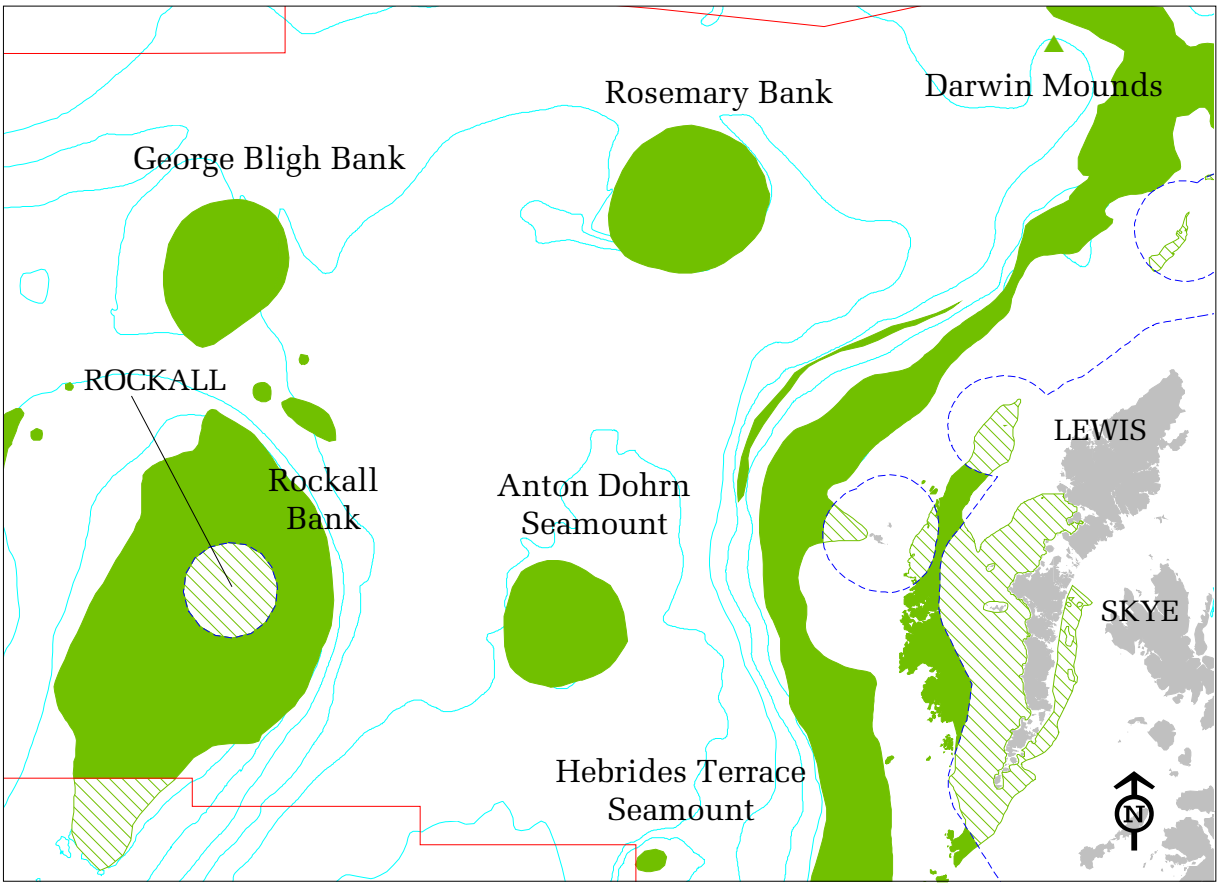
- In UK offshore waters
- In UK inshore and non-UK waters
- Land

- UK Continental Shelf Designated Areas
- UK 12 nm Territorial Seas
- Bathymetric contour >200 m

N.B. In UK inshore and non-UK waters only areas of potential reef habitat contiguous with those in UK offshore waters are shown.

Figure 2.16 Potential Annex I reef habitat in UK offshore waters in the Rockall Trough and Rockall Bank region

Scale 1:3500000



Potential reef habitat
- In UK offshore waters
- In UK inshore and non-UK waters
- Potential reef habitat (point location)

Land
- UK Continental Shelf Designated Areas
- UK 12 nm Territorial Seas
- Bathymetric contour >200 m

N.B. In UK inshore and non-UK waters only areas of potential reef habitat contiguous with those in UK offshore waters are shown.

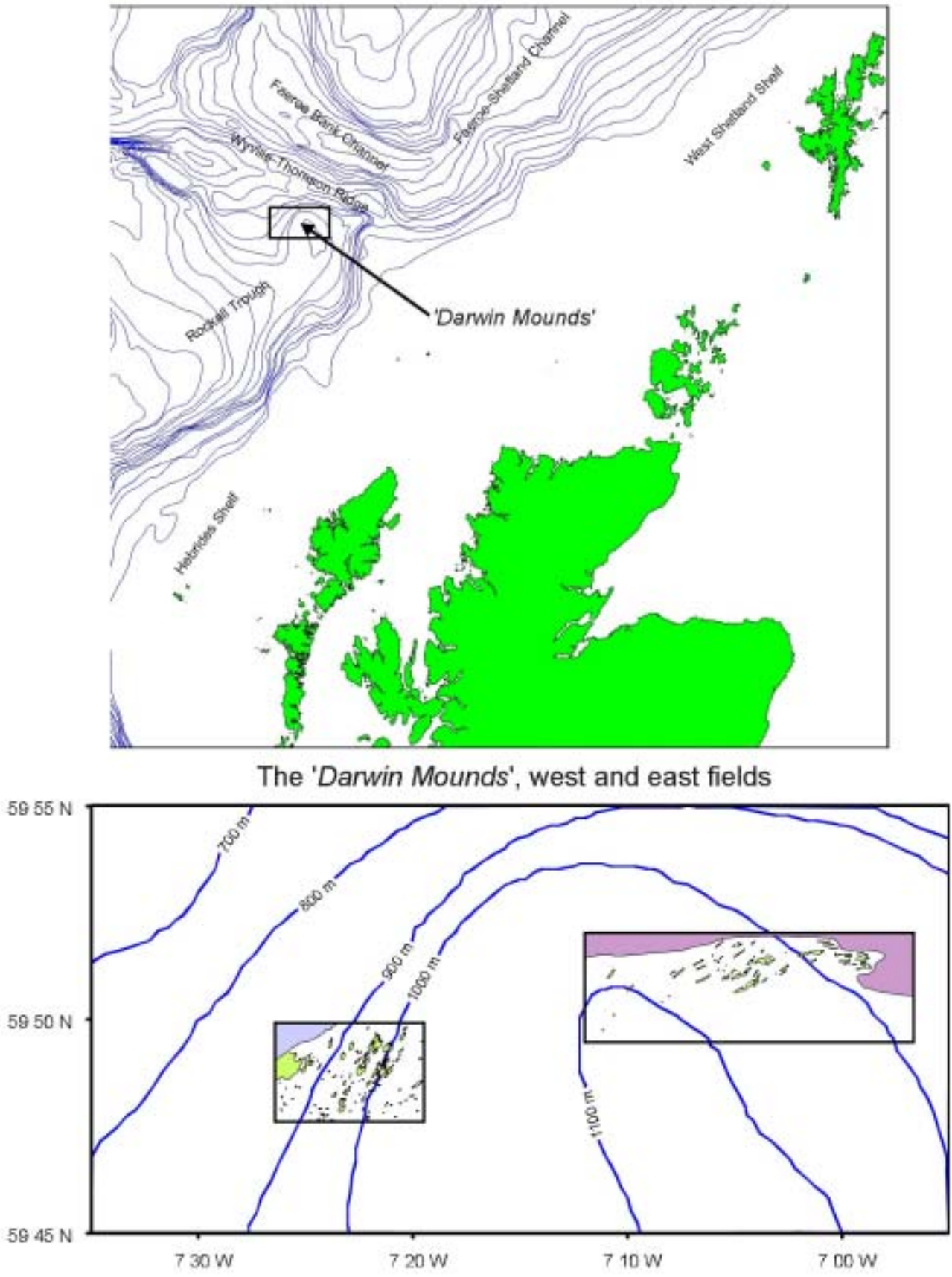
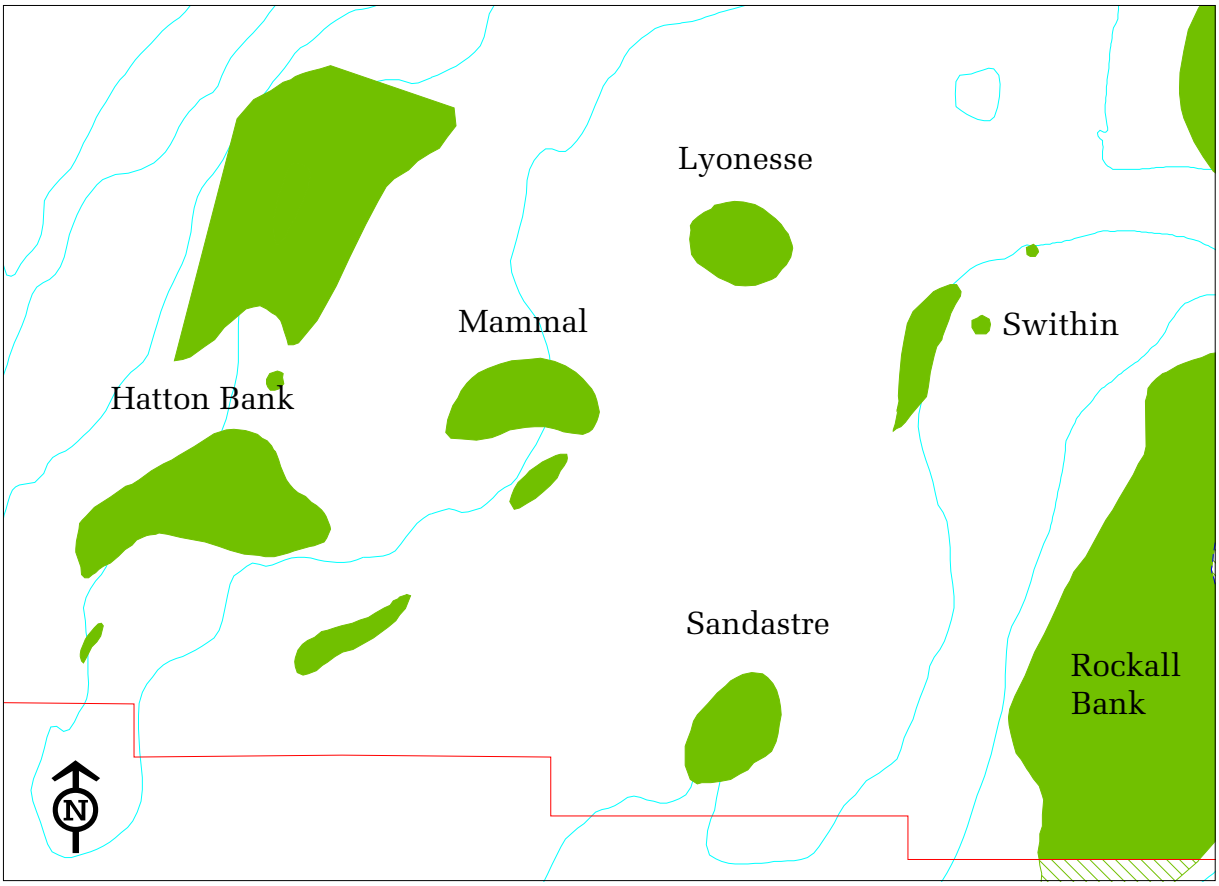


Figure 2.17 The location of the Darwin Mounds (courtesy of Brian Bett, SOC).

Figure 2.18 Potential Annex I reef habitat in UK offshore waters west of Rockall

Scale 1:2250000



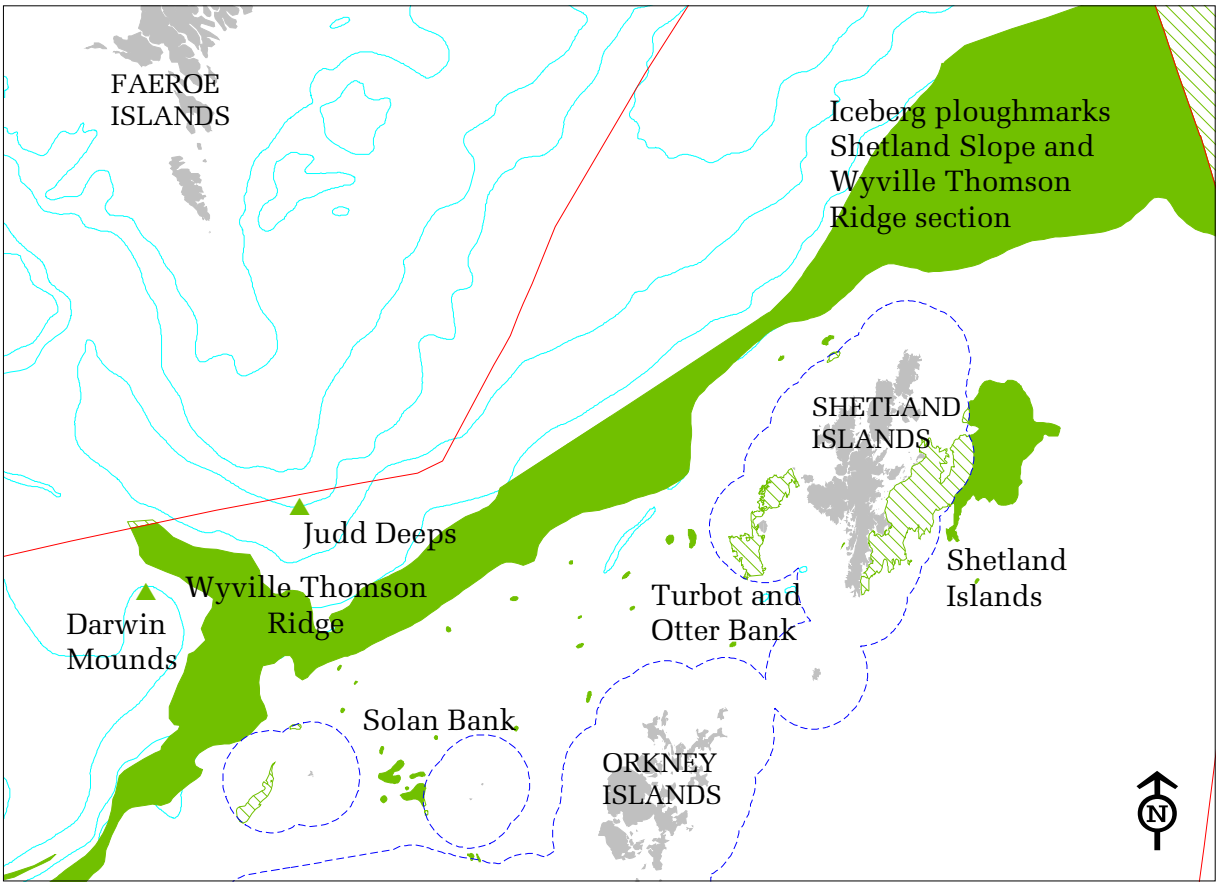
Potential reef habitat
- In UK offshore waters
- In UK inshore and non-UK waters

- UK Continental Shelf Designated Areas
- UK 12 nm Territorial Seas
- Bathymetric contour >200 m

N.B. In UK inshore and non-UK waters only areas of potential reef habitat contiguous with those in UK offshore waters are shown.

Figure 2.19 Potential Annex I reef habitat in UK offshore waters north of Scotland

Scale 1:3450000



Potential reef habitat

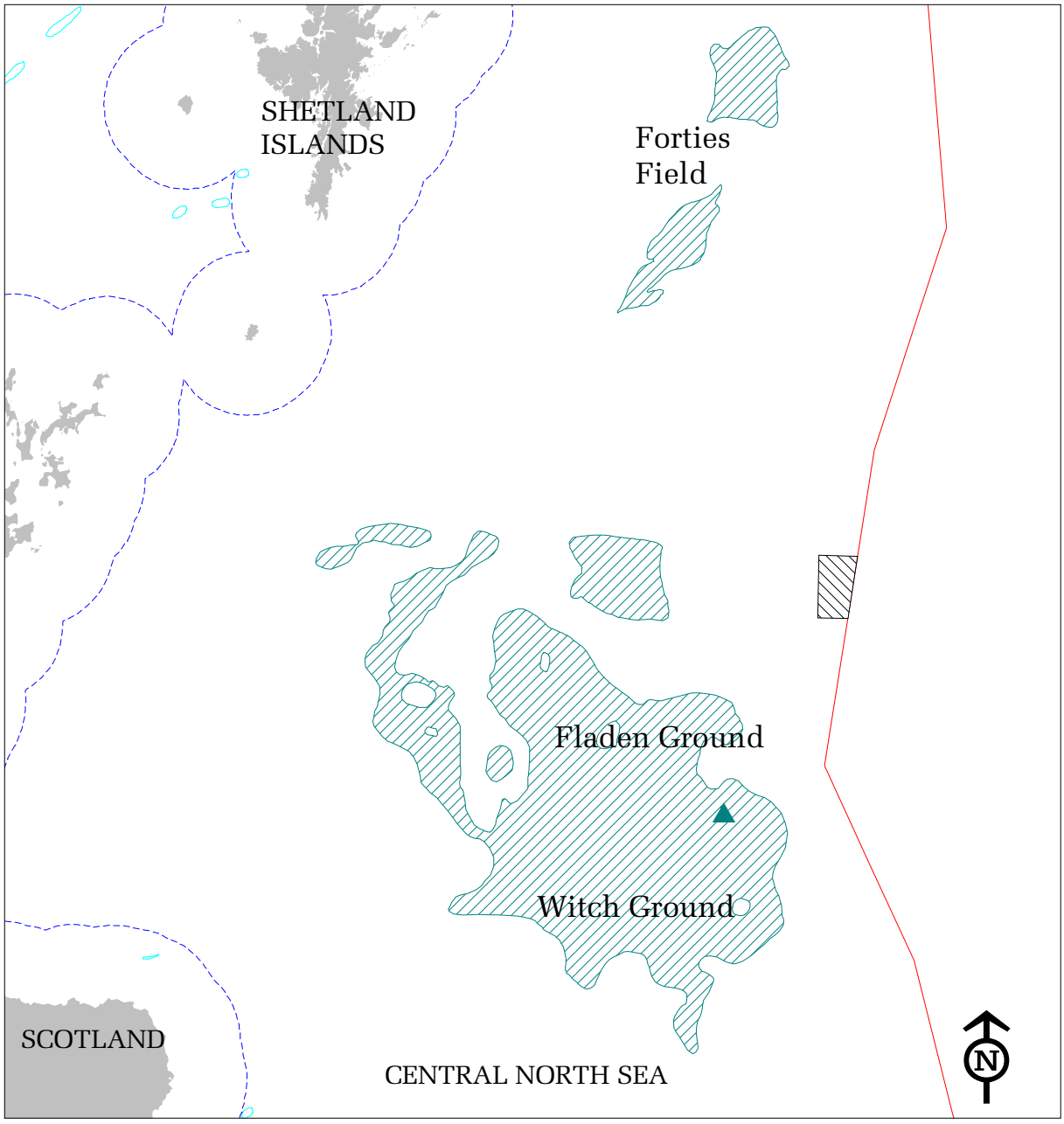
- In UK offshore waters
- In UK inshore and non-UK waters
- Potential reef habitat (point location)

- UK Continental Shelf Designated Areas
- UK 12 nm Territorial Seas
- Bathymetric contour >200 m
- Land

N.B. In UK inshore and non-UK waters only areas of potential reef habitat contiguous with those in UK offshore waters are shown.

Figure 2.20 Pockmark fields and other areas within which submarine structures made by leaking gases Annex I habitat may occur

Scale 1:2000000



3. Habitats Directive Annex II Species

3.1. Species for which SACs will be considered

Annex II of the Council Directive 92/43/EEC (as amended by Directive 97/62/EC) on the conservation of natural habitats and of wild fauna and flora lists those species of Community Interest whose conservation requires the designation of Special Areas of Conservation (SACs).

Annex II species occurring in the marine environment of the UK are listed in Table 3.1.

Table 3.1 Species listed on Annex II of Council Directive 92/43/EEC and known to occur in offshore waters of the UK.

Name	*Scientific name*	*Notes*	*Existing SAC(s) in UK?*
Grey seal	*Halichoerus grypus*		✓
Common seal	*Phoca vitulina*		✓
Bottlenose dolphin	*Tursiops truncatus*		✓
Harbour porpoise	*Phocoena phocoena*		
Loggerhead turtle	*Caretta caretta*	R	
Otter	*Lutra lutra*	I	✓
Lampern	*Lampetra fluviatilis*	I	✓
Lamprey	*Petromyzon marinus*	R	✓
Sturgeon	*Acipenser sturio*	R	
Shad	*Alosa* spp.	R	✓

Note: R = rare in UK offshore waters, without regular places of occurrence
I = inshore distribution (not found in UK offshore waters)

Of these species, otter and river lamprey (or lampern) occur only in inshore and inland waters. Lamprey, sturgeon and shad are all rare in UK offshore waters and without regular places of occurrence. Loggerhead turtle is primarily a tropical and subtropical species which may wander into temperate waters. It is recorded infrequently in UK waters, mostly as cold-stunned juveniles washed ashore on west coasts during or after periods of stormy weather in winter and spring (Pierpoint 2000). No sites "essential to their life and reproduction" (see Section 3.2 below) are likely to be identifiable in UK offshore waters for any of the above species. Therefore only the first four species in Table 3.1 (two species of seal and two cetaceans) are being considered further for identification of possible SACs in UK offshore waters.

