DEVELOPING REGIONAL SEAS FOR UK WATERS USING BIOGEOGRAPHIC PRINCIPLES

Background to the paper

JNCC has prepared this paper to take forward the concept of regional seas for implementing UK nature conservation strategy. It was developed with contributions from the inter-country conservation agency Marine Natura 2000 Project Group. However, the development of regional seas and the placement of their boundaries must be regarded as 'work in progress' and JNCC welcomes comment on the following text, along with any additional information to finalise the boundaries. Following this consultation with interested parties, the boundaries will be finalised and the regional seas will be proposed to Defra for use in future policy and management initiatives.

Please send comments or information to Caroline Turnbull at caroline.turnbull@jncc.gov.uk or JNCC, Monkstone House, City Road, Peterborough, PE1 1JY

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Introduction

The interim report of the Review of Marine Nature Conservation (RMNC) identified, as an issue faced in developing an effective framework, the need to direct policies at the most appropriate and effective scale. It suggested that one ecological level at which policies can be applied is at a regional sea level. Regional Seas should be based on ecologically meaningful subdivisions of the wider sea and incorporate a classification of marine landscapes. The regional seas approach could provide a framework to:

- Support an ecologically meaningful approach to the identification of nationally important marine landscapes, habitats and species for conservation action;
- Implement OSPAR recommendations on marine biodiversity[1] (including the selection of marine protected areas (MPAs));
- Break down Biodiversity Action Plan (BAP) targets to a level at which action can be taken to deliver the objectives;
- Express marine biodiversity objectives at an equivalent scale to that within other sectors, e.g. the proposed regional advisory councils for fisheries; and
- Provide a basis for regional assessments of the marine resource to implement specified regional-based initiatives, such as Particularly Sensitive Sea Areas. (after DETR, 2001).

Biogeography is the study of fauna and flora in a spatial and temporal context. Many biogeographic studies of various marine flora and fauna in the north east Atlantic in relation to different ecological parameters have been undertaken and biogeographic regions have been determined under various initiatives at an international, national and country scale. However, this paper draws on past studies and initiatives to propose regional seas to be used in implementing recommendations from the RMNC and other marine environmental policies.

For the purposes of selecting protected areas under the Habitats Directive, Annex III selection criteria require that sites selected encompass the full range of typical habitat for a feature having regard to geographical range (Hopkins & Buck, 1995). Whilst this is undertaken by the EC at a broad scale through the division of the territory covered by the EU into six biogeographic regions, it is also considered at a national scale to assess sites for representativity prior to proposal. OSPAR MPAs have the explicit aim of encompassing areas which best represent the range of species, habitats and ecological processes in the OSPAR area. Regional seas derived through biogeographic principles can provide a mechanism to achieve these aims systematically.

[1] The OSLO PARIS Convention, Annex V agreed in 1998 at Sintra, Portugal which contains provisions on protection of ecosystems and biodiversity across the North East Atlantic.

UK waters have been split into biogeographic regions on a number of occasions with varying results depending on the scale that has been used. The regional seas outlined in this paper have been derived taking previous work into account and, principally, with consideration of the biogeography of seabed fauna and species which are not wide ranging. It should also be noted that the fluid continuum of the marine environment precludes sharp boundaries and therefore, divisions on a map are only a representation of a transition from an area of one character to another.

OSPAR biogeographic regions

OSPAR biogeographic regions are sub-divided into deep-sea (greater than 1000 m deep) and the shelf and upper continental slope (less than 1000 m deep). The UK seabed area[2] currently falls into two deep-sea regions; Arctic sub-region and Atlantic sub-region (Figure 1) and two shelf/slope regions; Boreal and Boreal-Lusitanean (Figure 2) (Dinter, 2001). These sub-divisions have been undertaken on a large scale and were determined through reviews of literature and discussion within the OSPAR Biodiversity Committee. Whilst useful, these divisions are not at a fine enough scale for the derivation of regional seas within the UK.

UK biogeographic region initiatives

The subdivision of UK waters into biogeographic regions has already been commenced by English Nature in their "Natural Areas" work and considered by the Review of Marine Nature Conservation (RMNC) in their "regional seas" work. Inshore waters have been divided into a series of 15 sectors for the Marine Nature Conservation Review Programme since 1987.