3.2. Site assessment criteria and additional principles used for site selection for Annex II species in the UK

Article 4 of the Habitats Directive, requiring sites (SACs) to be proposed for Annex II species, states that, "For aquatic species which range over wide areas, such sites will be proposed only where there is a clearly identifiable area representing the physical and biological factors essential to their life and reproduction".

As for Annex I habitats (Section 2.2), the Habitats Directive includes, in Annex III, criteria for selecting sites eligible for identification as Sites of Community Importance and designation as Special Areas for Conservation. As for Annex I habitats, in preparing the UK national list of candidate SACs (for terrestrial and inshore species), as well as the Annex III selection criteria, additional principles for site selection have been developed, which interpret and supplement the Annex III selection criteria. The selection criteria and additional principles relating to Annex II species are listed in Table 3.2 below.

Again, as for Annex I habitats, the process of applying the selection criteria and additional principles to terrestrial and inshore sites in the UK is described in JNCC Report 270 (Brown *et al.* 1997), which is currently being updated (McLeod *et al.* in press).

Table 3.2 Summary of site assessment criteria and additional principles used for site selection in the UK (from McLeod *et al.* (in press)

Site assessment criteria (Annex II species)	***References***
Proportion of UK population	Annex III Stage 1B(a); Article 1I; Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 7).
Conservation of features important for species' survival	Annex III Stage 1B(b); Article 1i.
Isolation of species populations	Annex III Stage 1B(c); Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 7).
Global assessment	Annex III Stage 1B(d).
Additional principles	
Priority/non-priority status	Annex III Stage 1D; Article 1d; Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 3).
Geographical range	Articles 1e and 3.1.
Special UK responsibilities	Article 3.2; Conclusions of 1994 Atlantic Biogeographical Region (para. 6).
Multiple interest	Annex III Stage 2.2(d); Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 2).
Rarity	Conclusions of 1994 Atlantic Biogeographical Region Meeting (para. 5).

This section outlines how these site assessment criteria and additional principles will be applied to species and their habitats in the UK offshore area. Relevant extracts of text from the Directive and Annexes, and from the Atlantic Biogeographical Meeting in Edinburgh in 1994 (Hopkins & Buck 1995) are referred to in the following sections. The selection criteria and additional principles outlined above are unlikely to change, and there are currently no indications of imminent changes to the list of species in Annex II to the Directive. The scientific information on the Annex II species which occur in the UK offshore area in the following sections of this paper, however, is based on currently available knowledge, which in the offshore environment is scarce and continually developing. It is provided here only as an *indication* of the aspects of the relevant species and their habitats which are likely to be used to assist in site selection.

3.2.1. Application of Habitats Directive Annex III Stage 1B criteria

3.2.1.1. Proportion of UK population

Habitats Directive Annex III Stage 1B (a): "Size and density of the population of the species present on the site in relation to the populations present within national territory."

Atlantic Biogeographical Region Meeting Conclusions, paragraph 6: "Where Annex II species populations are too small to be naturally viable, or where they occur only as vagrants or reintroduction, Member States may exclude them from consideration for site selection." (Hopkins & Buck 1995).

The Explanatory Notes to the Natura 2000 Standard Data Form (EC 1995) explain that this criterion exists to evaluate the relative size or density of the population in the site with that of the national UK population.

Defining boundaries for sites which support a given percentage of the UK population of any mobile species occurring in UK offshore waters will be extremely difficult. This is due to the lack of natural boundaries (such as coast, topographical boundaries, etc.) in the open sea, the wide ranging behaviour of the species, and the mobile and wide ranging nature of the prey of the Annex II species concerned. In addition, as noted in EC (1995), the size of the national population is often difficult to evaluate, and again, this is likely to be more difficult for wide ranging species occurring in offshore waters than for many terrestrial or inshore species.

3.2.1.2. Conservation of features important for species survival

Habitats Directive Annex III Stage 1B (b): "Degree of conservation of the features of the habitat which are important for the species concerned and restoration possibilities."

The Explanatory Notes to the Natura 2000 Standard Data Form (EC 1995) explain that this criterion comprises two sub-criteria:

i. Degree of conservation of the features of the habitat important for the species - a global evaluation of the features of the habitat regarding the biological requirements of a given species;

ii. restoration possibilities - an evaluation of the viability of the population and potential for restoration; to be taken into account only when the elements are in an average or partially degraded condition.

To define sites using this criterion it is necessary to understand which habitat features are of importance for the species being considered. For wide ranging marine species, identifiable sites used for breeding and feeding are obviously important to that species' life and reproduction. There may also be identifiable sites used for other purposes which may be important for the species. However, whether any such site is "a clearly identifiable area representing the physical and biological factors essential to the life and reproduction" of the relevant species (Habitats Directive Article 4.1) will need to be determined.

If a site's features are seen to be in average or partially degraded condition then an evaluation of how possible it would be to restore the features to a well conserved condition needs to be made.

Grey seal (*Halichoerus grypus*), common seal (*Phoca vitulina*)

Common and grey seals are restricted to breeding on land, and do so in the UK at a number of shore sites, the principal ones of which are already identified as candidate SACs (i.e. submitted to the EC by UK Government) in the terrestrial and inshore SAC series. Current data on the distribution of seals in UK waters (away from breeding and haul-out sites) are relatively sparse, and are not comprehensive in terms of UK coverage. They consist of tagging studies of grey seals from a selection of breeding sites (see Figure 3.1), and of more limited tagging studies of common seals in the Moray Firth (McConnell *et al.* 1999; Thompson *et al.* 1996). These studies indicate that grey seals from those breeding sites studied, forage in a number of known areas, some of them separate from breeding colonies, in inshore as well as offshore waters. Distribution of common seals at sea is not known, although studies have indicated that they tend to have a more inshore distribution and do not appear to travel as widely as do grey seals.

It may be possible to define SACs for essential feeding areas, but there are inherent difficulties in defining fixed sites as feeding areas for mobile species such as seals, which feed on other mobile species such as fish. In the case of sandeels, a known prey species of grey seal, they tend to be less mobile than other fish, and are associated with particular types of seabed and water depth, therefore it may be possible to define areas important for sandeel, and consequently, for grey seals, and then to determine if such areas are "essential to their life and reproduction".

Bottlenose dolphin (*Tursiops truncatus*)

Bottlenose dolphins breed at sea, and similarly to harbour porpoises, much less is known about their breeding and feeding than is known for seals. There are two main areas of occurrence of bottlenose dolphin in UK nearshore waters – off north-east Scotland/Moray Firth and in Cardigan Bay. Smaller groups occur in other areas (Reid *et al.* in prep., and see Figure 3.2). These inshore groups appear to be reasonably resident within their home ranges, but may be visited by animals from elsewhere. Three SACs have been proposed in the UK waters to protect the two main areas of occurrence in the Moray Firth and Cardigan Bay. There is some evidence of genetic differentiation of animals between these two home ranges in inshore waters. In offshore waters, bottlenose dolphins can occur in large groups, but these groups appear to be very mobile usually in waters beyond the shelf break. This inshore/offshore differentiation in habit has led to suggestions that this might be the result of two separate species. There is currently no evidence in offshore waters for sub-populations of animals occurring in different areas, nor of 'home ranges'.

Harbour porpoise (*Phocoena phocoena*)

Harbour porpoises breed at sea and much less is known about their breeding and feeding than is known for seals. Harbour porpoises are highly mobile, and well distributed around UK coasts with the exception of the English Channel and the south-east of England (Reid *et al*. in prep. and see Figure 3.3). There is some genetic evidence pointing at some sub-structuring of the population using UK waters. Broadly there is differentiation between those living in the northern and southern North Sea, and those living south-west of the UK (e.g. Andersen *et al.* in press). Too little is known about the biology of the species as yet to draw conclusions about whether some parts of the range are more important for breeding than other parts. There is as yet no evidence of specific habitat requirements for mating and calving in UK waters (DETR *et al.* 2000).

The difficulty of identifying sites 'essential to the life and reproduction' of harbour porpoise (see Section 3.2) to propose as SACs, has meant that there have been very few proposals from EU member states for such sites. An ad hoc meeting convened by the European Commission on 14 December 2000 concluded that "it is possible to identify areas representing crucial factors for the life cycle of this species" (see below). These areas would be identifiable on the basis of:

- The continuous or regular presence of the species (although subject to seasonal variations);
- good population density (in relation to neighbouring areas);
- high ratio of young to adults during certain periods of the year.

Additionally, other biological elements are characteristic of these areas, such as very developed social and sexual life. Therefore, DG Environment advocates an approach

based on the above mentioned characteristics and suggests that this be applied with a view to site selection for this species (EC 2001a).

The UK is therefore re-examining distribution data for harbour porpoise in all of its waters (both inshore and offshore), to attempt to identify whether there are areas within which sites may be proposed as SACs for this species, taking the above into account.

3.2.1.3. Isolation of species populations

Habitats Directive Annex III Stage 1B (c): "Degree of isolation of the population present on the site in relation to the natural range of the species."

Atlantic Biogeographical Region Meeting Conclusions, paragraph 7): "Where Annex II species populations are too small to be naturally viable, or where they occur only as vagrants or reintroduction, Member States may exclude them from consideration for site selection." (Hopkins & Buck 1995)

The Explanatory Notes to the Natura 2000 Standard Data Form (EC 1995) indicate that this is an approximate measure of the contribution of a given population to the genetic diversity of the species and of the fragility of the specific population at the site being considered. This criterion has been found to be relevant to only a small number of terrestrial species populations in the UK in previous selection of sites (Brown *et al.* 1997).

None of the Annex II species occurring in offshore waters are considered to be isolated populations, mainly due to their mobility and the continuous nature of the marine environment.

3.2.1.4. Global assessment

Habitats Directive Annex III Stage 1B (d): "Global assessment of the value of the site for conservation of the species concerned."

The Explanatory Notes to the Natura 2000 Standard Data Form (EC 1995) indicate that this criterion is used to sum up the previous criteria and also to assess other features of the site thought to be relevant for a given species using best expert judgement.

3.2.2. Additional principles which should be taken into account in site selection for Annex II species

3.2.2.1. Priority/Non-priority species

Habitats Directive Article 1(h): "*priority species* means species referred to in (g) (i) for the conservation of which the Community has particular responsibility in view of the proportion of their natural range which falls within the territory referred to in Article 2;"

Atlantic Biogeographical Region Meeting Conclusions, paragraph 3: "Member States will give significant additional emphasis in number and area to sites containing priority habitat types and species." (Hopkins & Buck 1995)

None of the species that are being considered in UK offshore waters have priority status.

3.2.2.2. Geographical range

Habitats Directive Article 3 (1): "A coherent European ecological network of special areas of conservation shall be set up under the title Natura 2000. This network, composed of

sites hosting the … habitats of the species listed in Annex II, shall enable the … species' habitats concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range."

Favourable conservation status of each Annex II species is dependent upon the maintenance of the geographical range of the species. Therefore, the site series for each species should be chosen to reflect its distribution in the UK. However, where a very high proportion of the resource for a relatively widespread species type occurs, a high proportion of sites may be chosen in that vicinity (Brown *et al.* 1997).

Seals

Both common and grey seals occur throughout UK waters, although both are only infrequently seen in the English Channel. Common and grey seals have slightly different breeding and haul-out habitat preferences; grey seals are concentrated in the north and west of the UK, and common seals occur in the north and west, and also occur in more southerly waters of the North Sea. Inshore SACs for breeding and haul-out sites have been selected to represent the geographical range of each species. It is likely that due to the relative lack of knowledge of the distribution of seals in offshore waters, particularly for common seals, there will be little opportunity to select a range of offshore sites to represent the full geographical range for seals in UK offshore waters. If essential feeding sites could be identified, sites would be selected in the North Sea (possibly southern and northern), northern, north-western and western parts of the UK offshore area to reflect the distribution of seal species in UK waters.

Bottlenose dolphin

Bottlenose dolphin are widely distributed in UK waters, with the exception of the southern North Sea and English Channel, where their range and numbers have declined. Inshore SACs have been selected for this species to represent the geographical range for its occurrence inshore. There is a possibility that bottlenose dolphin in offshore waters form a separate population to those recorded in inshore waters. If it is possible to identify sites 'essential to their life and reproduction', offshore sites should be selected as well as those inshore, to represent that part of the species' geographical range.

Harbour porpoise

Harbour porpoise are widely distributed in all continental shelf waters around the UK, with the exception of the southern North Sea and the English Channel, where there has been an apparent reduction in numbers. Given the difficulties in selecting any sites for this species which represent factors 'essential to their life and reproduction', due to lack of knowledge of the ecology and distribution of this species as well as its wide ranging nature, it is likely that the opportunities to select sites representing different parts of its geographical range will be few.

3.2.2.3. Special UK responsibility/proportion of European population

Habitats Directive Article 3 (2): "Each Member State shall contribute to the creation of Natura 2000 in proportion to the representation within its territory of the …. Habitats of species referred to in paragraph 1."

Atlantic Biogeographical Region Meeting Conclusions, paragraph 6: "It is acknowledged that certain habitat types and species listed in Annexes I and II are relatively common and extensive in certain Member States. These Member States will have particular

responsibility for proposing a proportion of the resource that is sufficient to contribute significantly to the maintenance of the … species at a favourable conservation status" (Hopkins & Buck 1995).

In relation to the European Union populations, UK waters probably hold proportions above 30% of all four marine mammal species on Annex II of the Directive, with the grey seal population being of especial importance.

3.2.2.4. Multiple interest

Atlantic Biogeographical Region Meeting Conclusions, paragraph 2: "Acknowledging that outstanding single interest sites in terms of quality, extent or range make an important contribution to the Natura 2000 network, special emphasis will be given to identifying and delimiting sites containing complexes of interests on Annexes I and II as valuable ecological functional units." (Hopkins & Buck 1995)

It is quite likely that foraging sites identified in offshore waters for any of the four Annex II species occurring in offshore waters, would be used by several or all of the species at various times. This is due to the overlap in prey species taken by the Annex II species concerned. It is also quite likely that there may be multiple interest with the Annex I sandbank habitat in shallow offshore waters, as this habitat is used by sandeel, which are a prey item for several of the Annex II species concerned. The latter aspect of multiple interest will be considered when determining any site boundaries for any of the Annex II species. The EU interpretation of the Annex I sandbank habitat as being 'seldom more than 20m below chart datum' (EC 1999), will, however, need to be considered when determining the extent of any sandbank site which may also be of importance to Annex II species, as significant sandeel populations occur in sandbank habitat at much greater depths than 20m bcd.

3.2.2.5. Rarity

Directive text: None

Atlantic Biogeographical Region Meeting Conclusions, paragraph 5: "Acknowledging that sites containing Annex I habitat types and Annex II species at the centre of their range will make an important contribution to Natura 2000, Member States will take responsibility for proposing sites containing habitats and species that are particularly rare in that Member State with a view to preserving the range." (Hopkins & Buck 1995)

Grey seal, common seal and harbour porpoise are not considered rare in UK waters. Although widely distributed in UK waters, bottlenose dolphin occur in much lower numbers in UK offshore waters than do harbour porpoise. Numbers and range of both cetacean species appear to be declining, in particular in the English Channel (Evans 1993).

3.3. Information on Annex II species

3.3.1. Grey seal (*Halichoerus grypus*)

The following represents a brief summary of what is known of the distribution of grey seals. It is not a comprehensive review of their biology and distribution in UK waters. Estimates for the UK population of grey seals are obtained by the Sea Mammal Research Unit (SMRU) for the UK Government by modelling the population using annual aerial

surveys of grey seal pups from major breeding colonies in England and Scotland. Figures for Wales are based on annual counts taken between 1991 and 1994 (Baines *et al.* 1995). Information on the distribution of grey seals in marine areas other than at haul-out breeding sites is relatively sparse. Tracking studies by the Sea Mammal Research Unit (McConnell *et al.* 1999 and McConnell pers. comm.) provide some information about the areas where grey seals forage and the distances they travel. However, these studies are restricted to a small number of animals from a small number of haul-out sites, mostly in Scotland and eastern England. Conclusions drawn from these data may, therefore, not be applicable to animals breeding at other sites, nor to non-breeding animals.

Figure 3.1 shows tracks of grey seals from Abertay, Farnes, Orkney, Shetland and the Monach Isles, as an example of their patterns of distribution. The work from which this figure was derived indicates that grey seals are central place foragers, but that the central place can move (McConnell, pers. comm.). The seal movements were on two geographical scales: long and distant travel (up to 2100 km); and local, repeated trips from haul-out sites to discrete offshore areas. Long distance travel (of animals from the Farnes) included visits to Orkney, Shetland and the Faeroes, mostly to other known haul-out sites, and far offshore into the Eastern Atlantic and the North Sea. The large distances travelled indicate that grey seals that haul-out at the Farnes are not ecologically isolated from those at Orkney, Shetland and the Faeroes. Most trips to sea were, however, of 2-3 days duration, less than 40 km from the haul out site, and with the animal returning to the same haul-out site from which it departed. Destinations at sea were often localised areas characterised by a gravel/sand seabed. This is the preferred burrowing habitat of sandeels, which can form an important part of grey seal diet.

Studies of seal movements and diet in the Irish Sea were investigated in a transnational mark-recapture study between 1996 and 1998. Individual seals were observed to have travelled freely across the Irish Sea. Prey occurrence in the diet varied with geographic location of the haul-out site (Kiely *et al.* 2000).

As these studies only relate to a relatively small number of animals from a limited number of haul-out sites, it is not known if these conclusions may be applicable to the rest of the grey seal population in the UK. The ESAS (European Seabirds at Sea) database includes records of seals (both grey and common), but these are too few to be of use in delimiting important areas.

3.3.2. Common (or harbour) seal (*Phoca vitulina*)

The following represents a brief summary of what is known of the distribution of common seals. It is not a comprehensive review of their biology and distribution in UK waters. Population data for common seal are obtained by SMRU by counting seals at haul-out sites during the annual moult. However, these surveys are infrequent (approximately once every 5 or 6 years). Data on the distribution of common seals at sea are even more sparse than for grey seals. Studies at Aberdeen University and the Sea Mammal Research Unit (Thompson 1996) on those in the Moray Firth indicate that common seals have a more inshore distribution at sea than do grey seals, and tend to forage within 75 km of haul-out sites. Moray Firth common seals appeared to be a relatively discrete population, with little exchange of adults between the Moray Firth and adjacent breeding areas in Orkney and the Tay Estuary. To date, there have been no similar satellite tracking studies of common seal, due to technical difficulties in attaching the tracking devices.

Again, studies only relate to a small number of animals from a very limited number of haul-out sites, and it is not known if these conclusions may be applicable to the rest of the common seal population in the UK.

3.3.3. Bottlenose dolphin (*Tursiops truncatus*)

The Joint Cetacean Database, contributed to by the Joint Nature Conservation Committee, SeaWatch Foundation and SMRU contains most, but not all, effort-related cetacean data for north-west European waters up to 1998. Effort-related data from this database have been used to produce Figure 3.2, showing the distribution of bottlenose dolphin for north-west European waters (Reid *et al.* in prep.).

Bottlenose dolphin are distributed throughout UK waters with the exception of the southern North Sea and English Channel, where their range has declined. The estimated population for UK inshore waters is 300-500 individuals (Brown *et al.* 1997). Much less is known about the distribution of this species in offshore waters than in inshore waters. It appears to be widespread in much lower numbers than harbour porpoise (Reid *et al.* in prep.), but with records concentrated inshore around the western coasts of Wales, north-east Scotland and the Moray Firth, and a few other areas. Bottlenose dolphins are present in a wide range of habitats throughout the world and precise habitat requirements for the species are largely unknown. Bottlenose dolphins are generalist and opportunistic feeders (Arnold 2000), and food resources appear to be a primary factor in determining movements and site fidelity (Wells *et al.* 1990).

3.3.4. Harbour porpoise (*Phocoena phocoena*)

The Joint Cetacean Database described above also has records for harbour porpoise in UK waters. Effort-related data from this database have been used to produce Figure 3.3, showing the distribution of harbour porpoise for north-west European waters (Reid *et al.* in prep.). Harbour porpoise are widely distributed throughout the North Sea and in western UK waters (see Figure 3.3). They are rarely recorded in the southern North Sea and eastern English Channel. The estimated numbers of harbour porpoise using UK territorial waters (i.e. within 12 nm of the coast) at any one time, based on one survey, is of the order of 60,000 (DETR *et al.* 2000). Although harbour porpoise are widely distributed in UK offshore waters, current modelling of effort-related distribution data from the Joint Cetacean Database does not indicate any clearly identifiable areas where they are concentrated, and which could be deemed to represent "physical and biological factors essential to their life and reproduction" (see Section 3.2). Further data analysis is underway to try to identify areas for harbour porpoise in UK waters (see Section 6.2.4).

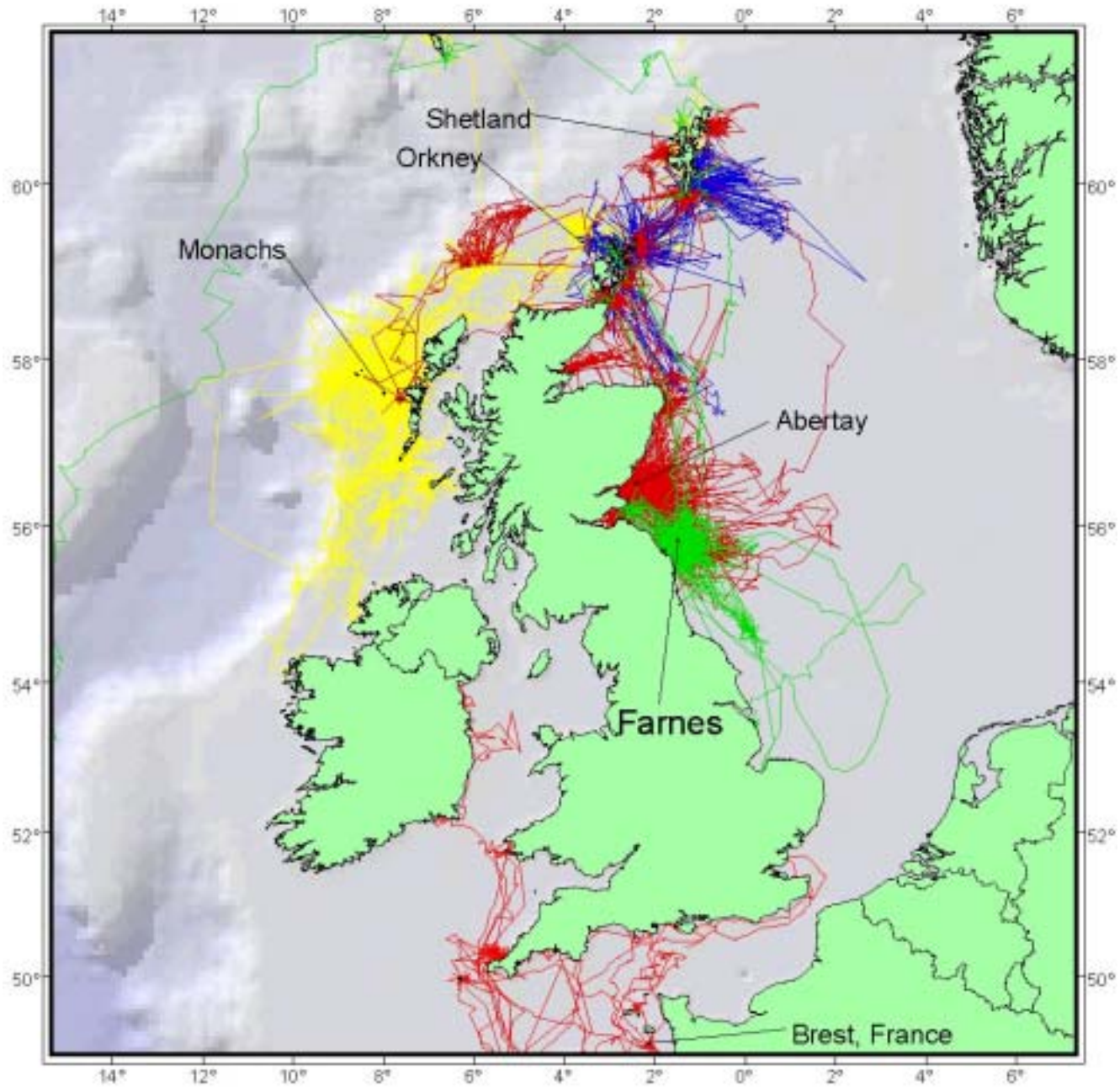


Figure 3.1 Grey seals tagged from colonies in the Farne Islands (green), Abertay (red), Shetland, Orkney, the Monach Isles (yellow) and Brest in France (red). The tracks represent 108 seals, with an average tracking duration of 80 days per seal (Sea Mammal Research Unit, unpublished data)

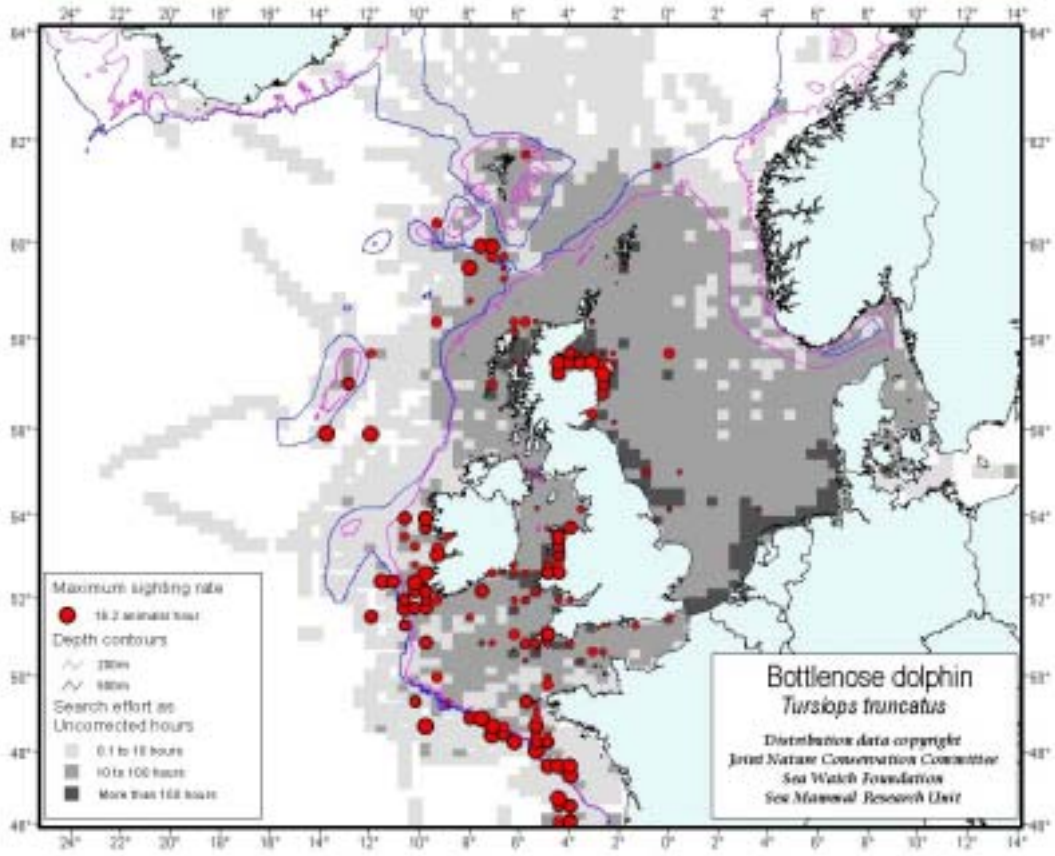


Figure 3.2 Distribution of bottlenose dolphin around the UK (Reid *et al.* in prep) © JNCC, SeaWatch Foundation and Sea Mammal Research Unit.

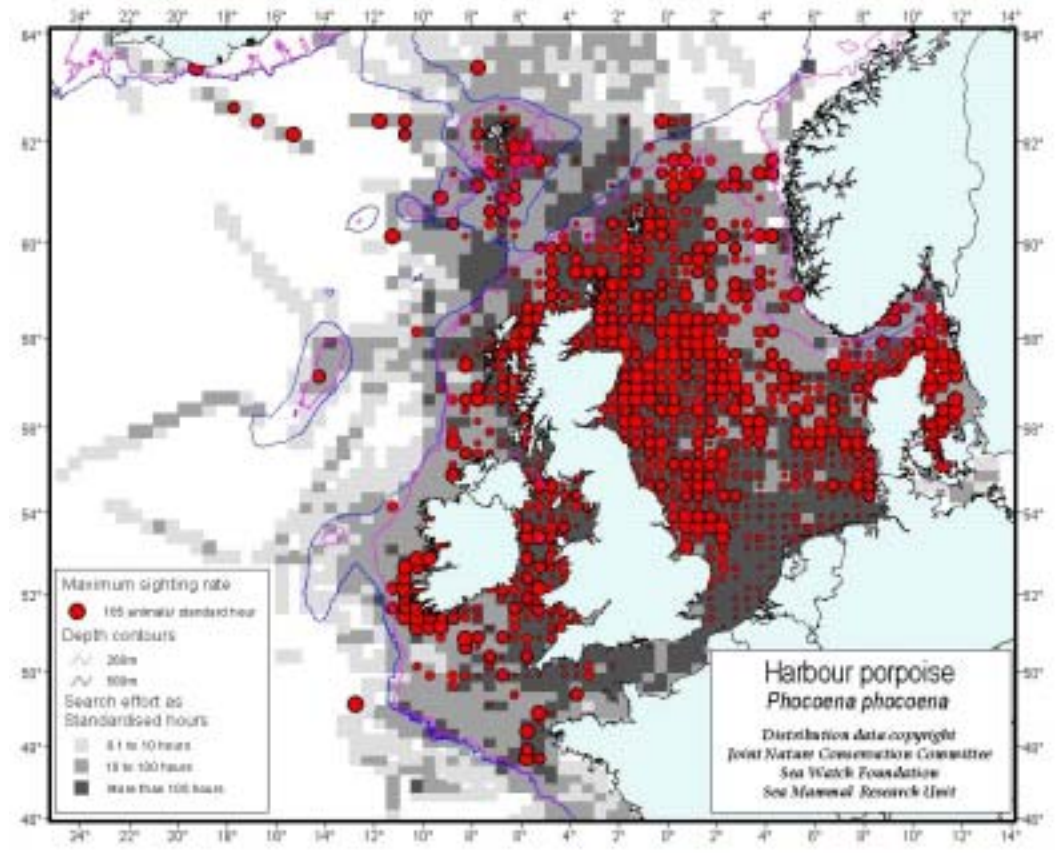


Figure 3.3 Distribution of harbour porpoise around the UK (Reid *et al.* in prep) © JNCC, SeaWatch Foundation and Sea Mammal Research Unit.

4. Birds Directive Annex I and Migratory Species

Council Directive 79/409/EEC (as amended) requires that species listed on Annex I and all species of regularly occurring migratory birds shall be the subject of special conservation measures concerning their habitat. Member states of the EU are required to classify Special Protection Areas for the conservation of these species. The main provisions relating to the classification of SPAs are contained in Article 4 of the Directive. Article 4 requires:

i. that Member States: "shall classify in particular the most suitable territories in number and size as special protection areas for the conservation of these [Annex I] species, taking into account their protection requirements in the geographical sea and land area where the Directive applies";

ii. and that Member States: "take similar measures for regularly occurring migratory species not listed in Annex I, bearing in mind their need for protection in the geographical sea and land area where this Directive applies, as regards their breeding, moulting and wintering areas and staging posts along their migration routes."

A network of Special Protection Areas (SPAs) has already been classified for inland, estuarine and terrestrial coastal areas in the UK (Stroud *et al.* 2001). However, currently SPAs exist only for land above mean low water (or mean low water springs in Scotland). Section 6.3.1 describes current work on identifying marine SPAs in the UK.

4.1. Birds for which marine SPAs will be considered

Table 4.1 below lists all birds in UK waters for which marine SPAs are being considered. Bird species to be considered have been identified by reference to the British List (British Ornithologists' Union 2000). Those species that are sufficiently rare in the UK that a description would need to be provided to the British Birds Rarities Committee for a record to be valid, are excluded from further consideration here (see British List). All other migratory species listed are assumed to be regularly occurring, as they are not vagrants. Note that one bird species is not included in Table 4.1 – the black guillemot (*Cepphus grylle*) – because it is not considered to be migratory in the UK, nor is it an Annex I species, and is therefore outside the scope of the Birds Directive.

Table 4.1 List of bird species for which marine SPAs are being considered

Common name	*Species*	*Status*	*Existing SPA(s) in UK?*
Red-throated diver	*Gavia stellata*	Ann. I	✓
Black-throated diver	*Gavia arctica*	Ann. 1	✓
Great northern diver	*Gavia immer*	Ann. I	
Great crested grebe	*Podiceps cristatus*	M	✓
Red-necked grebe	*Podiceps grisena*	M	
Slavonian grebe	*Podiceps auritus*	Ann. I	✓
Black-necked grebe	*Podiceps nigricollis*	M	
Fulmar	*Fulmarus glacialis*	M	✓
Cory's shearwater	*Calonectris diomedea*	Ann. I	
Great shearwater	*Puffinus gravis*	M	
Sooty shearwater	*Puffinus griseus*	M	
Manx shearwater	*Puffinus puffinus*	M	✓
Balearic shearwater[1]	*Puffinus mauretanicus*	Ann. I	
Storm petrel	*Hydrobates pelagicus*	Ann. I	✓
Leach's petrel	*Oceanodroma leucorhoa*	Ann. I	✓
Gannet	*Morus bassanus*	M	✓
Cormorant	*Phalacrocorax carbo*	M	✓
Shag	*Phalacrocorax aristotelis*	M	✓
Scaup	*Aythya marila*	M	✓
Common eider	*Somateria mollissima*	M	✓
Long-tailed duck	*Clangula hyemalis*	M	✓
Common scoter	*Melanitta nigra*	M	✓
Surf scoter	*Melanitta perspicillata*	M	
Velvet Scoter	*Melanitta fusca*	M	✓
Goldeneye	*Bucephala clangula*	M	✓
Red-breasted merganser	*Mergus serrator*	M	✓
Goosander	*Mergus merganser*	M	✓
Red-necked phalarope	*Phalaropus lobatus*	Ann. I	✓
Grey phalarope	*Phalaropus fulicarius*	M	
Pomarine skua	*Stercorarius pomarinus*	M	
Arctic skua	*Stercorarius parasiticus*	M	✓
Long-tailed skua	*Stercorarius longicaudus*	M	
Great skua	*Catharacta skua*[2]	M	✓
Mediterranean gull	*Larus melanocephalus*	Ann. I	✓
Little gull	*Larus minutus*	M	
Sabine's gull	*Larus sabini*	M	
Black-headed gull	*Larus ridibundus*	M	✓
Ring-billed gull	*Larus delawarensis*	M	
Common gull	*Larus canus*	M	✓
Lesser black-backed gull	*Larus fuscus*	M	✓
Herring gull	*Larus argentatus*	M	✓
Yellow-legged herring gull[3]	*Larus argentatus cachinnans*	M	
Iceland gull	*Larus glaucoides*	M	
Glaucous gull	*Larus hyperboreus*	M	
Great black-backed gull	*Larus marinus*	M	✓
Kittiwake	*Rissa tridactyla*	M	✓
Sandwich tern	*Sterna sandvicensis*	Ann. I	✓
Roseate tern	*Sterna dougallii*	Ann. I	✓
Common tern	*Sterna hirundo*	Ann. I	✓
Arctic tern	*Sterna paradisaea*	Ann. I	✓
Little tern	*Sterna albifrons*	Ann. I	✓
Black tern	*Chlidonias niger*	Ann. I	
Guillemot	*Uria aalge*	M	✓
Razorbill	*Alca torda*	M	✓
Little auk	*Alle alle*	M	
Puffin	*Fratercula arctica*	M	✓

Note: M = regularly occurring migratory species (Article 4.2, Birds Directive)
Ann. I = listed on Annex I of Birds Directive
Existing SPA(s) in UK? = Are there SPAs in the UK (Sept 2001) for which the species is a qualifying feature?

[1] Manx shearwater (balearic subspecies) *Puffinus puffinus mauretanicus* is listed Annex I to Birds Directive. Balearic shearwater is now considered a separate species *Puffinus mauretanicus*.

[2] Previously *Stercorarius skua*

[3] Yellow legged herring gull (*Larus argentatus cachinnans*) is currently considered a sub-species by the British Ornithologists' Union, but is considered a separate species (*Larus cachinnans*) by other European countries.

4.2. Selection criteria and additional principles used for site selection for Annex I and migratory birds in the UK

The Birds Directive does not set out criteria for the selection of SPAs in the manner provided for in the Habitats Directive for SACs, nor has the Commission's Ornis Committee ever formally agreed criteria or guidance for selection (other than in the most general of terms).

European case law indicates that Member States are required to list SPAs, notwithstanding other measures which may be in force for the protection of the species of birds concerned, and that the SPAs shall be selected on the basis of ornithological criteria (Case C-3/96 Commission v. Netherlands). The discretion of the Member States is limited to deciding upon the most suitable sites (and their extent) using those criteria. For the UK, guidelines relating to selection of terrestrial and intertidal SPAs have already been published, and criteria for marine SPAs will be an extension of these existing guidelines.

4.2.1. JNCC Selection Guidelines for Special Protection Areas

The criteria in Article 4 of the Birds Directive are very general, and some Member States have found it necessary to produce more specific guidance for SPA selection purposes. JNCC has published guidelines to assist in selection of sites as SPAs in the UK (JNCC 1999b). These guidelines are aimed at selection of terrestrial (including wetland and intertidal) SPAs, and may therefore need modification to make them relevant to the marine environment. The process is split into two stages:

Stage 1 to identify areas which are likely to qualify for SPA status.

Stage 2 to select the most suitable areas in number and size for SPA classification.

Stage 1 guidelines:

1. An area used regularly by 1% or more of the Great Britain (or in Northern Ireland, the all-Ireland) population of a species listed in Annex I of the Birds Directive (79/409/EEC as amended) in any season.

2. An area used regularly by 1% or more of the biogeographical population of a regularly occurring migratory species (other than those listed in Annex I) in any season.

3. An area used regularly by over 20,000 waterfowl (waterfowl as defined by the Ramsar Convention) or 20,000 birds in any season.

4. An area which meets the requirements of one or more of the Stage 2 guidelines in any season, where the application of Stage 1 guidelines 1, 2 or 3 for a species does not identify an adequate suite of most suitable sites for the conservation of that species.

The Stage 2 judgements are stated as being particularly important for selecting and determining boundaries (in terrestrial environments) of SPAs for thinly dispersed and wide ranging species. The following seven factors are used in Stage 2:

1. ***Population size and density***: Areas holding or supporting more birds than others and/or holding or supporting birds at higher concentrations are favoured for selection.

2. ***Species range**:* Areas selected for a given species provide as wide a geographic coverage across the species' range as possible.

3. ***Breeding success***: Areas of higher breeding success than others are favoured for selection.

4. ***History of occupancy**:* Areas known to have a longer history of occupation or use by the relevant species are favoured for selection.

5. ***Multi-species areas***: Areas holding or supporting the larger number of qualifying species under Article 4 of the Birds Directive are favoured for selection.

6. ***Naturalness***: Areas comprising natural or semi-natural habitats are favoured for selection over those which do not.

7. ***Severe weather refuges***: Areas used at least once a decade by significant proportions of the biogeographical population of a species in periods of severe weather in any season, and which are vital to the survival of a viable population, are favoured for selection.

Applicability of these guidelines in the marine environment is discussed in Section 6.3 of this report.

4.3. Information available on Annex I and migratory birds

4.3.1. European Seabirds at Sea database (ESAS)

Data that could be used to identify marine areas where birds have been observed to aggregate are held in the European Seabirds at Sea (ESAS) database at JNCC. It holds data from a number of groups and institutes in north-west Europe who have adopted standardised methods for censusing birds at sea, mainly from ships. One of the important aspects of the ESAS database is that it also includes data collection effort, therefore effort-related data analysis may be performed on the data. The ESAS database contains nearly 2 million bird and cetacean records, which were collected during boat-based transect surveys covering over 500,000 km of NW European waters. Data are collected in all months of the year and have been since the first surveys in 1979. Rare species and those whose distribution is primarily close to the shore (outside of the main area of sea-based surveys), are not well represented in the ESAS database.

Whilst the ESAS database provides an enormous amount of valuable data, one of the difficulties faced in terms of data availability, is the lack of repeat surveys which would allow us to assess the permanency of any aggregations identified, and consistency of use of areas over time. Analysis of counts of guillemots on the waters of the Moray Firth between May and July of 1992 and 1993 indicated that the distribution was widespread and variable at finer scales, though reasonably consistent at coarser scales. Many of the aggregations of guillemots identified on individual cruises appeared to be ephemeral, indicating that if data from a single sample cruise were used to identify important areas the results could be misleading. Combining interpolated data for all cruises, however, it was possible to identify some areas which tended to hold consistently high or low densities of birds. This suggests that numerous repeat surveys might be required to identify consistently important marine areas for birds (Harding and Riley 2000a).

There is also an issue of scale in the selection of marine areas for birds. Harding and Riley (2000b) looked to see whether important areas for birds could be identified within the

waters of the Moray Firth, focusing on an area of sea encompassed approximately within a line extending from Duncansby Head in the north to Fraserburgh in the south (Mudge & Crooke, 1986). Considering the overall distribution of birds in the North Sea, Skov *et al.* (1995) identified the Moray Firth as a component of a more extensive important marine area for birds known as the Moray Firth – Aberdeen Bank - Tees.