Natural Areas

Natural Areas have been formally defined as 'biogeographic zones which reflect the geological foundation, the natural systems and processes and the wildlife in different parts of England, and provide a framework for setting objectives for nature conservation' (Anon, 1995). Currently only English Nature has formally defined marine natural areas (MNAs) which focus on the conditions of the marine environment as defined by the bathymetric and oceanographic characteristics of the seas from mean low water out to the two hundred mile limit or median line of UK controlled waters. The motive for defining marine natural areas was primarily for delivering objectives under BAPs, Habitat Action Plans and Species Action Plans. The work has defined six natural areas which are listed below and shown in Figure 3.
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[2] The UK seabed area comprises the UK territorial seas which extend from the baseline to 12 nautical miles and the UK Continental Shelf designated areas, set out in orders made under section 1(7) of the Continental Shelf Act 1964, which extend from the outer territorial seas limit to the median line or approximately 350 nautical miles from the baseline (north west of Scotland).

1. Mid North Sea MNA
2. Southern North Sea MNA
3. Mid and Eastern English Channel MNA
4. South Western Peninsula MNA
5. Western Approaches MNA
6. Irish Sea MNA

Where these natural areas adjoin waters of another country, the lateral boundary is political rather than defined by ecological criteria (Pater, 1999). Elsewhere the lateral extent of the areas was determined by consideration of depth at which wave action on the seabed becomes of minimal significance, taken as the 50 m isobath (Brampton & Evans, 1998 in Pater, 1999). The boundary between the Western Approaches MNA and the South Western Peninsula MNA is the 100 m isobath. Whilst this initiative rightly ignores the division between territorial seas and the wider UK Continental Shelf, the boundaries are still influenced by country political boundaries since the MNAs are restricted to waters adjacent to England. In addition to this, the basis for some divisions between the MNAs needs re-examination and wider consultation.

Draft regional seas

Draft regional seas, for the purpose of implementing the strategy arising from the RMNC, have been derived under the Irish Sea Pilot Project. The boundaries are intended to reflect, as far as possible:

- ecosystem-based, ecologically meaningful subdivisions of the wider sea
- the distribution of natural resources
- the socio-economic uses made of the area (Atkins & Lumb, 2002).

Figure 4 shows the current draft boundaries for the regional seas using these criteria. The benefit of these boundaries is that they are simple and based on sounds science (frequently drawing on the same sources as noted in Dinter 2001 for OSPAR biogeographic boundaries). However, the boundaries in some places are too simple and the basis for their placement needs further examination. It is also important that consideration is given to the extension of boundaries beyond UK waters.

Proposed biogeographic regions in UK waters

A combination of English Nature's Natural Areas and the draft regional seas divides the whole of the UK waters on roughly the same scale using similar criteria. However, as noted above, further work is needed to provide regional seas which are not restricted by administrative boundaries and take full account of all information available, especially to the north west of Scotland. Figure 5 shows the UK waters divided into a proposed series of regional seas based on biogeographical considerations at an appropriate scale and each region is described in turn below. Regions abutting the median line or edge of the Continental Shelf designated area extend beyond UK waters. Extension of boundaries beyond UK waters has been undertaken tentatively, using Dinter (2001) as a main source of guidance. These extensions should be seen as draft and purely indicative of where regional seas may continue to.

1. Northern North Sea region – This is bounded by the Flamborough front to the south which marks the transition from shallow mixed water in the south to deeper stratified waters (50 – 200 m) in the north and a concomitant transition to muddier sediments

(Pantin, 1991). The bottom water temperature varies between 6 and 11ºC and in general the waters are cooler than those to the south of the front (MAFF, 1981). The water is coastal in origin but there is a strong influx of continental shelf current water sourced from the Atlantic at the northern edge. Turbidity is moderate. The northern boundary marks the transition from water dominated by the continental shelf current to the waters of the North Sea which are of mixed origin. The eastern edge is bounded by the Norwegian Deep where North Atlantic Drift mixes with brackish water originating from the Baltic (Dinter, 2001).

2. Southern North Sea region – This is bounded by the Flamborough front to the north and the Dover straits to the south where a transition from North sea water to Atlantic water commences. The waters in this region are shallow (generally between 0 and 50 m depth), mixed and undergo large seasonal temperature variations with water temperatures reaching up to 17ºC in summer (MAFF, 1981). The seabed is predominantly sand (Pantin, 1991). Coastal water influences are particularly marked in this region and the water is turbid. This region also has a characteristic plankton composition (MAFF, 1981). Studies of epibenthic invertebrates and fish confirm the continuation of this region to the west coast of Denmark (Callaway *et al*, 2002).