4.3.2. Aerial survey data

For some species that feed inshore, aerial survey data are also available. Surveys of common scoter have been carried out under contract to CCW in Carmarthen Bay since 1998 and in Liverpool Bay since 2000. These were expanded in 2001 to include other inshore species and covered all sites within the Irish Sea and St. George's Channel. The JNCC's Seabirds at Sea Team began surveys of inshore seabird species in the Moray Firth, Firth of Tay and Firth of Forth in 2000. These surveys were expanded to include the Thames Estuary in 2001, but may ignore those species with a significant 'western' distribution (i.e. long tailed duck, wintering divers etc.).

These surveys will be sufficiently detailed to allow population sizes to be worked out in these areas and plot the limits of the seabird distribution using spatial analysis techniques. However, there are not many repeat surveys yet for all species to determine consistency of the populations of inshore species in these areas.

There will be gaps in coverage in inshore waters, where aggregations of inshore seabirds are known from land-based surveys (e.g. WeBS), but systematic aerial surveys have yet to be carried out (e.g. the outer Wash and adjacent coastlines). Aerial surveys are not a particularly appropriate method to determine the size and distribution of inshore seabird aggregations in areas where there is a heavily indented coastline, such as in parts of western Scotland, the Orkney and Shetland Isles and in parts of Cornwall.

4.3.3. Other data

A number of other data sources may contain useful information on bird distributions in inshore waters, although they relate primarily to bird distributions whilst on land.

JNCC, as the UK Government's advisors on nature conservation, must regularly and accurately update their knowledge of the size and distribution of seabird populations, so that changes over time and their causes can be identified. This is currently achieved through three projects. The JNCC maintains the ***Seabird Colony Register***, which contains information on numbers at all known seabird colonies in Britain and Ireland dating back to 1969. JNCC co-ordinates the ***Seabird Monitoring Programme***. Under this scheme, breeding numbers, performance, survival and diet are recorded annually at selected colonies by conservation organisations, as well as by dozens of volunteers. ***Seabird 2000*** is a national seabird census, conducted in partnership between the JNCC and other nature conservation organisations, to census all seabird colonies between 1999 and 2002. *Seabird 2000* follows on from two previous seabird censuses conducted in 1969-70 and in 1985-87. *Seabird 2000* will:

- Reveal long-term national trends (over the last 30 years) by comparing its findings with those of the two previous censuses;

- determine whether population trends recorded at local levels by the Seabird Monitoring Programme are representative of national trends;

- provide the first accurate estimates of breeding population size of British storm petrel and Leach's storm petrel.

Wetland Bird Survey data (WeBS) The Wetland Bird Survey monitors non-breeding waterbirds annually in wetlands throughout the UK. Two types of data are collected in coastal wetlands; *core counts*, made at high tide, and *low-tide counts*. Wetland areas are divided into count sections and counts are made by the 'look-see' method from shore of most species of non-breeding waterbirds. However, some groups of species, such as gulls, are only partially monitored.

Core counts are made monthly from September to March, with count days co-ordinated nationally. The network of wetland sites in which core counts are made extends to around 2,000 sites and includes all major estuaries along with many soft-sediment coastal areas. Rocky shorelines are under-represented in core counts.

Low-tide counts have been made in 62 estuarine sites throughout the UK. They are not made annually, but are repeated typically every six years, however, more frequent coverage has been made on some sites. Counts are made monthly from November to February, and as with core counts most species are counted.

In general, for both types of count, all birds in the immediate open-water inshore area of a count section are recorded, although the offshore distance at which birds are recorded is highly variable. This latter problem, along with that of poor coverage of gulls, means that there is some limitation to the value of WeBS data for identifying SPAs in the marine environment. Summary WeBS data are published annually in *Wildfowl and Wader Counts* (BTO/WWT/RSPB/JNCC). Full WeBS *core count* data are readily available from the WeBS Secretariat at Wildfowl and Wetlands Trust and *low-tide count* data are available from the organiser (Andy Musgrove) at the British Trust for Ornithology.

WeBS Non-estuarine Waterfowl Survey (NEWS) – carried out in 1997/98 these were counts of waterbirds along 38% of the UK's non-estuarine coasts. ***Winter Shorebird Count*** – 1984/85 counts that covered 78% of UK coast, but were limited to waders and Eider. Data are available from WeBS Secretariat. Data for birds using inshore open-waters may have the same limitation as the WeBS data.

Data is also available from specific research projects by the country conservation agencies, non-government organisations and from consultant's reports and published studies, as well as from local bird recorders.

5. Possible Methods for Selection of Natura 2000 sites for wide ranging mobile marine species

5.1. Possible approaches for conservation of wide ranging marine species

A number of the scientific difficulties encountered when attempting to identify sites for wide ranging marine mammals are very similar to those encountered when attempting to identify sites for wide ranging birds. In practice, areas identified for both groups are likely to overlap as they often feed on common food sources (i.e. shoals of small fish). The main difficulty in identifying potentially important areas for both groups is in applying existing site selection criteria in an environment with no or few obvious natural boundaries, and to species which are widely dispersed, highly mobile and may be difficult to observe.

As outlined in the preceding sections of this report, there are administrative differences in requirements for site selection between Habitats Directive Annex II species, and those for birds in Article 4 of the Birds Directive, which should be borne in mind. In essence these are that:

- For Habitats Directive Annex II aquatic species which range over wide areas, such sites [SACs] will be proposed only where there is a "clearly identifiable area representing the physical and biological factors essential to their life and reproduction" (EEC 1992);

- for Birds Directive Annex I species Member States: "shall classify in particular the most suitable territories in number and size as special protection areas [SPAs] for the conservation of these species, taking into account their protection requirements in the geographical sea and land area where the Directive applies" (EEC 1979), and;

- "Member States shall take similar measures for regularly occurring migratory species not listed in Annex I [to the Birds Directive], bearing in mind their need for protection in the geographical sea and land area where this Directive applies, as regards their breeding, moulting and wintering areas and staging-posts along their migration routes" (EEC 1979).

In the UK, for all of the marine birds that breed in the UK, and the two UK breeding seal species, land based breeding colony sites have already been classified as SPA for birds or designated as SAC for seals. Whilst SAC boundaries extend into sea areas, SPA boundaries are currently limited in the main to land above mean low water (or mean low water springs in Scotland). There are currently (Nov 2001) three SACs for bottlenose dolphin in UK waters (within 12 nm of the coast). There are currently no SACs identified for harbour porpoise in UK waters (see Section 6.2.4).

Numerous discussions have taken place between bird and marine mammal specialists involved in the Offshore Natura 2000 project (the Operational Technical Group of the project) on the technical possibilities and difficulties involved trying to identify areas which might be 'essential' or 'most suitable' for marine mammals and birds (see above).

During these discussions, it has become clear that different groups of birds and Annex II species will need to be dealt with in different ways, due to differences in their abundance and distribution in the marine environment, and also due to the type and availability of data on the various groups. The flow diagram in Figure 5.1 is an attempt to represent the different groups of species and also processes which are either ongoing, or need to be put in place, in order to identify areas likely to qualify as SPAs or SACs for these mobile and often wide ranging marine species. Because of the overlaps between the Offshore Natura 2000 project, and the JNCC Marine SPAs Project (briefly outlined in Section 6.3.1), some of the information relating to the latter is presented here. The groups of species are provisional at present, and are further discussed in Sections 6.2 and 6.3.2.

The contents of the flow diagram are explained more fully in the following sections of this report. In brief, starting at the top of the diagram, all the Habitats Directive Annex II species and all Birds Directive Annex I and regularly occurring migratory birds are included. Working outwards, these are progressively subdivided into groups according to, firstly, different types of data analysis (determined by the nature of available data), and subsequently, according to the type of distribution of each species or species group. Lastly, the type of process envisaged (or currently in progress) to work towards identification of areas likely to qualify as SACs or SPAs in UK inshore and offshore waters is presented. A number of these divisions are currently tentative, as they cannot be confirmed until data analysis is performed.

5.2. Published approaches to conservation of Habitats Directive Annex II species and birds

The following section of this report presents summaries of three published examples of possible approaches to selecting important areas for birds occurring in UK waters, which could also be applied to marine mammals. It also presents the approach of introducing 'special measures' for protection of harbour porpoise, which could be applied to other wide ranging marine species, and developed further in addition to identification of protected sites, or where sites cannot be identified. Further information on each approach may be obtained from the references cited. These possible methods are discussed in Section 6.2 of the report, for the various groups of Habitats Directive Annex II species and in Section 6.3 for Birds Directive Annex I and migratory birds. Options and recommendations as to methods to be tested or used are also included in Sections 6.2 and 6.3 of the report. It is likely that the examples of approaches presented here may be modified, or a mix of several of the approaches used for different groups of Annex II species or Annex I or migratory birds.

5.2.1. Approach A: sites based on generic foraging radii from breeding colonies

A report published by RSPB (RSPB 2000) outlines this approach for birds, which involves generic extensions to breeding colonies according to theoretical foraging ranges of the species present at each colony. It involves delimiting boundaries offshore from known bird breeding colonies, based on existing published data on foraging ranges for relevant breeding birds.

RSPB (2000) recommends:

- The offshore boundary should be drawn as a radius from points at the margins of the colonies (and parallel to the shoreline where the colony extends along a stretch of coast);

- the distance to the offshore boundary should be determined on the basis of generic published information on foraging range, feeding and surface use by breeding birds;
- the distance to the offshore boundary should be species-specific;
- where there is more than one breeding species using the site, the highest recommended figure should be used to set the distance to the offshore boundary;
- known and regularly used feeding areas adjacent to a recommended boundary should be incorporated within the site;
- where known and regularly used feeding areas do not lie adjacent to recommended boundaries, these locations should be considered as sites in their own right;
- where the recommended offshore boundaries of sites overlap they should be merged to form a single site for management purposes.

In order to simplify the data and arrive at the map in Figure 5.2, birds were split into three groups according to generic foraging distance from the colony (5 km, 15 km and 40 km). It is recognised in RSPB (2000) that this approach is not appropriate for some wide ranging birds (such as fulmar, Leach's petrel, storm petrel, Manx shearwater and gannet) which forage at great distances from their colonies.

5.2.2. Approach B: sites based on observed distributions at sea

A report published by BirdLife International outlines this approach to identify Important Bird Areas (IBAs) for birds in the North Sea (including the Channel and Kattegat). The approach is based on spatial analysis and modelling of observed distributions of birds at sea, to identify areas where aggregations of each species occur in different seasons, and from these, to identify and delimit Important Bird Areas. Data from the European Seabirds at Sea database were used, obtained from transect surveys of birds from 1979 to 1994 in the North Sea (Skov *et al.* 1995).

Each of the 30 species of bird used in the analysis had a population in the study region (the North Sea including the Channel and Kattegat) of at least 1% of the species' biogeographic (breeding or non-breeding) population during parts of the year. The analysis in Skov *et al.* (1995) related to the whole of the North Sea (UK and other Member State) waters, but not to western UK waters. The list of birds used in the analysis is shown in Table 5.1 below (Skov *et al.* 1995).

Table 5.1 List of bird species included in analysis by Skov *et al.* 1995

Common name	*Latin name*	*Status*
Red-throated diver	*Gavia stellata*	Ann. I
Black-throated diver	*Gavia arctica*	Ann. I
Great northern diver	*Gavia immer*	Ann. I
Great crested grebe	*Podiceps cristatus*	M
Red-necked grebe	*Podiceps griseigena*	M
Cormorant	*Phalacrocorax carbo*	M
Shag	*Phalacrocorax aristotelis*	M
Fulmar	*Fulmarus glacialis*	M
Gannet	*Morus bassanus*	M
Scaup	*Aythya marila*	M
Common eider	*Somateria mollissima*	M
Common scoter	*Melanitta nigra*	M
Velvet Scoter	*Melanitta fusca*	M
Goldeneye	*Bucephala clangula*	M
Red-breasted merganser	*Mergus serrator*	M
Goosander	*Mergus merganser*	M
Great skua	*Catharacta (Stercorarius) skua*	M
Little gull	*Larus minutus*	M
Common gull	*Larus canus*	M
Lesser black-backed gull	*Larus fuscus*	M
Herring gull	*Larus argentatus*	M
Great black-backed gull	*Larus marinus*	M
Kittiwake	*Rissa tridactyla*	M
Sandwich tern	*Sterna sandvicensis*	Ann. I
Common tern	*Sterna hirundo*	Ann. I
Guillemot	*Uria aalge*	M
Black guillemot	*Cephus grylle*	
Razorbill	*Alca torda*	M
Little auk	*Alle alle*	M
Puffin	*Fratercula arctica*	M

Note: M = regularly occurring migratory species
Ann. I = Birds Directive Annex I species

Figure 5.3, Figure 5.4 and Figure 5.5 show seasonal densities and distributions for three example bird species produced using this approach.

The selection of IBAs, determined as those holding at least 1% of the biogeographic population, was based on the assumption that the bird species concentrate in geographically limited areas. However, a number of bird species have a dispersed distribution, and accordingly only a small proportion of their total population can be covered through areas identified by the 1% criterion. Skov *et al.* (1995) therefore devised a formula (the Marine Classification Criterion or MCC) to test whether a population of international significance used a relatively larger area of sea than expected from the proportion of the total population present. Without the application of the Marine Classification Criterion almost the entire study region (North Sea) would satisfy the 1% criterion at any time (Skov *et al.* 1995).

The MCC formula incorporated the international 1% criterion for establishing areas of international importance and a simple test of proportions between the relative size of the population and the area of the site. Given a determination of a marine area supporting a minimum of 1% of a total biogeographic population it is tested whether the area of the site is disproportionate to the size of the population by the equation:

$$MCC = (p/P) \times 100/a/A$$

Where: p = estimated number of birds of the site
P = total population in the biogeographic region
a = the area of the site, and
A = 3000 km^2

A site was then classified as an IBA if the criterion exceeded 1. The parameter "A" defines the scale of sites, for example with A defined as 3000 km^2 a site holding 2% of an appropriate population should not exceed 6000 km^2 in area if it is to be identified as an

important sea area for birds. To keep the MCC as simple as possible, and to ensure that the maximum scale of an area supporting 1% was applicable in a wide range of marine environments, the maximum scale was set at 3000 km^2, using average feeding radii of key species from colonies in the region.

Final maps of the main areas of importance to each species were combined in a Geographic Information System (GIS). The total value of each area for all species was then calculated as the sum of proportions of the total populations of the species occurring in internationally important concentrations within the area (refer to Skov *et al.* (1995) for how this was done).

There are also other modelling approaches that could be applied to the ESAS data. The Skov *et al.* (1995) method utilises a data interpolation procedure that stratifies the density of birds into several density ranges, including areas of high density, areas of low density and areas of density gradients. As with Skov *et al.* (1995), the following method is based on analyses of aggregations of organisms, but for this method there is no requirement for stratification of density values.

Spatial modelling can be performed utilising a data interpolation technique called kriging, which employs variogram models to specify the spatial variability of the data (Begg & Reid 1997). The underlying principle of variogram analysis is that of spatial autocorrelation. Positive spatial autocorrelation occurs when the values of neighbouring sample sites have a higher probability of being more similar than sites situated further apart (Goodchild 1986; Legendre 1993). Kriging uses the variogram to interpolate values into a grid covering the whole of the region being investigated. It is possible to export the grids to a GIS and generate contour maps of density and use other GIS analytical procedures.

This method is currently being used as part of the JNCC Marine SPA Project to investigate small-scale (hundreds of metres) aggregations of active breeding birds around colonies. However, it can also be applied to the large-scale data (hundreds of kilometres) held in the ESAS database. Potentially, kriging could be used to interpolate bird and cetacean density values over the whole of UK waters. If concentrations of a species were found, an adaptation of the Marine Classification Criterion (Skov *et al.* 1995) could be adopted to delimit proposed SPA boundaries.

5.2.3. Approach C: sites based on habitats identified for feeding

This approach proposes identification of SPAs based on areas of habitat important for bird populations. RSPB (2000) suggested that habitats such as the following may be suitable for protection as SPAs:

- Sandbanks which are important for prey species of a number of bird species, such as sandeel;
- shelf areas or offshore shoals important as feeding areas;
- areas where prey tend to be concentrated, such as ocean or coastal fronts.

A number of marine areas are identified in a report by RSPB (2000) as important feeding areas for birds (see Table 5.2 below). The references cited were not specific studies designed to identify and delimit important habitats for birds for their protection. It is also worth noting that this approach could not be employed in isolation for either Annex II species or birds, as it does not involve assessment of numbers of species or birds using the habitat areas identified. Moreover fronts and areas where prey may concentrate are general areas rather than specific localities, which would make their permanent reference as a site difficult.

Table 5.1 Areas identified in RSPB 2000 as important for bird feeding

Species	*Site*	*Type*	*Reference*
Guillemot	Flamborough front	Seasonal front	Webb *et al.* 1985
	Bell Rock (inshore)		Tasker *et al.* 1987
	Wee Bankie	Sandbank	Tasker *et al.* 1987
	Whale rock bank?		Leaper *et al.* 1988
Gannet	Smalls, Hats & Barrels (inshore)		Stone *et al.* 1992
	Dogger Bank	Sandbank	Camphuysen *et al.* 1995
	Wee Bankie	Sandbank	Camphuysen *et al.* 1995
	Whale rock bank (Minch)		Leaper *et al.* 1988
Lesser black backed gull	The smalls (inshore)		Stone *et al.* 1992?
Kittiwake	Wee Bankie	Sandbank	Wanless *et al.* 1998?
	Marr Bank	Sandbank	Wanless *et al.* 1998
	Whale rock bank (shelf break)		Leaper *et al.* 1988
Razorbill	Wee Bankie	Sandbank	Wanless *et al.* 1999
	Smith Bank	Sandbank	Mudge & Crooke 1986
	Whale rock bank		Leaper *et al.* 1988
All species?	Shelf break		No references – areas noted on Map 10 of RSPB (2000) (reproduced as Figure 5.2 in this report)
	Rockall bank		
	Aberdeen front		
	Irish Sea front		
	Jura & Islay fronts		

5.2.4. Approach D: Special measures

This section describes a number of examples of possible 'special measures' which could be achieved or extended (if already implemented) under various formal agreements or International Conventions. The list is not exhaustive and will vary for the different species groups. Special measures are here taken to mean measures taken to conserve species throughout a large proportion of their range of occurrence in the UK (and elsewhere) and not solely within specific sites. They thus operate to regulate potentially widespread human activity that affects the species concerned. The following are examples of non-site based mechanisms which are already being used, or could be used to protect wide ranging marine species.

5.2.4.1. Annexes IV and V of the Habitats Directive

Article 12 of the Habitats Directive states that Member States "shall take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV (a) in their natural range" (EEC 1992). In particular, it states that "Member States shall establish a system to monitor the incidental capture and killing" of these animals (relevant UK marine animals listed Table 5.3 below). "In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned".

Article 14 states *inter alia* that "if …. Member States deem it necessary, they shall take measures to ensure that the taking in the wild of specimens of species of wild fauna and flora listed in Annex V as well as their exploitation is compatible with their being maintained at a favourable conservation status" (EEC 1992). Those Annex V species relevant to UK offshore waters are listed below.

Table 5.2 Marine species found in UK offshore waters and listed on Annex IV or Annex V of the Habitats Directive.

Common name	*Latin name*	*Status*
All cetaceans	*Cetacea*	Ann. IV
Loggerhead turtle	*Caretta caretta*	Ann. IV
Green turtle	*Chelonia mydas*	Ann. IV
Kemp's ridley turtle	*Lepidochelys kempii*	Ann. IV
Hawksbill turtle	*Eretmochelys imbricata*	Ann. IV
Leatherback turtle	*Dermochelys coriacea*	Ann. IV
Seals	*Phocidae*	Ann. V

5.2.4.2. Convention on Biological Diversity

UK Biodiversity Action Plans, established under the Biodiversity Convention, refer to 'UK waters' as those out to 200 nautical miles from the baseline from which the territorial sea is measured (illustrated by the boundary to the Fisheries Act 1964 as amended). It is noted, however, that the extent of potential UK action under the plans in marine areas beyond territorial waters (12 nm) is, under the UN Convention on the Law of the Sea (UNCLOS), subject to the rights of other states. This is particularly notable in terms of regulation of impacts due to fisheries outside 12 nm as "Member States do not have the possibility of acting unilaterally beyond their territorial waters to take conservation and resource management measures which would apply to ships registered in other Member States or non-member countries", and "it is therefore up to the Member States to ask the Commission to take the regulatory measures [under the Common Fisheries Policy] so that these sites [SACs and SPAs] are protected from potentially harmful fishing activities" (EC 2001b).

'Priority Species' under the UK Biodiversity Action Plan (UK Biodiversity Group 1999) are those which are:

- Threatened endemic and globally threatened species;
- species where the UK has more than 25% of the world or appropriate biogeographical population;
- species where the number or range has declined by more than 25% in the last 25 years;
- species found in fewer than 15 ten km squares around the UK; or
- species for which the UK has international obligations or which are protected under UK legislation.