3. Eastern English Channel region – This region is bounded by the Dover straits to the east and to the west by a line from Weymouth across to Cherbourg. Waters here are mixed and generally shallow (0-100 m deep) although tidal streams are strong. The seabed is variable with a general transition from coarser sediments in the west to sand in the east although there are localised rock outcrops throughout the English Channel basin. Water temperatures vary seasonally from 7 to 17ºC (MAFF, 1981). The western boundary denotes a transition in benthic fauna from the eastern English Channel (Boreal fauna) to a different community in the western English Channel (Lusitanean fauna present (Holme, 1966 & Dinter, 2001))

4. Western English Channel and Celtic Sea region – This large region is bounded by a line from Weymouth to Cherbourg in the east and the 1000 m contour marking the base of the continental slope to the west. It is bounded to the north east by the Celtic sea front which marks the transition from oceanic water to coastal influenced waters of the Irish Sea. The waters are generally subject to seasonal stratification although the eastern end of the region undergoes greater mixing due to shallower depths. Bottom water temperatures undergo little variation (approximately 10ºC) although in the eastern part of the region they undergo more seasonal variation (MAFF, 1981). The southern boundary is delimited by a transition to warmer water and a community containing a greater number of Lusitanean species (Dinter, 2001). The water depth of the region varies from 50 to 200 m with a general trend of shallower to deeper from east to west. The region is heavily influenced by Atlantic water and coastal influences are reduced leading to moderate turbidity. The seabed is largely composed of sand and gravels with isolated rocky outcrops (Pantin, 1991).

5. Atlantic South West Approaches region – this region is bounded to the east by the shelf break and extends westwards into the north east Atlantic beyond UK waters. The water is oceanic in origin (North Atlantic Water/Gulf Stream) with negligible coastal influences leading to low turbidity. The water column is stratified and bottom water temperatures are typically between 10 and 11ºC. Surface waters vary seasonally between c. 11 and 17ºC (MAFF, 1981). The seabed is generally composed of fine material. Whilst similar

in nature to regions 10 (Rockall Trough and Bank) and 11 (Atlantic North West Approaches), influences from the Mediterranean current are stronger in this region leading to Lusitanean species being present in the water column (Dinter, 2001).

6. Irish Sea region – this region is bounded to the south by the Celtic Sea front but for practical reasons has been aligned to the boundary of the Irish Sea Pilot Project. It is bounded to the North by a line from Mull of Kintyre (Scotland) to Fair Head (Northern Ireland) encompassing the North Channel within the region. Movements of species through the North Channel indicate that there is a slow change in conditions through the channel into the Malin basin (JNCC, 2003) and this boundary is indicative of transition rather than a sharp change. The boundary taken is that of the Irish Sea Pilot Project. The water is strongly influenced by coastal processes and turbid with influxes of water from the Celtic sea and north from the continental shelf current. Stratification occurs in deeper waters but not in the coastal margin or in the north east of the area. The seabed is variable in nature but dominated by glacigenic deposits which have been re-worked by tidal currents (Pantin, 1991). Bottom water temperatures vary from 6 to 13ºC (MAFF, 1981).

7. Minches and West Scotland region – This region is bounded to the south by a line from Mull of Kintyre to Fair Head, to the west by the Malin front and to the north by a line from the Butt of Lewis to Cape Wrath. These boundaries encompass waters which are sheltered by Northern Ireland and the Outer Hebrides from Atlantic swells. The waters in the region largely comprise of North Atlantic Water as part of the continental shelf current but are modified by coastal influences. Bottom water temperatures are between 8 and 10ºC (MAFF, 1981) and turbidity is moderate to low. The seabed is characterised by muddy sand and mud although in the south of the region the seabed contains more gravel (Pantin, 1991). The majority of the waters in the region stratify in the summer months (MAFF, 1981).

8. Scottish Continental Shelf region – This region runs along the continental shelf to the north of the UK, bounded to the west, south of the Wyville Thomson Ridge, by the 1000 m contour to reflect the changes in community composition which has been observed at around 1000 m in various studies on shelf slope fauna (see Dinter, 2001 for references). The boundary to the west, north of the Wyville Thomson Ridge is placed along the 600 m contour where the influence of cold Norwegian Sea/Arctic Intermediate water commences (Borenäs *et al*, 2001). The entire continental shelf is dominated by the warm (>8ºC) waters of the continental shelf current (North Atlantic Water) until the Orkney and Shetland Isles (Aurora Environmental Ltd & Hartley Anderson Ltd, 2001). The main division between Lusitanean and Boreal fauna occurs in the channel between the Orkney and Shetland Islands (Dinter, 2001 and John Baxter, pers. comm.), with Lusitanean fauna occurring in the Orkney Islands but not in the Shetland Islands. The boundary between this region and region 1 (Northern North Sea) reflects this. It is likely that the Fair Isle current and other currents into the northern North Sea are the structuring force for this division but their precise influence is not currently known by the author. The region is bounded to the north east by the Norwegian Deep where North Atlantic Drift mixes with brackish water originating from the Baltic (Dinter, 2001). Water in this region has low turbidity and there is a low level of terrigenous material entering the region. It is subject to seasonal stratification. The seabed is characterised by sand and coarse sediment of glacigenic origin which has been re-worked by tidal processes (Pantin, 1991). In deeper

areas close to the shelf break, sediments have been formed into iceberg ploughmarks; a complex matrix habitat of coarse gravel ridges and sand troughs (Belderson *et al*, 1973).

9. Faroe-Shetland Channel region – This region is characterised by an influx of dense cold water from the Arctic and Norwegian sea into the channel at depths below 600 m (Borenäs *et al*, 2001). The northern and southern boundaries of this region are, therefore, at the 600 m contour. The western boundary of the region is the Wyville Thomson Ridge which prevents the majority of the flow of cold water from entering the Rockall Trough. Water temperatures at the seabed are approximately 0ºC but water temperatures in water less than 600 m, where North Atlantic Water flows, are between 6.5 and 8ºC (Borenäs *et al*, 2001). Both waters in the region are oceanic in origin and turbidity is low. The cold waters at depth result in a different characteristic benthic community to that found at shallower depths in the channel or in the Rockall Trough (Bett, 2001). The seabed of the channel is mainly composed of silt and clay at the base with more sand and some areas of gravel on the continental slope and Wyville Thomson Ridge (Bett, 2001).

10. Rockall Trough and Bank region – This deep-sea region is bounded to the east by the 1000 m depth contour and to the west by the 1000 m depth contour on the western edge of the Rockall Bank, extending north to George Bligh Bank and Outer Bailey Bank (see Dinter, 2001 for references). The waters of the region are totally oceanic in origin with a negligible input of terrigenous material and little seasonal change in primary productivity. Turbidity is very low and the waters are relatively warm at c. 8ºC (Aurora Environmental Ltd & Hartley Anderson Ltd, 2001). The seabed supports a different faunal community to that observed at depths less than 1000 m (Gage, 1986) and is mainly composed of muddy sand and mud (Masson *et al*, 2000). On Rockall Bank and the seamounts, in shallower waters, the fauna is likely to be similar to those found at the western edge of region 8 (Scottish Continental Shelf).

11. Atlantic North West Approaches region – This deep-sea region is bounded to the east by a line which approximately follows the 1000 m depth contour along Rockall, George Bligh and Outer Bailey Banks and extends out to the west beyond the UK Continental Shelf designated areas into the North Atlantic. The waters are totally oceanic in origin with no terrigenous input and little seasonal change in primary productivity which is low. Turbidity is very low and waters are cool due to an influx of south flowing Arctic water (Aurora Environmental Ltd & Hartley Anderson Ltd, 2001). The entire region is deep (>1000 m) and the seabed is composed of fine clay and mud.

Figure 1. OSPAR deep-sea biogeographic regions (Dinter, 2001)