Of the marine species found in UK offshore waters, harbour porpoise, small dolphins and marine turtles are all priority species. Species Action Plans have been published for:

- Harbour porpoise (*Phocoena phocoena*).
- Small dolphins grouped plan – includes bottlenose dolphin (*Tursiops truncatus*).
- Marine turtles grouped plan - includes loggerhead turtle (*Caretta caretta*).
- Common scoter (*Melanitta nigra*).
- Red-necked phalarope (*Phalaropus lobatus*) – action plan relates exclusively to terrestrial (mostly breeding) sites.
- Roseate tern (*Sterna dougallii*) – action plan relates exclusively to terrestrial breeding sites.

Actions and targets proposed for each of the above are included in the Species Action Plans (UK Biodiversity Group 1999). These broadly include for cetaceans and turtles current and future research on distribution of the species in UK waters, including research into scale and effects of bycatch, measures to reduce bycatch in fishing gear, and publication of guidelines to minimise effects of acoustic disturbance to cetaceans from seismic surveys. Proposed actions include extending the ASCOBANS treaty boundary (see below), seeking to further improve discharges of persistent toxic chemicals

(especially PCBs and organohalogens), consider wider impacts on non-target species when determining fishery management measures, consider need to monitor and control fisheries to reduce bycatch, and introduce codes of practice to reduce disturbance from whale and other cetacean-watching operations.

Species Action Plans for both red-necked phalarope and roseate tern relate exclusively to action on land, mostly at breeding sites to improve breeding success and maintain breeding populations. For common scoter, the Species Action Plan relates to marine wintering as well as terrestrial breeding and feeding areas. The principle marine actions recommended are to protect important scoter marine wintering sites, improve controls on discharge of oil (accidental or deliberate) due to the high vulnerability of this species to oil pollution, and improve shellfish harvesting and monitoring practises in important scoter wintering areas.

5.2.4.3. ASCOBANS

ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas) is a regional agreement under the Bonn Convention. Under the agreement, formulated in 1992, provision is made for protection of specific areas, monitoring, research, information exchange, pollution control and heightening of public awareness. Measures are aimed specifically at protecting dolphins and porpoises in the North and Baltic Seas, and cover the monitoring of fisheries interactions and disturbance, resolutions for the reduction of by-catches (below 2% of stock sizes), and recommendations for the establishment of specific protected areas for cetaceans.

Proposals under the Species Action Plans (UK Biodiversity Action Group 1999) for harbour porpoise and for small dolphins include that the ASCOBANS treaty boundary should be extended to include all UK waters.

5.2.4.4. Seabird oil vulnerability maps

An example of a potential set of special measures exists in relation to seabirds and oil exploration and production activities in UK waters. The ESAS database provides monthly density estimates for every seabird species in most of UK's waters. Due to their habits and biological features, each of these species has a different vulnerability to oil pollution on the surface of the sea. These features may be placed in four categories (Williams *et al.* 1994):

- Size of biogeographic population (a small biogeographic population would be more sensitive to the loss of a number of individuals than a large one);
- proportion of time spent on the surface of the sea by individuals (those species that spend a greater time on the sea's surface would be more sensitive than those spending a lesser proportion of time there);
- potential population growth rate (a species that can produce large numbers of offspring in a year would be less sensitive than those species only producing one young per year);
- reliance of the species on the marine environment (some species may use inland habitats as well as the sea for feeding, these will be less sensitive than those species entirely reliant on the sea).

Williams *et al.* 1997 and subsequent authors have scored each species using quantitative information where possible on scales relating to the above features. Each species score

has then been combined with the density map of the species to create an indication of the distribution of the vulnerability of each species to oil spills on a monthly basis. Monthly maps of overall seabird community vulnerability to oil spills may then be compiled by adding the species maps together for each month. It is then possible to determine which areas and times are of particular seabird sensitivity. These monthly sensitivity maps have been issued as a series of atlases (e.g. Tasker & Pienkowski 1987; Carter *et al.* 1993).

These sensitivity maps are in use in providing advice on several stages of oil exploration and production. Offshore oil licensing is conducted in a series of rounds during which a set of areas (blocks) are offered for leasing. The Department of Trade and Industry is responsible for this process and first consults the statutory conservation agencies for its recommendations on the round and any conditions that might apply. At this stage the maps are used to advise on particularly sensitive periods when any activity that might add to the risk of oil spill might be advised against or prohibited. This advice is usually taken. Oil companies in bidding for each block are required to put forward a programme of work that takes account of environmental interests and sensitivities. Such sensitivity may also be derived partly from the atlases.

Once licensing has occurred, companies are required to submit an environmental impact statement (or a formal request not to complete a statement) ahead of drilling or development. This again may be informed by knowledge of bird communities at risk. Many operations also require an oil spill contingency plan; these too may be informed by the vulnerability maps.

If an oil spill occurs, whether derived from shipping or from exploration/production, the scale of the response to the spill can be guided by the vulnerability of the birds in the area of the spill. In general, oil spills in highly sensitive areas should be removed from the surface of the water rapidly, while those in areas with few birds might be left to degrade naturally.

The advantage to this approach is that it has the capability of guiding measures that will help safeguard birds regardless of the area that they are located in. It is not necessary to designate sites for conservation actions to apply to the bird populations. It would be comparatively easy to translate this guidance into a more formal statutory 'special measure', especially using mechanisms such as Environmental Impact Assessments.

The same techniques as described above can be adapted to identify relative sensitivity to other pressures. Camphuysen and Leopold (1998) applied the technique to identify concentrations of birds at risk from shipping disturbance. A similar technique was used to identify concentrations of seabirds sensitive to reduction in sandeel abundance (ICES 1999). A large proportion of the areas in the north-western North Sea identified in this way were subsequently closed to sandeel fishing in order to avoid adverse effects on predators (including fish) reliant on sandeels.

5.2.4.5. Agreement on the Conservation of Albatrosses and Petrels

This agreement was signed by the UK in 2001, and is due to come into force in 2002. It seeks to achieve and maintain a favourable conservation status for albatrosses and petrels, particularly in the southern hemisphere where the majority of these species occur, and where the longline fishing results in high mortalities. Regulation of longline fisheries in the southern hemisphere has reduced albatross bycatch in regulated fisheries by 95% over the last 5 years (ACAP News Dec 2001), but the agreement seeks to reduce this figure further. However, such measures have limited relevance to petrels in UK waters they do not suffer the same rates of mortality, largely due to the relative lack of

longline fisheries in the northern hemisphere, and different feeding strategies of the northern species.

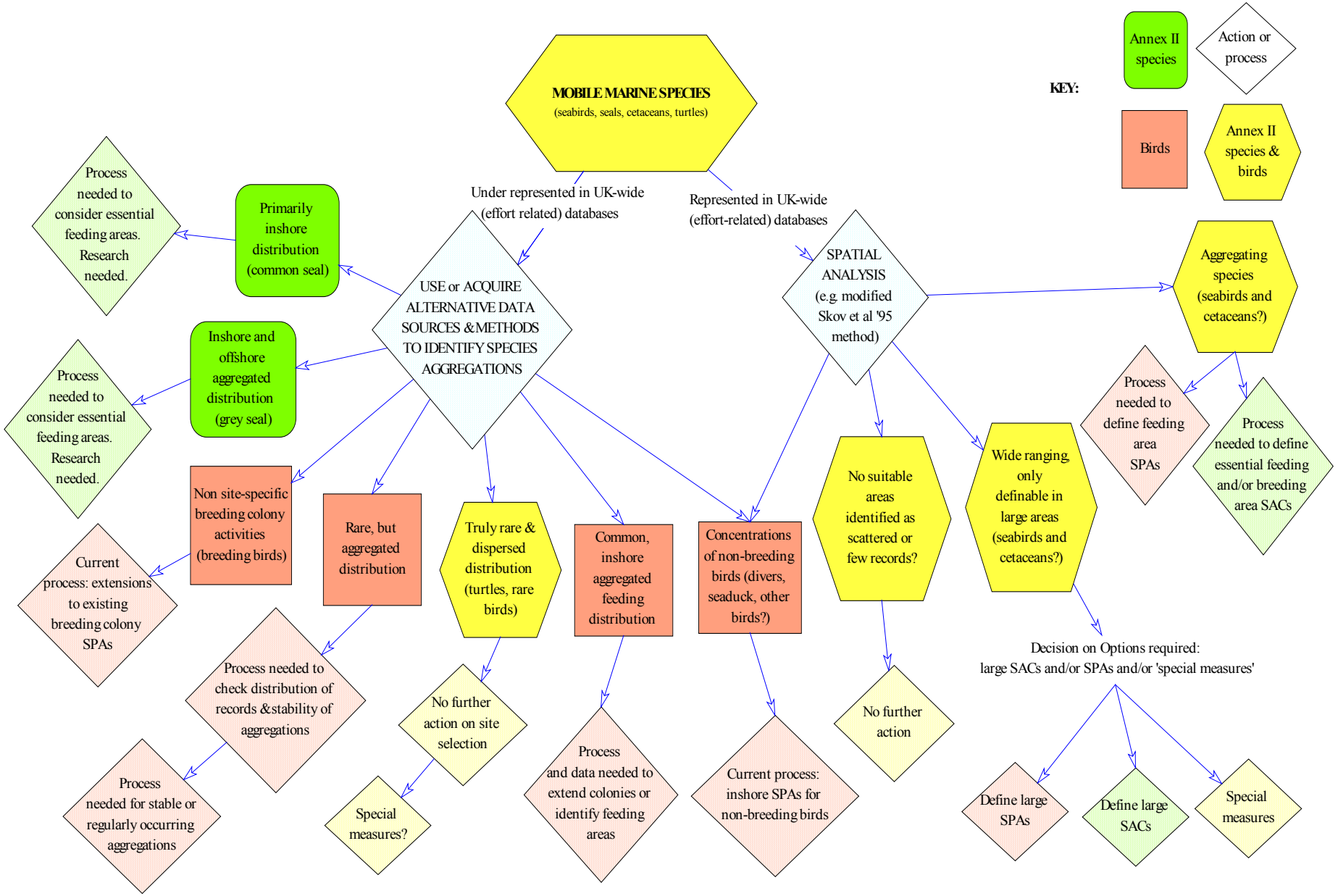


Figure 5.1 Draft data analysis and process diagram for wide ranging mobile species in UK marine waters

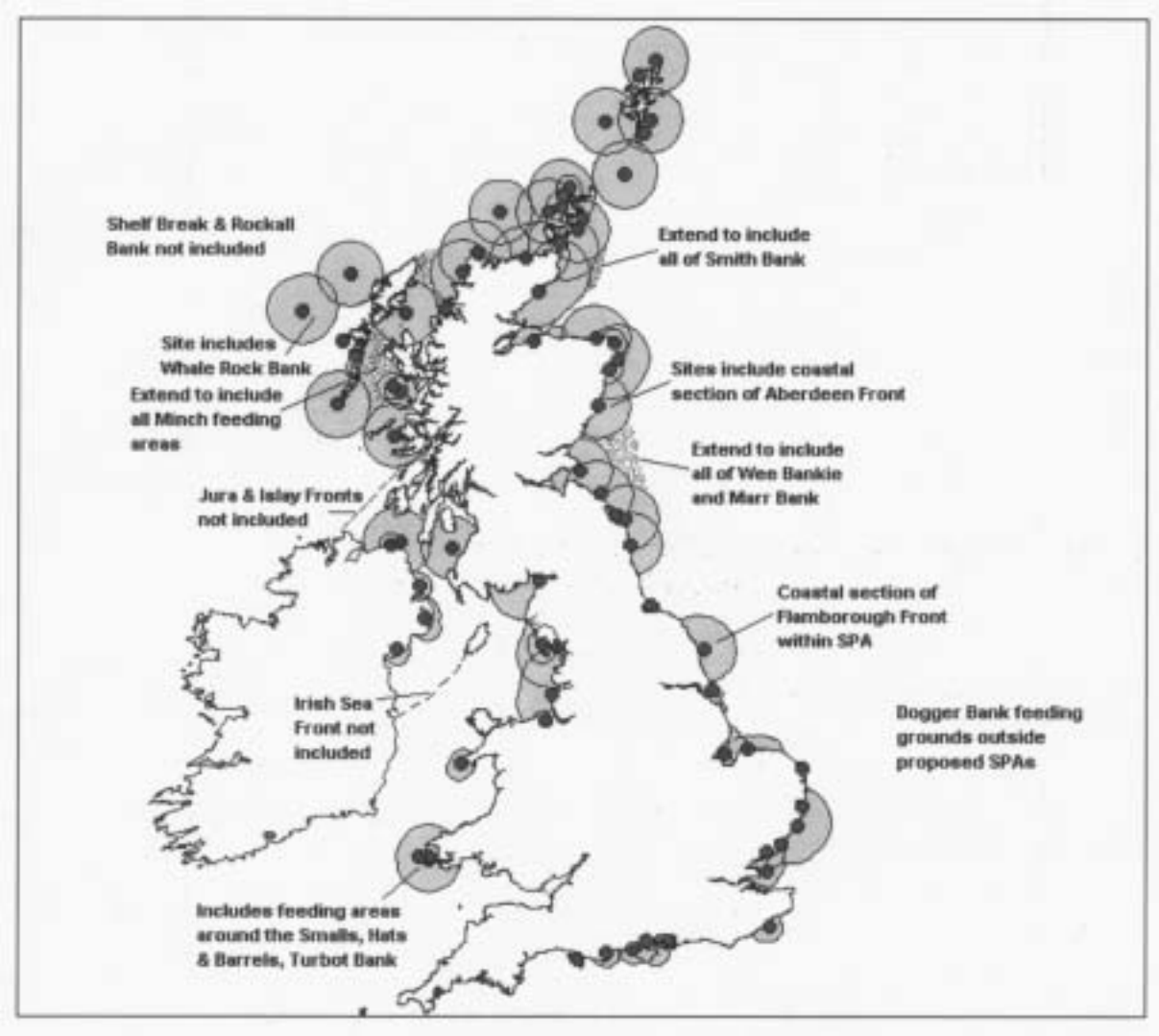
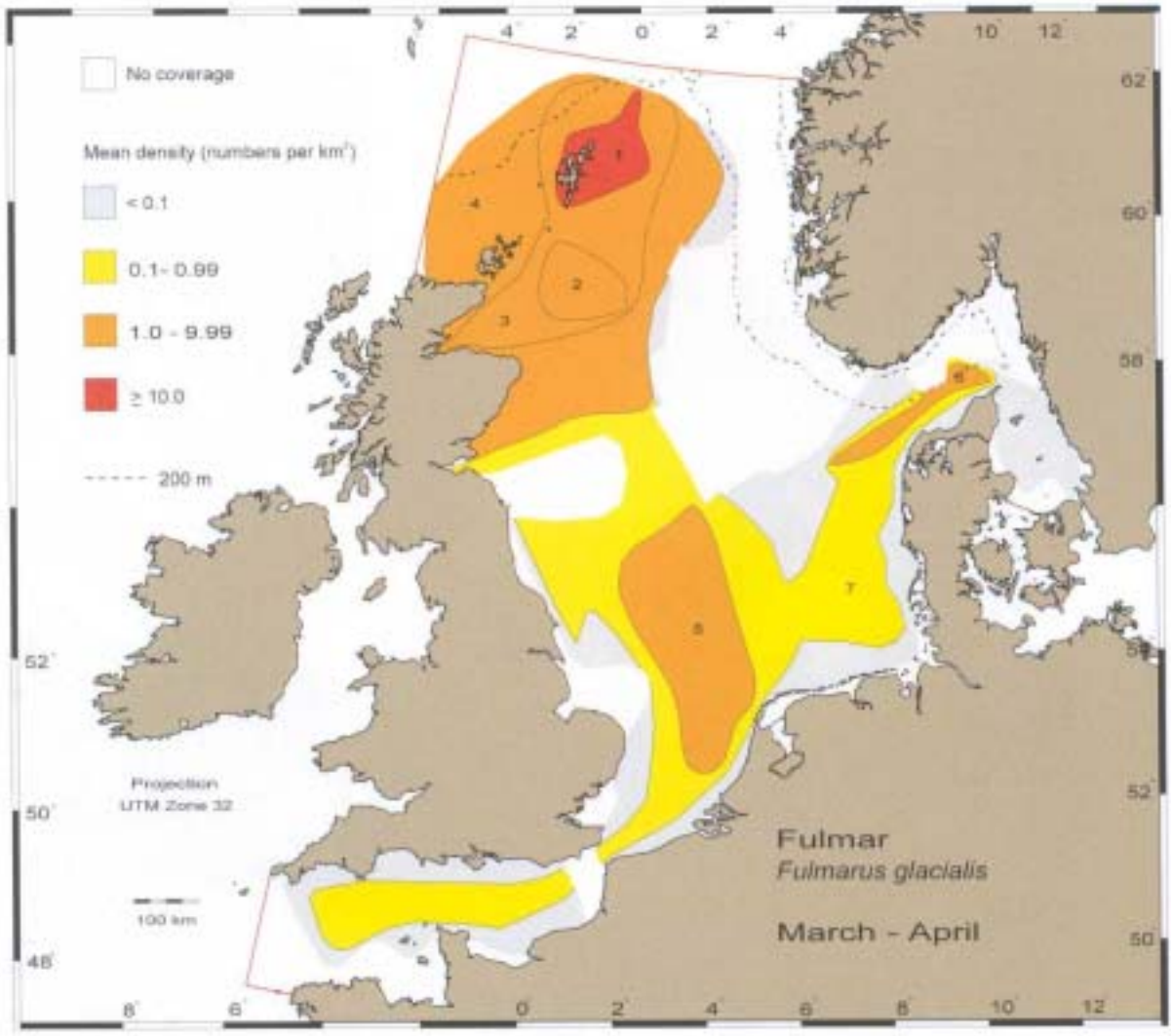


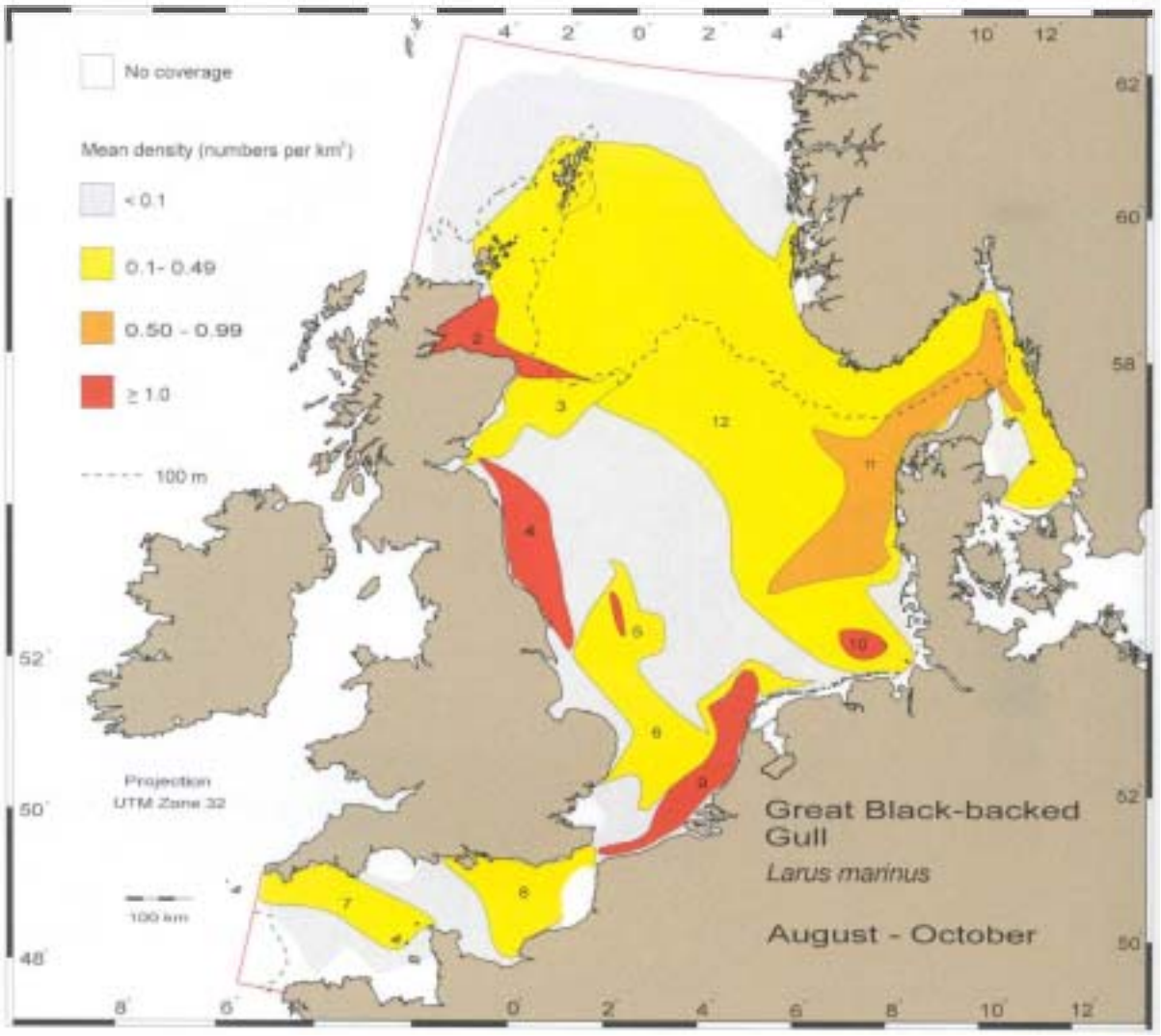
Figure 5.2 RSPB proposals for marine extensions to breeding bird SPAs in the UK, including feeding areas (RSPB 2000)