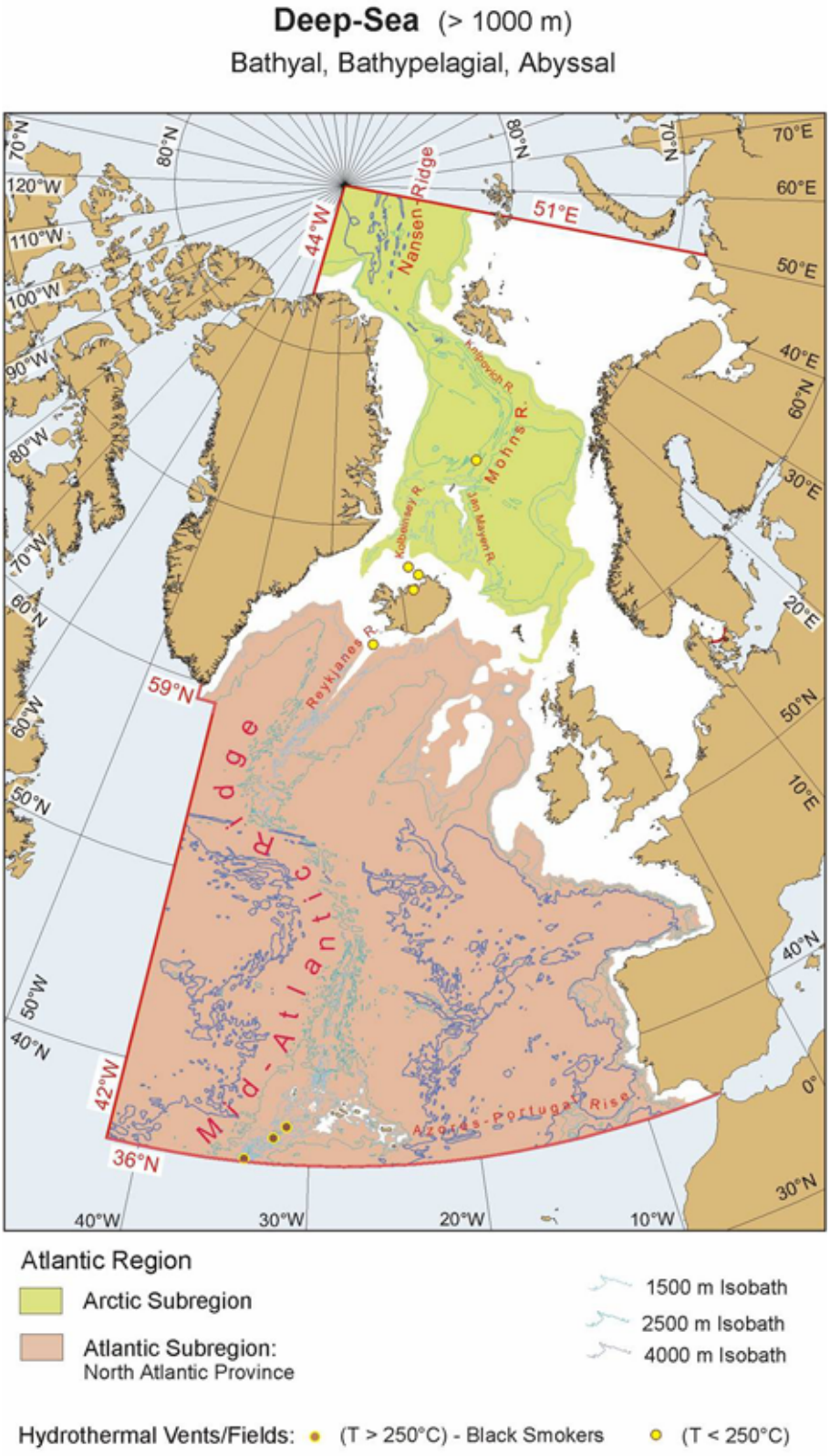


Figure 2 OSPAR continental shelf and slope biogeographic regions (Dinter, 2001)

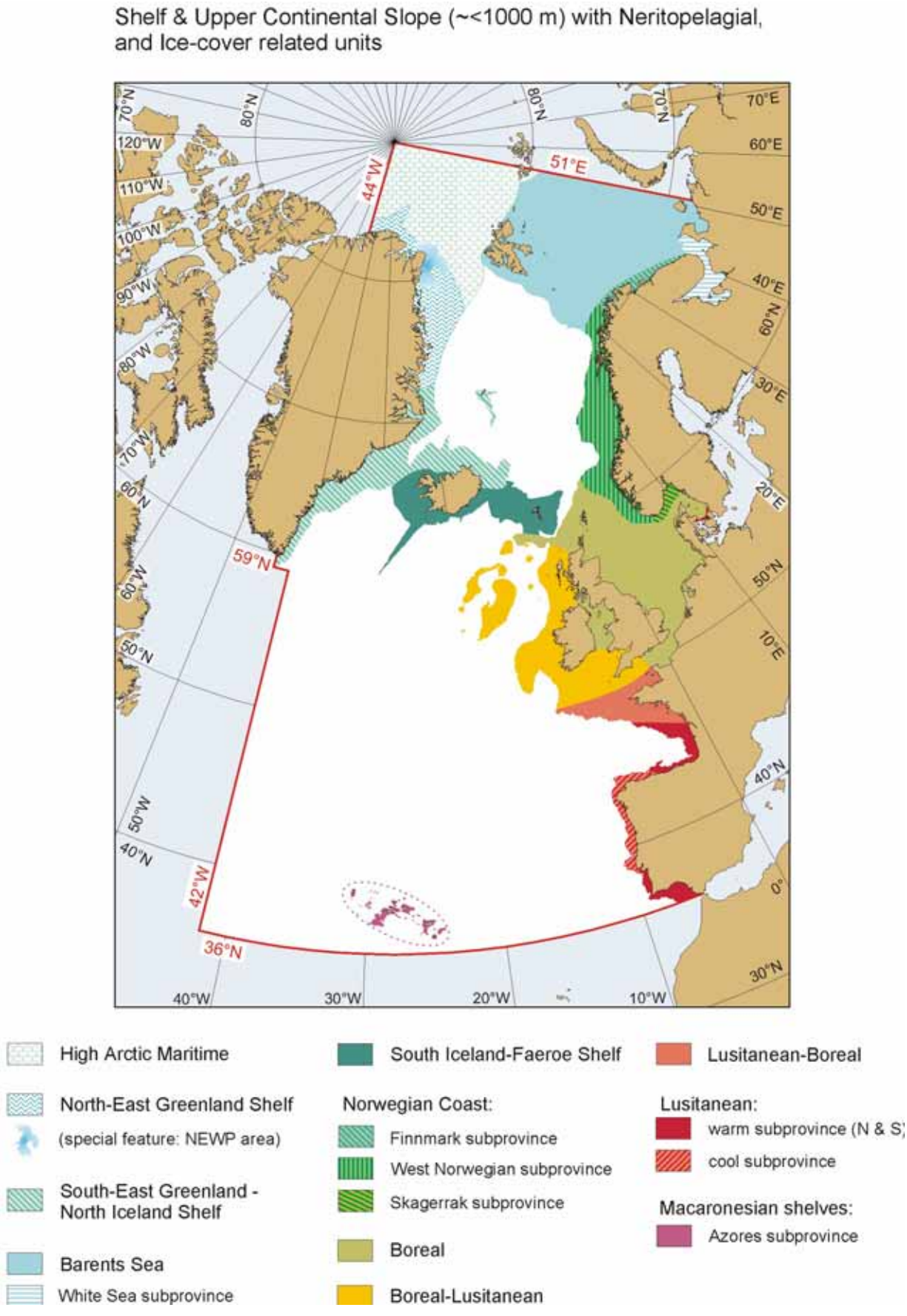


Figure 3 Marine Natural Areas for English waters and adjacent offshore waters