The average numbers of Fulmar *Fulmarus glacialis* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

	Locality	Density	Km²	Estimate	%
1	Shetland	25.66	18640	478000	46.75
2	Little Halibut Bank	9.30	15500	144000	14.09
3	Northern North Sea, medium	1.76	43860	7700	7.55
4	Northern North Sea, low	1.06	123600	131000	12.81
5	Brown Ridge - Dogger Bank	1.63	58880	96000	9.38
6	Little Fisher Bank - Skagerrak	1.35	10500	14000	1.39
7	North Sea - Channel	0.29	280000	81000	7.94
Residual				1000	0.10
Total				**1023000**	**100.00**

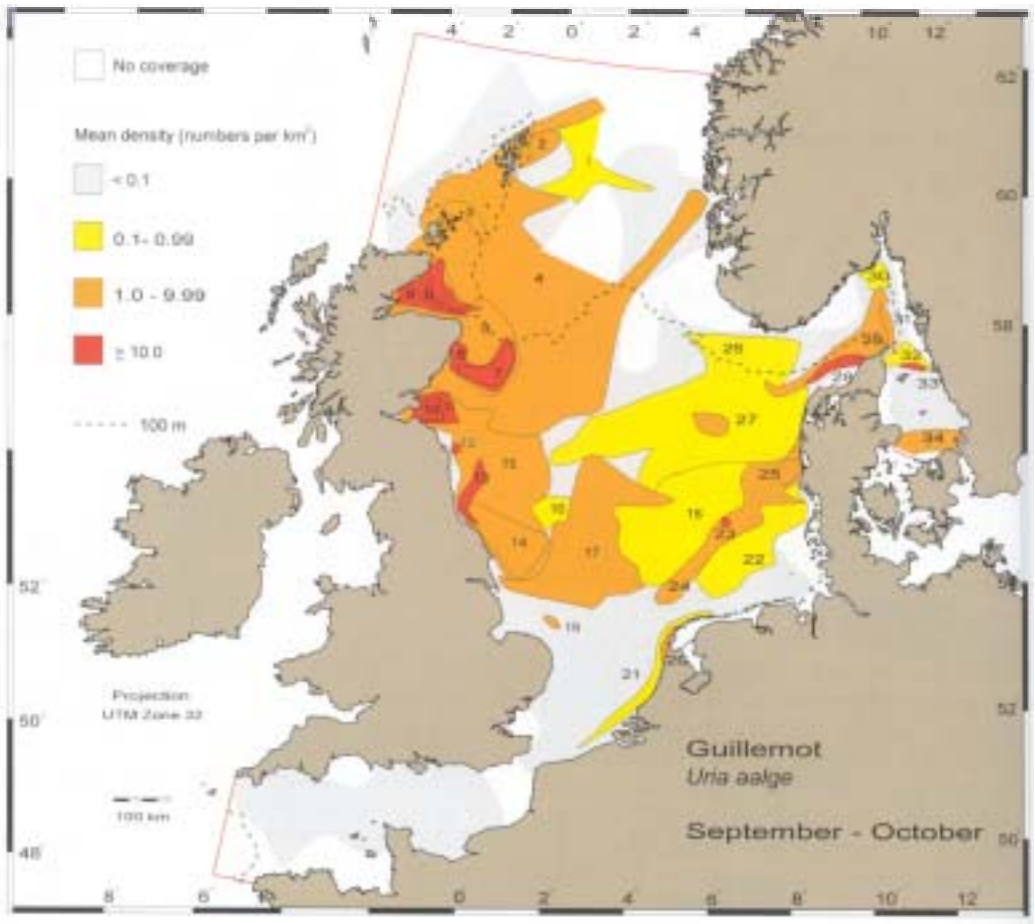
Figure 5.3 Distribution and density of fulmar (*Fulmarus glacialis*) in the North Sea during March to April (Skov *et al.* 1995)



The average numbers of Great Black-backed Gull *Larus marinus* in key areas from August to October 1980-1994. Areas marked with bold are of international importance (MCC criteria).

	Locality	Density	Km²	Estimate	%
1	Eastern Shetland	0.30	4000	1200	0.76
2	**Moray Firth**	**2.16**	**9950**	**22000**	**14.01**
3	Aberdeen Bank	0.20	14550	2900	1.85
4	Barmade Bank - North East Bank	1.50	15500	23000	14.65
5	**Outer Silver Pit**	**4.66**	**1450**	**6750**	**4.30**
6	Lemon Bank - Brown Ridge	0.18	37280	6700	4.27
7	Western Channel	0.25	21350	5350	3.41
8	Eastern Channel	0.21	19840	4200	2.68
9	Dutch - Belgium coast	1.21	15435	20000	12.74
10	Helgoland	1.37	3725	5000	3.18
11	Skagerrak - Danish Westcoast	0.54	48800	26400	16.82
12	Northeast North Sea, low	0.12	265725	32000	20.38
Residual				1500	0.96
Total				**157000**	**100.00**

Figure 5.4 Distribution and density of great back-backed gull (*Larus marinus*) in the North Sea during August to October (Skov *et al.* 1995)



The average numbers of Guillemot *Uria aalge* in key areas from September to October 1980-1994. Areas marked with bold are of international importance (MCC criteria).

	Locality	Density	Km²	Estimate	%
1	Northern North Sea, Low	0.80	10430	8000	0.56
2	Shetland, east	3.18	3040	10000	0.70
3	North Orkney	6.77	2690	18000	1.26
4	Northern North Sea	2.77	112335	311000	21.81
5	Moray Firth, central	31.16	1025	32000	2.24
6	**Moray Firth**	**15.91**	**5250**	**84000**	**5.89**
7	**Aberdeen Bank, core**	**28.17**	**3475**	**98000**	**6.87**
8	Aberdeen Bank, periphery	13.04	3045	40000	2.80
9	Northeast Scotland, high	7.97	11430	91000	6.38
10	**Inner Firth of Forth**	**42.18**	**1370**	**58000**	**4.07**
11	Wee Bankie	11.95	1960	23000	1.61
12	Farne Deeps	18.29	250	5000	0.35
13	**Tees Bay - Barmade Bank**	**34.71**	**2300**	**80000**	**5.61**
14	Flamborough Head - Barmade Bank	7.04	8820	62000	4.35
15	North East Bank	5.60	28340	160000	11.22
16	Dogger North Ground	0.40	2000	800	0.06
17	Dogger Bank	3.89	33300	130000	9.12
18	Kvitbanken	0.97	23500	23000	1.16
19	Leman Bank	6.42	450	3000	0.21
20	Texel coast	2.53	650	1500	0.11
21	Dutch - Belgian coast	0.41	250	2000	0.14
22	German Bight	0.61	12550	8000	0.56
23	Weisse Bank	18.02	150	2800	0.20
24	Horns Rev - Weisse Bank, medium	2.18	12950	28200	1.98
25	Northern Horns Rev	8.26	1380	11400	0.80
26	Great Fisher Bank - Klondyke	0.60	56550	34000	2.38
27	Little Fisher Bank	7.31	1950	14000	0.98
28	Western Skagerrak, high	11.50	1760	20000	1.40
29	Skagerrak, medium	2.46	6950	17000	1.19
30	Eastern Skagerrak, low	0.56	1175	700	0.05
31	Eastern Skagerrak, high	9.73	1050	10000	0.70
32	Northern Kattegat	0.70	1720	1200	0.08
33	Kummel Banke	8.94	500	9500	0.67
34	Southern Kattegat	4.71	4200	20000	1.40
Residual				9000	0.63
Total				**1426100**	**100.00**

Figure 5.5 Distribution and density of guillemot (*Uria aalge)* in the North Sea during September to October (Skov *et al.* 1995)

6. Conclusions

6.1. Conclusions for Habitats Directive Annex I habitats

The following builds upon the information obtained during this project as outlined in Section 2.3, and outlines the recommended next steps in a process to identify possible SACs for the three Annex I habitats present in UK offshore waters. This complements and builds upon the process previously followed for proposal of SACs in the UK for terrestrial, coastal and inshore habitats.

- Before a list or lists of SACs can be proposed to UK Government, decisions need to be made on whether to put forward some of these areas as SACs for different reef or sandbank types based only on interpolated generalised seabed geological data, with little or no biological information on communities present, or whether new survey work will be required.

- Several habitat-specific site identification problems need to be resolved:

  ◊ Reefs: broad scale survey, or specific analysis of seismic or sidescan data if available, will be required in order to distinguish between boulder and cobble (i.e. stony reef) and other 'gravel' (according to Folk classification) habitat areas which do not fit the definition of Annex I reef.

  ◊ Reefs: broad scale survey will be required to help determine boundaries for areas of different types of reef (especially for iceberg ploughmarks and deep cold water reefs).

  ◊ Reefs: strategic surveys in likely areas will be required to identify examples of biogenic reef (cold water corals and *Sabellaria spinulosa*).

  ◊ Shallow sandbanks: bathymetry data will need to be acquired (available summer 2002) and used to determine the full extent of individual sandbank features (as opposed to sandy sediments in less than 20 m water depth, as identified by BGS contract).

  ◊ Submarine structures made by leaking gases: a decision needs to be made as to whether the two examples of 'pockmarks' for which there is good information fit the definition of this Annex I habitat type.

- An estimate of the area of each habitat in UK waters, including offshore and inshore waters, needs to be made, to be used during the site selection process to estimate area of habitat within sites in relation to the total area covered by that habitat within the UK (see Section 2.2.1.2). The GIS developed for this project can be used to provide an estimate for UK offshore waters.

- Propose a number of sites, based on the selection criteria and principles outlined in Section 2.2, to best represent the different types of each Annex I habitat (see Section 2.1) and representing the different biogeographic zones and depth and temperature regimes in UK offshore waters. The proposed sites should be selected on best available information taking account of the decisions reached on adequacy of data (see above). Where uncertainties remain over the location of certain types (see above),

the list of sites should be considered interim until such time as adequate information becomes available.

- The offshore SACs proposed above should complement the existing SAC series for UK inshore waters, and complete the list of sites for UK marine waters as a whole.

6.2 Conclusions for Habitats Directive Annex II species

The purpose of this section of this report is to identify possible approaches and options that could be used to identify SAC sites for Annex II species in UK waters. Further data collation and analysis and, in some cases, survey work, will be required before this can be done. Further work on quantifying the populations occurring in UK waters (inshore as well as offshore) for each of the Annex II species will be required. For bottlenose dolphin and harbour porpoise, populations using UK waters are not well known, but it is likely that further research to improve estimates will prove unrealistic to achieve.

Special conservation measures (Approach D) require further investigation for all marine Annex II species under the Habitats Directive. Such measures may be required for particular activities which affect seals and/or cetaceans whilst at sea, whether or not areas qualifying as SAC can be identified.

6.2.1. Grey seal (*Halichoerus grypus*)

Existing SACs for grey seal breeding sites in the UK already include some sea areas around their colonies. From further examination of the limited data currently available on seal distributions at sea, it may be possible to identify preferred feeding areas in UK inshore and offshore waters. If such areas can be identified, it remains to be established whether they would fulfil SAC selection criteria and principles, in particular whether they are essential to the life and reproduction of the species, and consequently whether they should be considered as possible SACs.

Because of the lack of UK-wide effort-related data for grey seals in marine waters, it will not be possible to identify important feeding areas for them by spatial analysis (Approach B). It might be possible to employ a generic approach such as defining generic feeding radii around breeding colonies and haul-out sites (Approach A), but further data will be required in order to test the validity of this approach. One of the difficulties with employing a generic radius approach encountered during work carried out by JNCC on extensions to bird breeding colonies, is that feeding locations for birds from a particular breeding colony appear to be specific to that colony, rather than determined by a generic foraging distance for each species (Harding & Riley 2000b). From the limited data available on their feeding habits, it appears that the same is true of grey seals. Approach C based on identification of habitat, could be used to assist in the process of identification of important feeding areas for grey seals (for example, by identifying areas of sandeel habitat), but would need to be combined with actual data on the use of any area by the seals themselves. Also, although sandeels do form a major component of the diet of grey seals from some locations, they also feed on a wide range of other fish species and molluscs (McConnell *et al.* 1999). In addition to identification of sites, 'special measures' (Approach D) may be required if certain activities result in significant disturbance or harm to seal populations.

Because of the above, the flow diagram of possible processes for site identification in Figure 5.1 shows grey seals on a separate 'branch' to those for other groups of Annex II species or birds which have different distributions, behaviour and data availability.

Further work is required to better describe dispersion and feeding patterns (both temporal and spatial) for grey seal, in particular in those geographical areas not fully covered by previous work (England, the Irish Sea and inner west coast of Scotland). If important feeding areas can be identified, further work on determining whether such areas are essential to the life and reproduction of grey seals would need to be carried out.

6.2.2. Common (or harbour) seal (*Phoca vitulina*)

Similarly to grey seals, existing SACs for common seals in the UK also include some sea areas around their haul-out, moulting and breeding sites. Existing at-sea distribution data for common seal are even more sparse than for grey seal. The limited data appear to indicate that common seals forage much closer to their haul-out sites than do grey seals (McConnell *et al.* 1999, Thompson *et al.* 1996). However, considerable further survey will be required before it can be determined if it will be possible to identify preferred feeding areas in UK inshore and offshore waters for common seals.

Possible approaches to site identification in waters away from the coast for common seals are similar to those discussed above for grey seals.

As for grey seals, the flow diagram of possible processes for site identification in Figure 5.1 shows common seals on a separate 'branch' to those for other groups of Annex II species or birds which have different distributions, behaviour and data availability.

Further work is required to better describe dispersion and feeding patterns (both temporal and spatial) for common seals, in particular in offshore areas. If important feeding areas can be identified, further work on determining whether such areas are essential to the life and reproduction of common seals would need to be carried out.

6.2.3. Bottlenose dolphin (*Tursiops truncatus*)

There are currently three candidate SACs for bottlenose dolphin in the UK: Cardigan Bay, the Lleyn Peninsula and the Sarnau in Wales, and the Moray Firth in Scotland. As can be seen from Figure 3.2 the main European aggregations of bottlenose dolphin in the UK, based on current data, are in inshore waters. However, there also appears to be a concentration of records of this species in the area of the Wyville-Thomson ridge in north-western UK offshore waters.

SAC sites for bottlenose dolphins in UK inshore waters were selected on the basis of the best available information at the time, consisting of sightings data and site-specific studies. These studies tended to concentrate on a relatively small area; there was little relevant data from wider afield with which to make any true comparisons. The boundaries of the SACs are drawn to encompass the areas most consistently used by bottlenose dolphins, in the case of Cardigan Bay, out to the 12 nm limit of the territorial sea. The SAC sites were considered as representing areas essential to the life and reproduction of the species but clearly do not encompass the entirety of the area over which individuals within the populations range. Their repeated occurrence and continual presence indicate that these sites are critical for the maintenance of the population(s) of bottlenose dolphin. At Newquay, in Cardigan Bay, the high proportion of dolphins with calves indicates that the area is favoured as a nursery area, with groups of females and calves joined intermittently by large males and other dolphins (Bristow & Rees 2001).

Effort related data on distribution of bottlenose dolphin exist throughout UK offshore waters, in the Joint Cetacean Database, and have been mapped in Figure 3.2 (Reid *et al.* in

prep). An approach such as spatial analysis of these data (by Approach B or other methods) may be appropriate to identify aggregations of this species in addition to those already included within inshore SAC boundaries. It will then be necessary to try to determine whether these areas are "essential to the life and reproduction" of the species before proposing SACs in UK offshore waters. Bottlenose dolphins breed at sea, therefore any approach to site identification based on generic radii around breeding colonies (similar to Approach A) will not be appropriate. Because bottlenose dolphins are present in a wide range of habitats throughout the world, and the precise habitat requirements for this species are largely unknown, Approach C (based on identification of specific habitat for the species) is unlikely to identify any further sites "essential to the life and reproduction" for this species. Due to the wide-ranging nature, sparse records, and apparent decline of this species in UK waters, 'special measures' (Approach D) will be required in addition to any further possible site identification, in order to ensure appropriate conservation of this species. The UK Species Action Plan for small dolphins outlines research work and actions needed to assist in non-site-based conservation of this species (UK Biodiversity Group 1999).

6.2.4. Harbour porpoise (*Phocoena phocoena*)

There are currently no SACs identified for harbour porpoise in the UK. Harbour porpoises breed at sea and much less is known about their breeding and feeding than is known for seals. They are not currently known to have discrete breeding areas, therefore any approach to site identification based on generic radii around breeding colonies (Approach A) will not be appropriate. Not enough is currently known about the ecology of the species to be able to identify areas of habitat (Approach C) which may be important to harbour porpoises. Earlier analysis of data from the Joint Cetacean Database was performed by JNCC, but no discrete areas could be identified which might be considered "essential to the life and reproduction" of this species.

In response to discussions with experts and the EC (see Section 3.2.1.2), data analyses (including spatial analysis involving kriging, described in Section 5.2.2 under Approach B, and analyses of sightings data) are currently being carried out by JNCC and by CCW with the aim of identifying for harbour porpoise areas of:

1. Continuous or regular presence;

2. elevated population density; and

3. areas with good adult to young ratio.

If discrete areas fulfilling any of the above criteria for harbour porpoise can be identified in UK waters by this further analysis, these will be suitable for consideration as possible SACs.

One of the difficulties encountered when trying to identify aggregations of wide ranging species is that because of the lack of easily identifiable natural boundaries in the marine environment, the size of any area identified has to be to some extent defined by the detail of the analytical method employed. This situation is very similar to that for certain species of wide-ranging birds such as fulmar, gannet and Manx shearwater (Group 2B in Section 6.3.2), as well as for harbour porpoise. The criteria to be used to select possible sites for these two groups will, however, be different (see Sections 3.2 and 4.2) as sites are selected under different EC Directives. The flow diagram in Figure 5.1 indicates two options for processes that could be followed for this group of species:

1. Define areas as described above.

2. Where sites cannot be identified as "essential to the life and reproduction" of the species (for Annex II species) or as the "most suitable territories" (for Annex I and regularly occurring migratory birds), special measures (Approach D) will be required to ensure the conservation of these species.

6.3 Conclusions for Birds Directive Annex I and migratory birds

6.3.1. The JNCC Marine SPA Project

Some of the work to try to identify areas that may qualify for classification as SPAs for inshore groups of Annex I and migratory birds is already ongoing under JNCC's Marine SPA Project, separate from the 'Offshore Natura 2000 project'. Although initially separate projects, the two are closely integrated due to potential overlap in work areas. The three main types of marine SPAs are currently envisaged as:

a) Seaward extensions of breeding colony SPAs beyond low water mark;

b) inshore areas used by birds in the non-breeding seasons e.g. seaduck and divers; and

c) marine feeding areas.

The third type is the only one that relates to offshore waters, and forms part of the JNCC 'Offshore Natura 2000 Project'.

Work on JNCC's Marine SPA Project is in progress. For work on *seaward extensions of breeding colony SPAs*, JNCC conducted surveys of bird use of waters close to certain breeding colony SPAs in 2001, with the aim of applying a radius approach to extensions to bird breeding colonies. These data were collected up to 4-5 km from each colony, and are being interpolated (using the kriging/variogram method described in Section 5.2.2). Initial analyses of these survey data (Andy Webb pers. comm.), indicate that relatively well defined areas within a short distance (approximately 1km) of the colonies were used during the breeding season by birds (mainly the auks and gannets) engaged in behaviour such as bathing, preening, resting, etc. Location of feeding areas in relation to each colony depended on the species, the site, and variable physical and environmental conditions. For those species that have enough observations to model spatially (guillemots, razorbills, gannets, puffins), analyses of the interpolated data will generate proposed boundaries for each species. These proposed boundaries will be applied to all UK colonies, paying particular attention to the predominant species on that colony, and tailoring the size of the SPA to species-specific priorities.

For the identification of *inshore areas used by birds in the non-breeding seasons* that may qualify for classification as SPAs, aerial survey data, combined with some data from the ESAS database and WeBS core counts, are likely to be the primary sources of data. This aspect of the 'Marine SPA Project' is ongoing.

For *marine feeding areas* that may qualify for classification as SPAs, work is proceeding under JNCC's 'Offshore Natura 2000 Project'. Work on this aspect of marine SPAs is not as far advanced as for *seaward extensions of breeding colony SPAs* and *inshore areas used by birds in the non-breeding seasons*. However, some preliminary analyses have been carried out in order to subdivide the long list of birds into relevant groups of

species. The following section of this report (Section 6.3.2) identifies different groups of birds for which different sets of data may be used to identify marine feeding areas that may qualify for classification as SPAs. The ESAS database is likely to be the primary source of data for identification of such areas for species for which there are adequate data in the database. Other sources of data will need to be investigated for the other groups of species. The following analysis (and the flow chart in Figure 5.1) include feeding areas for all UK Annex I and migratory birds, irrespective of whether other aspects of their lifecycles are included in the JNCC 'Marine SPA Project' or not.

Once data analysis has been concluded to try to identify important marine feeding areas for birds, consideration of these areas in relation to the guidelines for SPA site selection will need to be carried out. The JNCC SPA guidelines (see Section 4.2) will provide a starting point, but will need to be adapted for use in defining marine SPAs. Adaptation of the guidelines will be an iterative process as the consideration of methods for selection of areas likely to qualify for marine SPA status proceeds. In relation to selection of feeding sites for birds it is possible that the provisions of Stage 1 guideline 4 will need to be extended or applied flexibly.

6.3.2. Groups of birds

The list of Annex I and regularly occurring migratory species to be considered for marine SPAs (Table 4.1) consists of a number of different bird species with very different distributions and behaviours. Many of the species breed in the UK, however, a number do not and occur in UK waters only during the non-breeding season. A number of the bird species are primarily of inshore and often localised distribution, whilst others travel great distances over offshore waters. In order to attempt to identify important areas for this group of species, it must, therefore, be subdivided. The most appropriate methods for identifying important areas or aggregations of these species will depend partly on the type of data available on each, and on the type of dispersion for each species. The list presented in Table 4.1 has, therefore, been split into sub-groups of species, firstly by the nature of data available on their distribution, and secondly, by the geographical distribution of records for each species in UK waters in terms of inshore or offshore. These subgroups (described below) are not definitive, and it may be that during the course of further data analysis or data acquisition, other splits or groupings may be employed. The flow diagram presented in Figure 5.1 reflects these sub-groups.

Special conservation measures (Approach D) require further investigation for both Annex II species under the Habitats Directive, and for birds. Such measures may be required for particular activities which affect birds whilst at sea, whether or not areas qualifying as SPA can be identified by one or a combination of the following measures.

For a number of species that occur in UK waters, the European Seabirds at Sea (ESAS) database contains few records. In order for spatial analysis to work efficiently and be statistically valid, sufficient records must be included within the analysis. For those species with less than 20 records in the ESAS database, spatial analysis using ESAS data would be unreliable because of the number of zero abundance values, and other methods or data sources will need to be used. For some species with more than 20, but still few records in the database, other methods for identification of aggregations may also be more appropriate than spatial analysis.

Species for which there are few records in the database are either uncommon in UK waters, or their distribution is primarily inshore of the main survey areas covered. In order to separate this group of birds from those with an adequate number of records in the database as objectively as possible, numbers of records for all species within the

ESAS database were plotted. The resulting graph (see Annex A) was examined for 'breaks' in the frequency of records at a level above the point where an excess of zero abundance values might appear in the spatial analysis. The clearest split in the number of records in the database appeared to be at about 400 records. Those bird species with fewer than 400 records in the database (listed in Table 6.1) will be better analysed using other methods and/or alternative data, whilst those with greater than 400 records in the ESAS database (listed in Table 6.2) may be analysed using spatial analysis.

Table 6.1 Bird species with less than 400 records in the ESAS database

Common name	***Species***	***Status***	***Existing SPA(s) in UK?***	***Marine extension to breeding colony SPA likely?***
Black-throated diver	*Gavia arctica*	Ann. I	✓	
Great northern diver	*Gavia immer*	Ann. I		
Black-necked grebe	*Podiceps nigricollis*	M		
Red-necked grebe	*Podiceps griseigena*	M		
Slavonian grebe	*Podiceps auritus*	Ann. I	✓	
Cory's shearwater	*Calonectris diomedea*	Ann. I		
Great shearwater	*Puffinus gravis*	M		
Balearic shearwater	*Puffinus mauretanicus*	Ann. I		
Scaup	*Aythya marila*	M	✓	
Velvet scoter	*Melanitta fusca*	M	✓	
Goldeneye	*Bucephala clangula*	M	✓	
Surf scoter	*Melanitta perspicillata*	M		
Red-breasted merganser	*Mergus serrator*	M	✓	
Goosander	*Mergus merganser*	M	✓	
Red-necked phalarope	*Phalaropus lobatus*	Ann. I	✓	
Grey phalarope	*Phalaropus fulicaria*	M		
Pomarine skua	*Stercorarius pomarinus*	M		
Long-tailed skua	*Stercorarius longicaudus*	M		
Mediterranean gull	*Larus melanocephalus*	Ann. I	✓	✓
Sabine's gull	*Larus sabini*	M		
Ring-billed gull	*Larus delawarensis*	M		
Yellow-legged herring gull	*Larus argentatus cachinnans*	M		
Iceland gull	*Larus glaucoides*	M		
Glaucous gull	*Larus hyperboreus*	M		
Sandwich tern	*Sterna sandvicensis*	Ann. I	✓	✓
Roseate tern	*Sterna dougallii*	Ann. I	✓	✓
Little tern	*Sterna albifrons*	Ann. I	✓	✓
Black tern	*Chlidonias niger*	Ann. I		

Note: M = regularly occurring migratory species (Article 4.2, Birds Directive)
Ann. I = listed on Annex I of Birds Directive
Existing SPA(s) in UK? = Are there SPAs in the UK (Sept 2001) for which the species is a qualifying feature?

Table 6.2 Bird species with greater than 400 records in the ESAS database

Common name	*Species*	*Status*	*Existing SPA(s) in UK?*	*Marine extension to breeding colony SPA likely?*
Red-throated diver	*Gavia stellata*	Ann. I	✓	
Great crested grebe	*Podiceps cristatus*	M	✓	
Fulmar	*Fulmarus glacialis*	M	✓	✓
Sooty shearwater	*Puffinus griseus*	M		
Manx shearwater	*Puffinus puffinus*	M	✓	✓
Storm petrel	*Hydrobates pelagicus*	Ann. I	✓	✓
Leach's petrel	*Oceanodroma leucorhoa*	Ann. I	✓	✓
Gannet	*Morus bassanus*	M	✓	✓
Cormorant	*Phalacrocorax carbo*	M	✓	✓
Shag	*Phalacrocorax aristotelis*	M	✓	✓
Common eider	*Somateria mollissima*	M	✓	
Long-tailed duck	*Clangula hyemalis*	M	✓	
Common scoter	*Melanitta nigra*	M	✓	
Arctic skua	*Stercorarius parasiticus*	M	✓	✓
Great skua	*Catharacta skua*	M	✓	✓
Little gull	*Larus minutus*	M		
Black-headed gull	*Larus ridibundus*	M	✓	✓
Common gull	*Larus canus*	M	✓	✓
Lesser black-backed gull	*Larus fuscus*	M	✓	✓
Herring gull	*Larus argentatus*	M	✓	✓
Great black-backed gull	*Larus marinus*	M	✓	✓
Kittiwake	*Rissa tridactyla*	M	✓	✓
Common tern	*Sterna hirundo*	Ann. I	✓	✓
Arctic tern	*Sterna paradisaea*	Ann. I	✓	✓
Guillemot	*Uria aalge*	M	✓	✓
Razorbill	*Alca torda*	M	✓	✓
Little auk	*Alle alle*	M		
Puffin	*Fratercula arctica*	M	✓	✓

Note: M = regularly occurring migratory species (Article 4.2, Birds Directive)
Ann. I = listed on Annex I of Birds Directive
Existing SPA(s) in UK? = Are there SPAs in the UK (Sept 2001) for which the species is a qualifying feature?

Using ESAS data, a preliminary examination of the proportions of records for each species in 5 km bands from shore was performed on a sample of records (see Annex A). This preliminary analysis indicated that a suitable cut-off point to split the bird species into an 'inshore' group and an 'offshore' group was at 15 km (approximately 8 nm) from the coast. A graphical view of this analysis revealed two classes of seabird species: those where the cumulative percentage of abundance increased steeply within about 15km of the coast, and those where the percentage increased more gradually. Where 50% of database records occurred at less than 15 km from the coast, these species were termed 'inshore' (groups 1A and 2A in Table 6.3 below). Where 50% of records in the ESAS database occurred at greater than 15 km from the coast, these species were termed 'offshore' (groups 1B and 2B in Table 6.3 below). For those species with less than 400 records in the ESAS database, the split into inshore and offshore species (groups 1A and 1B in Table 6.3) was performed on the limited number of records held in the ESAS database, and was supplemented by general knowledge of the distribution of the species.

Table 6.3 Split of bird species into 'inshore' and 'offshore' groups

Common name	*Species*	*Status*	*Existing SPA(s) in UK?*	*Marine extension to breeding colony SPA likely?*
1A Species of primarily INSHORE distribution. Less than 400 records in ESAS database therefore no spatial analysis by modified Skov *et al.* 1995 methodology. Use of additional data and other methods required.				
Black-throated diver	*Gavia arctica*	Ann. I	✓	
Great northern diver	*Gavia immer*	Ann. I		
Red-necked grebe	*Podiceps grisegena*	M		
Slavonian grebe	*Podiceps auritus*	Ann. I	✓	
Black-necked grebe	*Podiceps nigricollis*	M		
Scaup	*Aythya marila*	M	✓	
Surf scoter	*Melanitta perspicillata*	M		
Velvet scoter	*Melanitta fusca*	M	✓	
Goldeneye	*Bucephala clangula*	M	✓	
Red-breasted merganser	*Mergus serrator*	M	✓	
Goosander	*Mergus merganser*	M	✓	
Ring-billed gull	*Larus delawarensis*	M		
Sandwich tern	*Sterna sandvicensis*	Ann. I	✓	✓
Little tern	*Sterna albifrons*	Ann. I	✓	✓
1B Species of primarily OFFSHORE distribution. Less than 400 records in ESAS database therefore no spatial analysis by modified Skov *et al.* 1995 methodology. Use of additional data and other methods required.				
Cory's shearwater	*Calonectris diomedea*	Ann. I		
Great shearwater	*Puffinus gravis*	M		
Balearic shearwater	*Puffinus mauretanicus*	Ann. I		
Red-necked phalarope	*Phalaropus lobatus*	Ann. I	✓	
Grey phalarope	*Phalaropus fulicaria*	M		
Pomarine skua	*Stercorarius pomarinus*	M		
Long-tailed skua	*Stercorarius longicaudus*	M		
Mediterranean gull	*Larus melanocephalus*	Ann. I	✓	✓
Sabine's gull	*Larus sabini*	M		
Yellow-legged herring gull	*Larus argentatus cachinnans*	M		
Iceland gull	*Larus glaucoides*	M		
Glaucous gull	*Larus hyperboreus*	M		
Roseate tern	*Sterna dougallii*	Ann. I	✓	✓
Black tern	*Chlidonias niger*	Ann. I		
2A Species of primarily INSHORE distribution (more than 50% of records in ESAS within 15 km of coast), adequately represented in ESAS database, therefore spatial analysis by modified Skov *et al.* 1995 methods to be performed, plus use of other data as appropriate.				
Red-throated diver	*Gavia stellata*	Ann. I	✓	
Great crested grebe	*Podiceps cristatus*	M	✓	
Cormorant	*Phalacrocorax carbo*	M	✓	✓
Shag	*Phalacrocorax aristotelis*	M	✓	✓
Common eider	*Somateria mollissima*	M	✓	
Long-tailed duck	*Clangula hyemalis*	M	✓	
Common scoter	*Melanitta nigra*	M	✓	
Little gull	*Larus minutus*	M		
Black-headed gull	*Larus ridibundus*	M	✓	✓
Common gull	*Larus canus*	M	✓	✓
2B Species of primarily OFFSHORE distribution (less than 50% of records in ESAS within 15 km of coast), adequately represented in ESAS database, therefore spatial analysis by modified Skov *et al.* 1995 method is primary analysis tool to identify aggregations.				
Fulmar	*Fulmarus glacialis*	M	✓	✓
Sooty shearwater	*Puffinus griseus*	M		
Manx shearwater	*Puffinus puffinus*	M	✓	✓
Storm petrel	*Hydrobates pelagicus*	Ann. I	✓	✓
Leach's petrel	*Oceanodroma leucorhoa*	Ann. I	✓	✓
Gannet	*Morus bassanus*	M	✓	✓
Arctic skua	*Stercorarius parasiticus*	M	✓	✓
Great skua	*Catharacta skua*	M	✓	✓
Lesser black-backed gull	*Larus fuscus*	M	✓	✓
Herring gull	*Larus argentatus*	M	✓	✓
Great black-backed gull	*Larus marinus*	M	✓	✓
Kittiwake	*Rissa tridactyla*	M	✓	✓
Common tern	*Sterna hirundo*	Ann. I	✓	✓
Arctic tern	*Sterna paradisaea*	Ann. I	✓	✓
Guillemot	*Uria aalge*	M	✓	✓
Razorbill	*Alca torda*	M	✓	✓
Little auk	*Alle alle*	M		
Puffin	*Fratercula arctica*	M	✓	✓

Note: M = regularly occurring migratory species (Article 4.2, Birds Directive)
Ann. I = listed on Annex I of Birds Directive
Existing SPA(s) in UK? = Are there SPAs in the UK (Sept 2001) for which the species is a qualifying feature?

The above groupings of bird species are represented in the flow diagram (Figure 5.1) presenting data analysis and processes for wide ranging marine species. The following sections outline possible approaches to identification of important feeding areas for each of the groups of birds shown in Table 6.3.

6.3.2.1. Inshore species, not adequately represented in ESAS database

Refer to Table 6.3 for the list of species included within this group (Group 1A). Aggregations or concentrations of birds adjacent to existing SPAs will be covered, for the two species that breed at coastal colonies in the UK (sandwich tern and little tern), by the Marine SPA Project under possible seaward extensions to breeding colony SPAs. Some of the other species in this group may be covered by the Marine SPA Project under the category of 'inshore areas used by birds in the non-breeding seasons'. Spatial analysis to identify feeding areas will not be appropriate for this group, due to the lack of records for these species in the ESAS database. Alternative sources of data other than the ESAS database will need to be used to try to identify feeding areas for these species. For some species where data on their distribution at sea are sparse, but a reasonable amount is known about their foraging behaviour (e.g. terns) it may be most appropriate to use a radius-based approach to define extensions to breeding colony SPAs generically for UK colonies. Alternatively, it may be best to use data from the individual colony studies from which the radius approach was derived, to define colony-specific radii. Existing data on important habitats for birds (Approach C), and results of other site-specific studies, may help in identifying areas important for feeding birds of this group of species. It may also be very useful to find out what approaches have been considered by other Member States.

6.3.2.2. Offshore species, not adequately represented in ESAS database

Refer to Table 6.3 for the list of species included within this group (Group 1B). Identification of areas that may qualify as SPAs for this group of species, many of which are comparatively rare in UK waters, will be difficult due to a lack of suitable data. Examination of the geographic locations of records over a suitable period of time may indicate that although rare, occurrences have followed an aggregated distribution pattern. If this is the case, it may be possible to identify important feeding areas for some species for consideration as SPAs, but if not, then it is unlikely that SPAs can be identified for such species in UK waters. For the two of these species which breed in the UK, extensions to breeding colony SPAs will also be considered, although such extensions may not cover important feeding areas.

6.3.2.3. Inshore species, fully represented in ESAS database

Refer to Table 6.3 for the list of species included within this group (Group 2A). Most of these species will fall within the Marine SPA Project category of 'inshore areas used by birds in the non-breeding seasons'. Such areas will be identified using aerial survey and WeBS core counts, possibly supplemented by spatial analysis of ESAS data. For several of these species, extensions to breeding colony SPAs will also be considered. Consideration of inshore SPAs for breeding red-throated divers (*Gavia stellata*) will also be necessary.

6.3.2.4. Offshore species, fully represented in ESAS database

Refer to Table 6.3 for the list of species included within this group (Group 2B). The ESAS database is the primary source of data on wide ranging species offshore. Therefore,

for this group of species, spatial analysis of data to identify aggregations is the only suitable method by which important areas might be identified. General distribution patterns of seabird densities in UK waters can be established using field data and spatial modelling techniques. Essentially, spatial modelling investigates the inter-relationships between density values across the region being investigated. Approach B (Section 5.2.2) briefly outlines two methods of modelling spatial distribution of birds.

Examination and testing of several variations of spatial analysis is likely to be the best first step to identifying important feeding areas for this group of birds. For all those of this group of species which also breed in the UK, extensions to breeding colony SPAs will also be considered. There are several technical difficulties that will need to be examined before any areas of elevated bird densities identified by spatial analysis techniques can be considered as possible SPAs:

- In using either of these spatial analysis techniques (Approach B), the boundaries of areas identified are determined by statistical parameters, and will change if details of the analyses of the data are changed or disputed.

- Important Bird Areas identified in Skov *et al.* (1995) applied only to the North Sea; to be applicable to selection of areas that may qualify as SPAs under the Birds Directive, data will need to be analysed, by whatever spatial analysis method is selected, for the whole of the UK Continental Shelf waters, rather than just North Sea waters.

- If the Skov *et al.* (1995) approach were used, further consideration would need to be given to the ecological justification of 3000 km^2 as a 'scaling parameter' for site selection (A in the MCC formula reproduced in Section 5.2.2). For example, Skov *et al.* (1995) used 3000 km^2 as a scaling parameter for all species and all seasons. For the purposes of marine SPA selection it might be considered appropriate to identify scaling parameters for individual species and/or seasons.

- Stroud *et al.* (2001) clearly recognises that many thinly dispersed and wide ranging species i.e. raptors, seabirds and many migrants in general are difficult to represent in an SPA site series using 1% as a selection level (see Section 4.2). This affects the possible use of the MCC formula to identify possible SPAs. Stroud *et al.* (2001) further caution that (terrestrial) SPA which have been selected are distinct in habitat and/or ornithological importance from the surroundings and have definable and recognisable character - a situation which is complicated and difficult to address in many seabirds away from their breeding grounds.

- On land, SPA guidelines are defined with some reference to absolute numbers of birds. The European Seabirds at Sea (ESAS) data (and those from the Joint Cetacean Database) are, however, relative abundances. The Stage 2 JNCC Guideline for selecting SPAs based on population density states that 'areas holding or supporting more birds than others and/or holding birds at higher concentrations are favoured for selection (see Section 4.2), therefore use of relative numbers rather than absolute numbers may be justified.

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Annex A Preliminary Analysis of Records in the ESAS Database

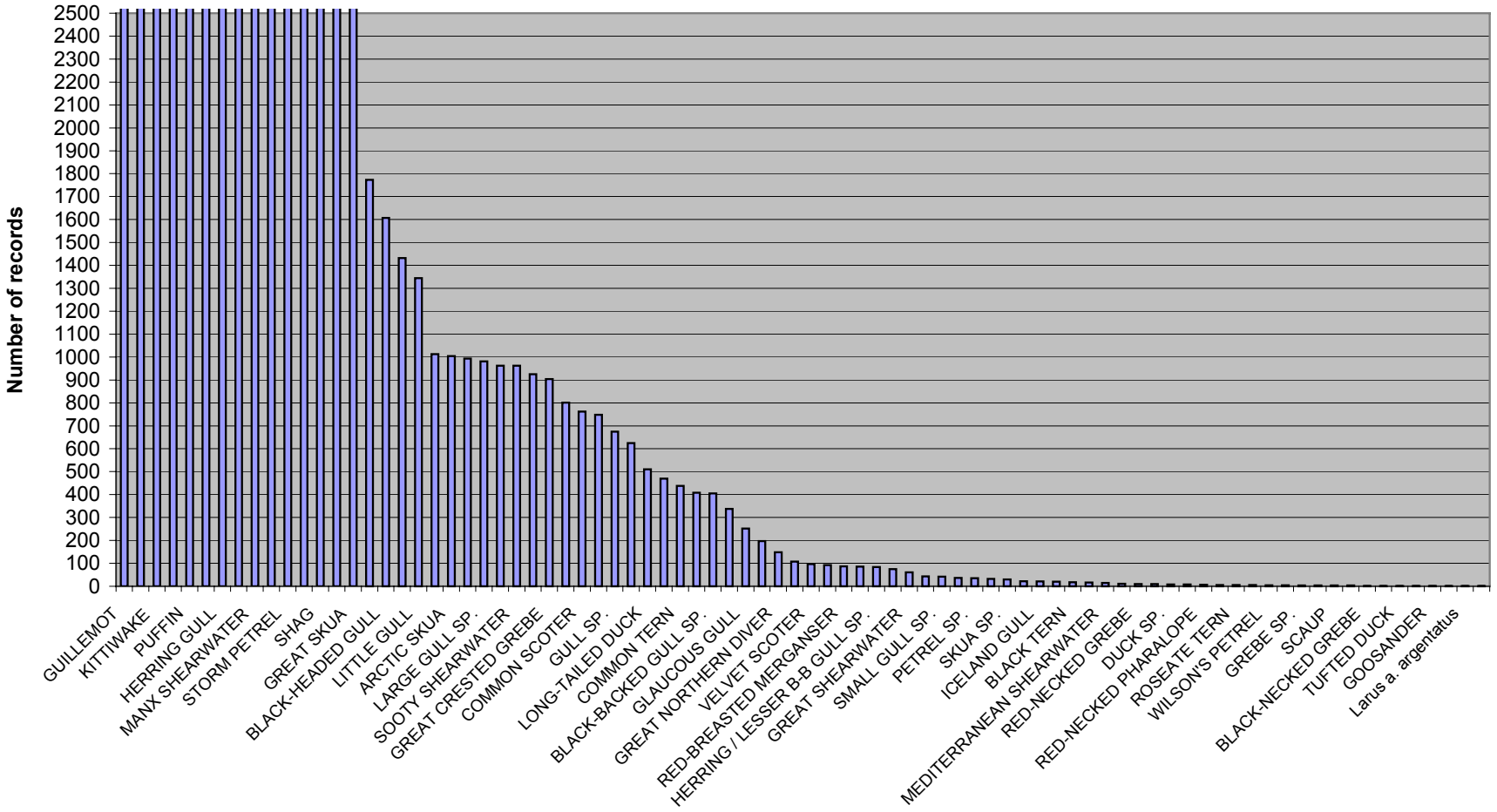
1. Distribution of records within ESAS database

The following table and graph represent a rough preliminary analysis of the number of records for all species in the ESAS database, based on a sample of the database records, to assist in determining a cut-off point below which spatial analysis of ESAS records will not be employed as a principal method to identify areas where aggregations of species occur.