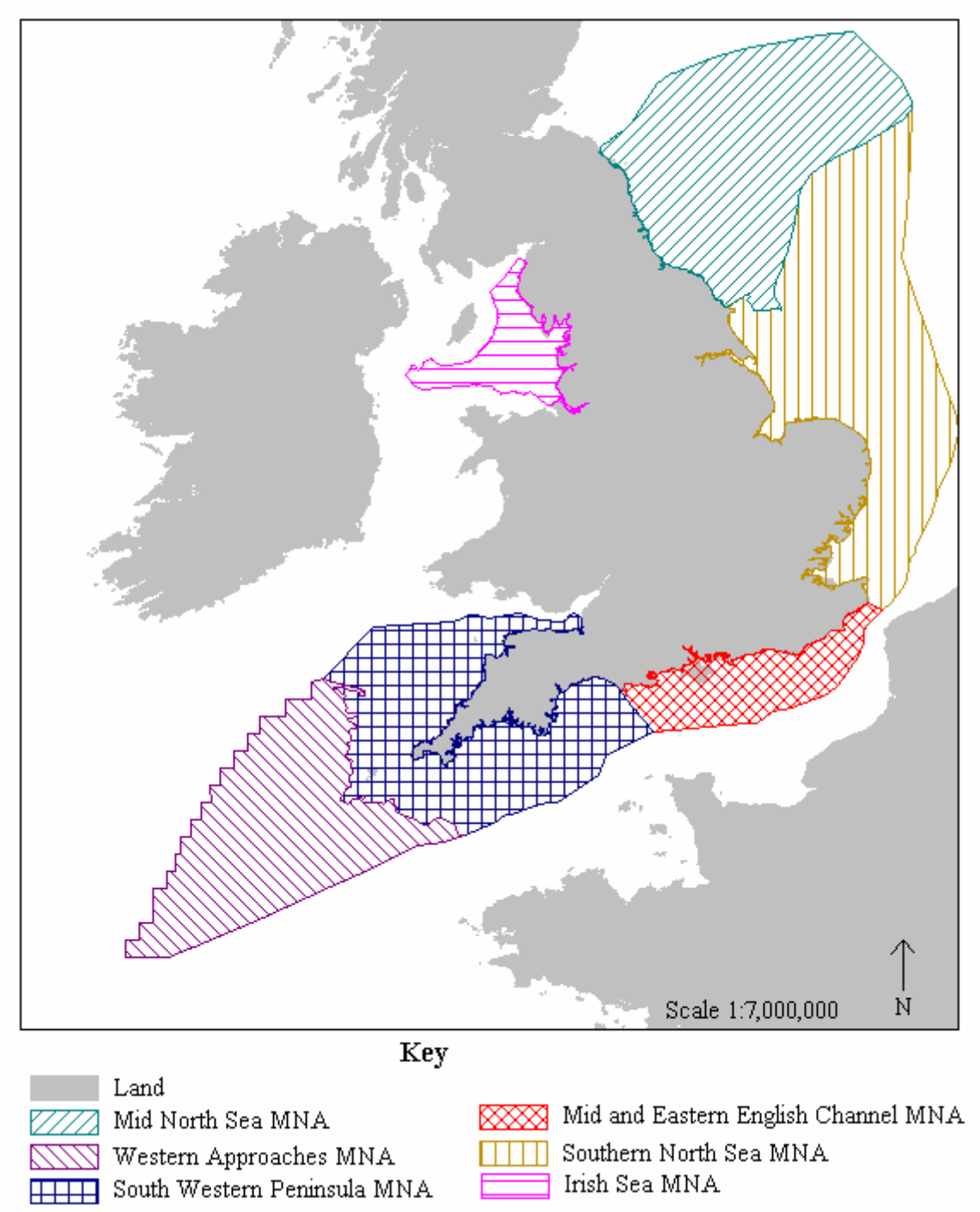


Figure 4 Draft RMNC regional seas boundaries (October 2001)