Species name	No birds recorded	Number of records
GUILLEMOT	396506	159069
FULMAR	467468	113422
KITTIWAKE	207614	47551
GANNET	90578	45078
PUFFIN	129625	39199
RAZORBILL	62944	24728
HERRING GULL	98539	17916
GREAT BLACK-BACKED GULL	45736	13970
MANX SHEARWATER	111635	12131
GUILLEMOT / RAZORBILL	65300	11363
STORM PETREL	13548	6951
LESSER BLACK-BACKED GULL	27266	6949
SHAG	15703	4343
COMMON GULL	11516	4022
GREAT SKUA	4847	3822
LITTLE AUK	3543	1773
BLACK-HEADED GULL	6699	1607
AUK SP.	3635	1432
LITTLE GULL	3829	1344
ARCTIC TERN	2473	1013
ARCTIC SKUA	1135	1004
BLACK GUILLEMOT	1454	993
LARGE GULL SP.	15936	981
RED-THROATED DIVER	1257	962
SOOTY SHEARWATER	3208	962
COMMON EIDER	7856	925
GREAT CRESTED GREBE	1693	904
COMMIC TERN	2320	801
COMMON SCOTER	22326	762
LEACH'S PETREL	1189	748
GULL SP.	13796	674
CORMORANT	1098	625
LONG-TAILED DUCK	9666	510
DIVER SP	627	470
COMMON TERN	1182	438
TERN SP.	967	408
BLACK-BACKED GULL SP.	1735	405

SANDWICH TERN	572	338
GLAUCOUS GULL	343	252
POMARINE SKUA	226	197
GREAT NORTHERN DIVER	174	148
BLACK-THROATED DIVER	123	108
VELVET SCOTER	991	97
SHAG / CORMORANT	143	92
RED-BREASTED MERGANSER	344	87
LONG-TAILED SKUA	132	86
HERRING / LESSER B-B GULL SP.	455	84
COMMON / HERRING GULL	158	75
GREAT SHEARWATER	174	60
Larus fuscus graellsii	53	43
SMALL GULL SP.	346	42
SCOTER SP.	1083	36
PETREL SP.	239	35
CORY'S SHEARWATER	64	32
SKUA SP.	32	30
MEDITERRANEAN GULL	23	22
ICELAND GULL	24	21
GREY PHARALOPE	25	20
BLACK TERN	22	18
SABINE'S GULL	21	16
MEDITERRANEAN SHEARWATER	18	14
YELLOW-LEGGED GULL	13	11
RED-NECKED GREBE	13	10
LITTLE TERN	20	10
DUCK SP.	20	8
PUFFIN / LITTLE AUK	9	8
RED-NECKED PHARALOPE	9	7
PHARALOPE SP.	9	5
ROSEATE TERN	6	5
BRUNNICH'S GUILLEMOT	5	5
WILSON'S PETREL	4	4
GOLDENEYE	35	4
GREBE SP.	3	3
SHEARWATER SP.	3	3
SCAUP	45	3
GLAUCOUS / ICELAND GULL	3	3
BLACK-NECKED GREBE	1	1
CORY'S / GREAT SHEARWATER	1	1
TUFTED DUCK	1	1
SURF SCOTER	2	1
GOOSANDER	1	1
Larus f. fuscus	1	1
Larus a. argentatus	1	1
GLAUCOUS / HERRING HYBRID	1	1

Species abundance around Britain and Ireland



2. Distance from shore

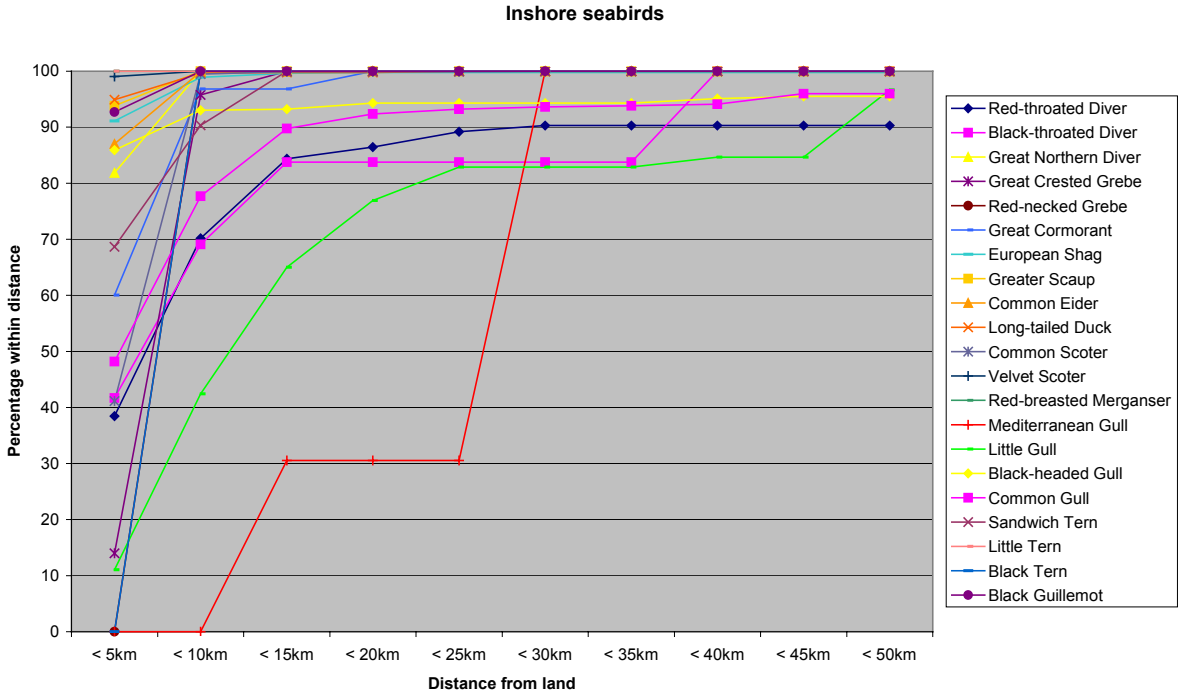
The following table and three graphs represent a preliminary analysis of the percentage of records of observations of seabirds in the ESAS database according to distance from shore. For example, for red throated diver, 38% of records occurred within 5 km of the UK shore, 70% within 10 km, etc.

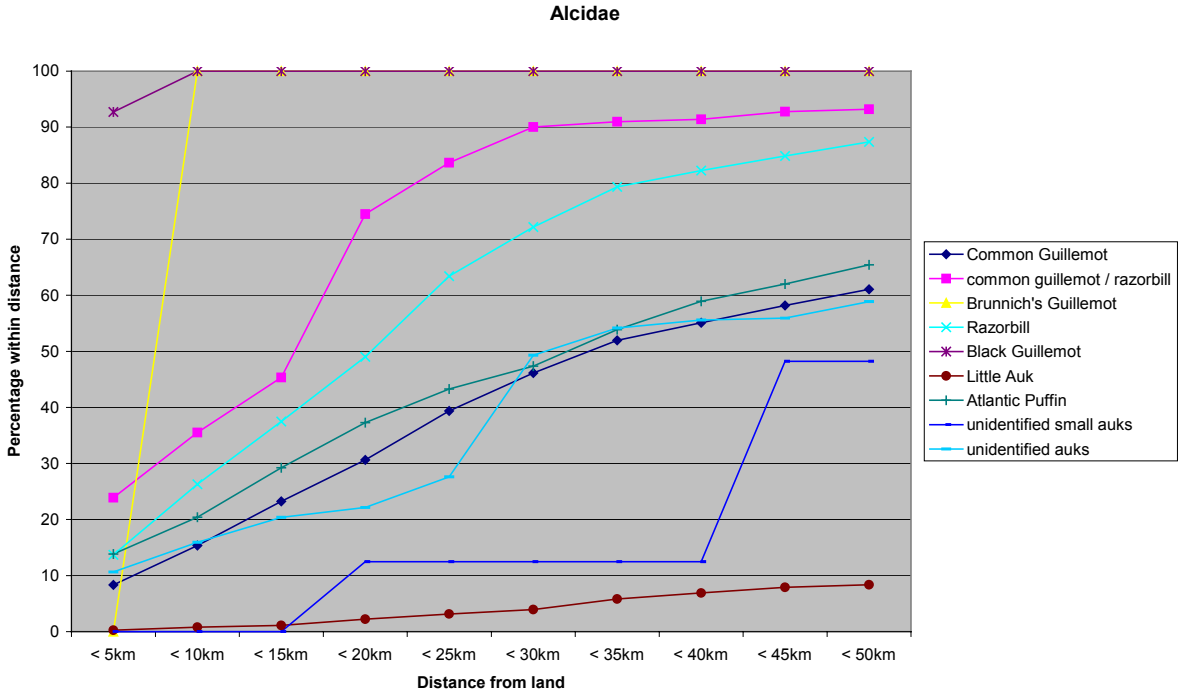
This analysis is taken from a sample of 2877 ten-minute recording periods randomly selected from the ESAS database. All records were between 48°N, 63°N, 18°W and 3°E. Only birds "in transect" were used (the full methodology can be found in Komdeur, K, Bertelson, J & Cracknell G. (eds) 1992. Manual for aeroplane and ship surveys of waterfowl and seabirds. IWRB Spec. Publ. 19, Slimbridge, UK, 37pp). Distance was calculated to the nearest point of land, taken from the World Vector Shoreline (USDA). The density (number per km^2) of each species was calculated using the sample, and from this, the percentage occurring within 5 km zones. The number of birds used to perform this calculation is low for many of the species presented here, but would increase if this analysis were extended to the whole database of over 290,000 ten-minute recording periods.

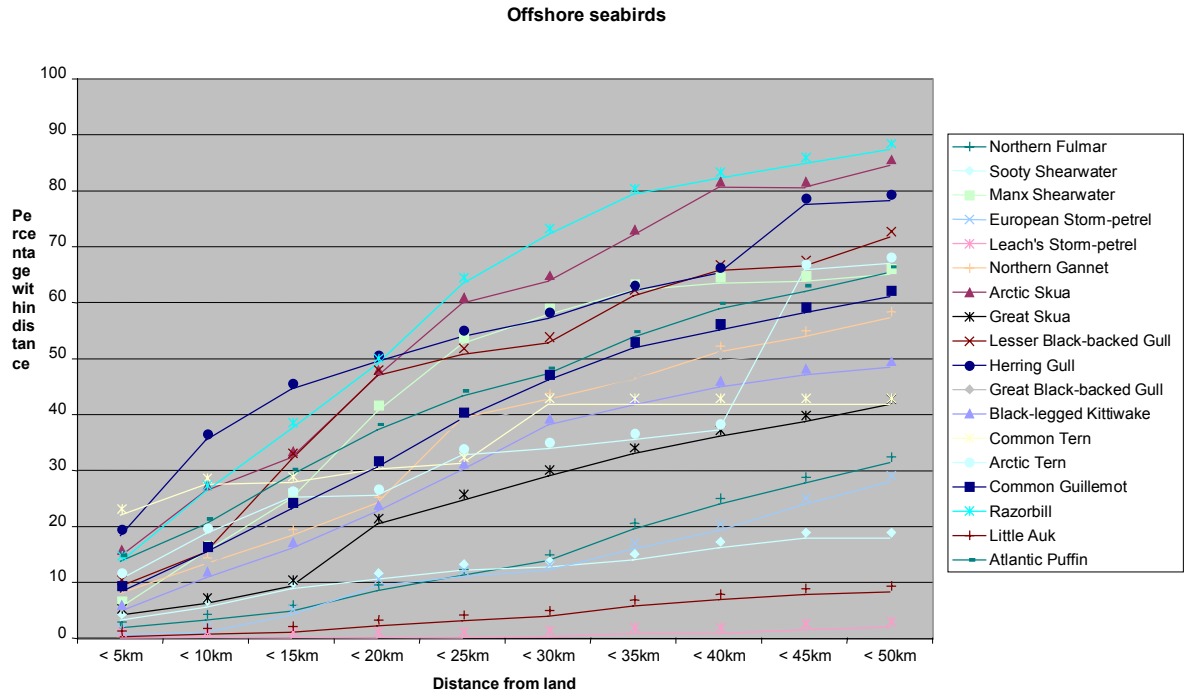
Number of individuals	Species name	< 5km	< 10km	< 15km	< 20km	< 25km	< 30km	< 35km	< 40km	< 45km	< 50km
236	Red-throated Diver	38.43	70.19	84.38	86.44	89.19	90.31	90.31	90.31	90.31	90.31
23	Black-throated Diver	41.69	69.09	83.78	83.78	83.78	83.78	83.78	100	100	100
44	Great Northern Diver	81.85	100	100	100	100	100	100	100	100	100
140	unidentified divers	33.36	57.12	86.76	90.12	90.12	90.12	90.12	90.12	90.12	90.12
313	Great Crested Grebe	13.98	95.78	100	100	100	100	100	100	100	100
4	Red-necked Grebe	0	100	100	100	100	100	100	100	100	100
59296	Northern Fulmar	1.92	3.26	4.87	8.5	11.29	13.9	19.54	24.02	27.79	31.37
20	Cory's Shearwater	43.9	43.9	43.9	43.9	49.34	49.34	49.34	49.34	49.34	49.34
4	Great Shearwater	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69
134	Sooty Shearwater	3.23	5.63	8.83	10.62	12.23	12.71	14.06	16.19	17.91	17.91
14712	Manx Shearwater	5.61	15.53	24.98	40.61	52.69	57.86	62.28	63.49	63.79	65.01
1	Balearic Shearwater	0	0	0	100	100	100	100	100	100	100
1064	European Storm-petrel	0.66	1.14	4.17	9.51	11.06	12.17	15.99	19.36	23.96	27.99
119	Leach's Storm-petrel	0	0.15	0.15	0.15	0.15	0.34	0.89	0.89	1.59	1.98
7	European / Leach's storm-petrel	0	0	0	0	0	0	0	0	0	0
11134	Northern Gannet	8.04	13.36	18.41	24.19	39.44	42.72	46.26	51.2	53.95	57.34
116	Great Cormorant	60.05	96.83	96.83	100	100	100	100	100	100	100
2361	European Shag	91.11	98.9	99.61	99.74	99.74	99.74	99.74	99.74	99.74	99.74
17	unidentified cormorant / shags	80.23	100	100	100	100	100	100	100	100	100
40	Greater Scaup	93.83	100	100	100	100	100	100	100	100	100
1351	Common Eider	87.02	99.88	99.88	100	100	100	100	100	100	100
878	Long-tailed Duck	94.92	99.64	99.77	99.77	100	100	100	100	100	100
3697	Common Scoter	41.12	99.47	99.91	99.91	99.91	100	100	100	100	100
120	unidentified scoters	98	100	100	100	100	100	100	100	100	100
185	Velvet Scoter	99.03	100	100	100	100	100	100	100	100	100
73	Red-breasted Merganser	100	100	100	100	100	100	100	100	100	100
1	Red-necked Phalarope	0	0	0	100	100	100	100	100	100	100
3	Grey Phalarope	0	0	15.18	15.18	15.18	49.69	49.69	100	100	100
13	Pomarine Skua	5.5	21.76	21.76	54.31	54.31	80.74	80.74	100	100	100
82	Arctic Skua	14.72	26.33	32.38	46.9	59.87	63.8	72.01	80.6	80.6	84.5
16	Long-tailed Skua	3.3	3.3	20.73	20.73	20.73	100	100	100	100	100
534	Great Skua	4.25	6.22	9.34	20.39	24.66	29.02	32.99	36.16	38.81	41.79
4	unidentified skuas	3.87	6.15	6.15	6.15	6.15	6.15	19.07	19.07	19.07	19.07

2	Mediterranean Gull	0	0	30.55	30.55	30.55	100	100	100	100	100
399	Little Gull	11.06	42.43	65.01	76.91	82.89	82.89	82.89	84.65	84.65	96.65
4	Sabine's Gull	0	0	0	0	0	0	0	0	0	0
937	Black-headed Gull	85.9	93.01	93.23	94.33	94.33	94.33	94.33	95.08	95.53	95.53
1539	Common Gull	48.19	77.68	89.77	92.37	93.24	93.6	93.84	94.1	95.97	95.97
137	unidentified small gulls	19.22	50.31	50.31	50.31	50.31	50.31	50.31	50.31	50.31	50.31
3329	Lesser Black-backed Gull	9.4	15.44	32.03	46.94	50.78	52.82	61.16	65.74	66.53	71.64
137	Lesser black-backed / herring gulls	5.01	9.24	100	100	100	100	100	100	100	100
12485	Herring Gull	18.42	35.44	44.54	49.53	54.02	57.17	62.04	65.23	77.57	78.23
36	Common / herring gulls	98.34	100	100	100	100	100	100	100	100	100
2	Iceland Gull	0	0	0	0	0	40.69	40.69	100	100	100
17	Glaucous Gull	0	0.44	0.44	1.54	1.54	1.54	4.02	4.02	4.02	14.67
7750	Great Black-backed Gull	4.54	12.44	23.22	32.92	38.07	41.98	46.4	49.68	51.18	52.89
1563	unidentified large gulls	51.61	73.66	90.91	91.32	93.53	95.2	95.2	98.11	98.11	98.45
29236	Black-legged Kittiwake	4.89	10.84	16.12	22.75	30.18	38.22	41.77	44.95	47.1	48.47
25	Sandwich Tern	68.67	90.33	100	100	100	100	100	100	100	100
143	Common Tern	22.09	27.57	27.86	30.28	31.36	41.84	41.84	41.84	41.84	41.84
193	Arctic Tern	10.58	18.68	25.28	25.64	32.79	33.95	35.55	37.24	65.84	66.98
248	'commic' terns	30.13	41.6	56.97	58.5	98.34	100	100	100	100	100
9	Little Tern	100	100	100	100	100	100	100	100	100	100
1	Black Tern	0	100	100	100	100	100	100	100	100	100
59	unidentified terns	89.38	90.38	97.51	100	100	100	100	100	100	100
74827	Common Guillemot	8.33	15.37	23.21	30.64	39.37	46.15	51.96	55.09	58.18	61.07
11132	common guillemot / razorbill	23.88	35.51	45.31	74.47	83.65	90.02	90.95	91.39	92.75	93.17
1	Brunnich's Guillemot	0	100	100	100	100	100	100	100	100	100
12664	Razorbill	13.7	26.29	37.5	49.04	63.4	72.17	79.36	82.25	84.84	87.37
204	Black Guillemot	92.69	100	100	100	100	100	100	100	100	100
596	Little Auk	0.26	0.76	1.1	2.24	3.13	3.93	5.81	6.88	7.9	8.36
16554	Atlantic Puffin	13.82	20.39	29.22	37.29	43.28	47.38	53.87	58.91	62.01	65.43
3	unidentified small auks	0	0	0	12.45	12.45	12.45	12.45	12.45	48.21	48.21
629	unidentified auks	10.63	15.93	20.38	22.12	27.59	49.31	54.15	55.6	55.9	58.86

The results in the above table, when presented graphically, demonstrate the split between 'inshore' and 'offshore' groups of birds at around 15 km (approximately 8 nm) from shore.






Offshore seabirds
Percentage within distance
100
90
80
70
60
50
40
30
20
10
0
< 5km
< 10km
< 15km
< 20km
< 25km
< 30km
< 35km
< 40km
< 45km
< 50km
Distance from land
Northern Fulmar
Sooty Shearwater
Manx Shearwater
European Storm-petrel
Leach's Storm-petrel
Northern Gannet
Arctic Skua
Great Skua
Lesser Black-backed Gull
Herring Gull
Great Black-backed Gull
Black-legged Kittiwake
Common Tern
Arctic Tern
Common Guillemot
Razorbill
Little Auk
Atlantic Puffin