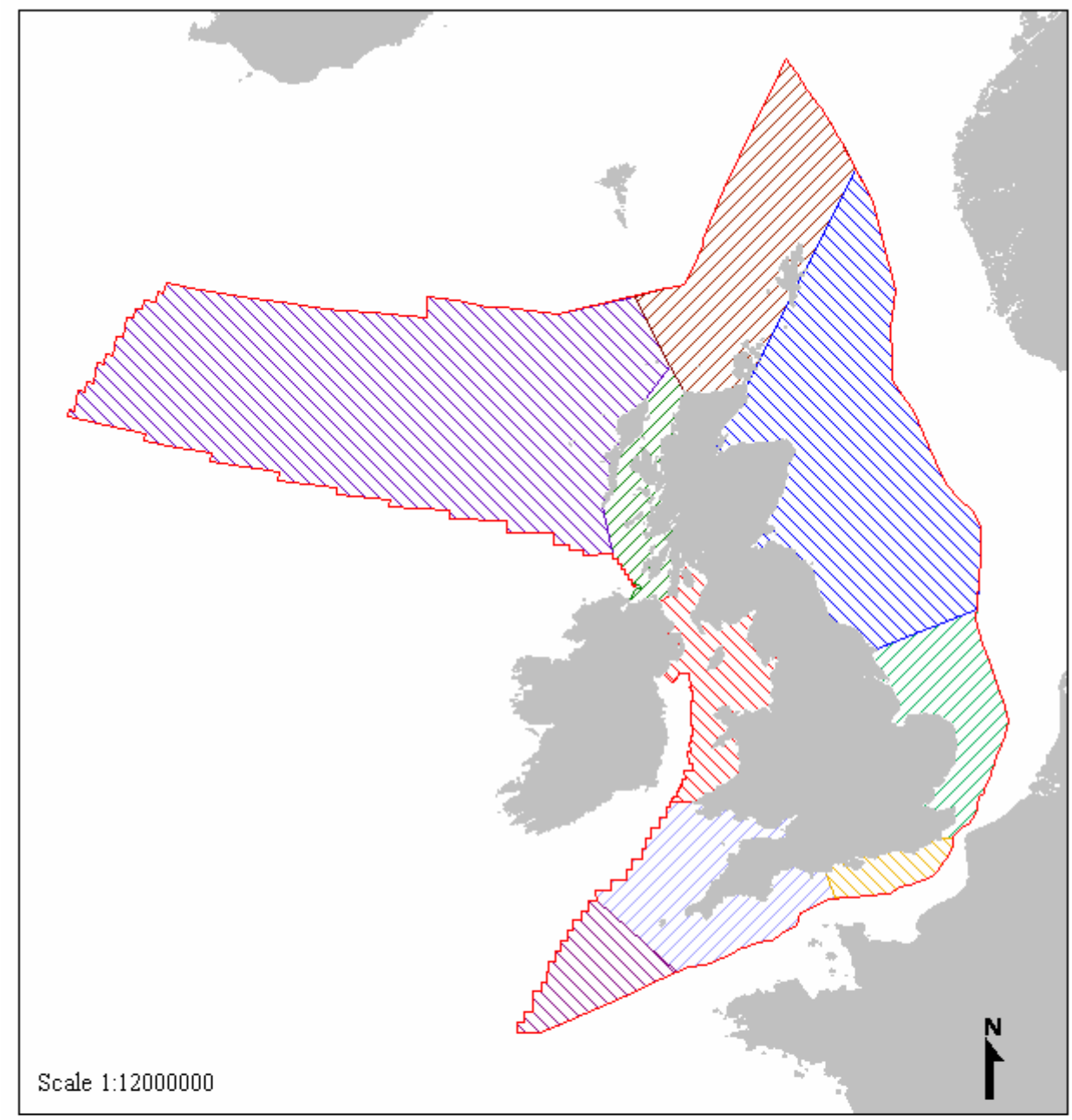
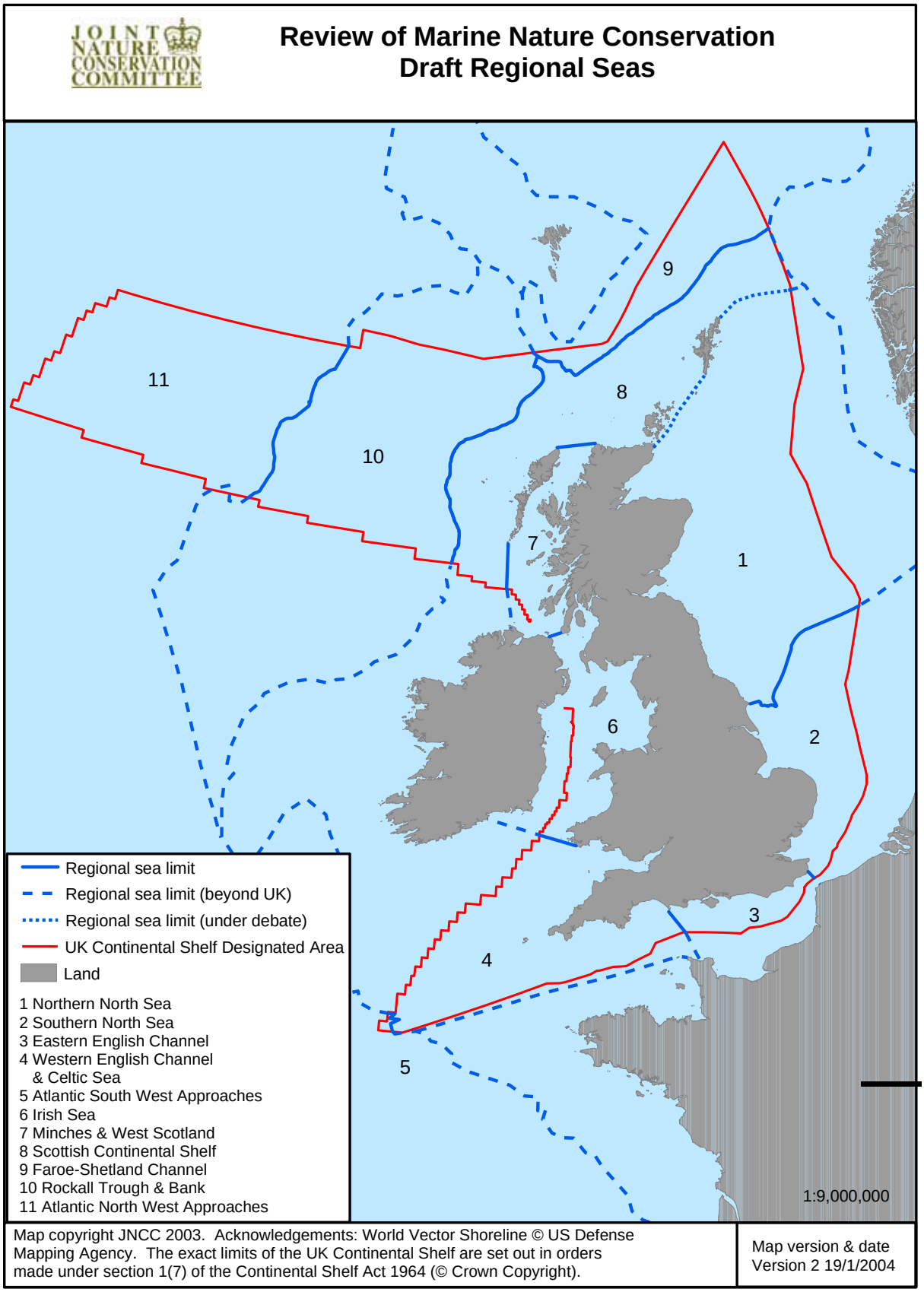


Figure 5 Draft Regional Seas in UK waters.



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