Accessing and developing the required biophysical datasets and data layers for Marine Protected Areas network planning and wider marine spatial planning purposes

Report No 16: Mapping of Protected Habitats (Task 2C)

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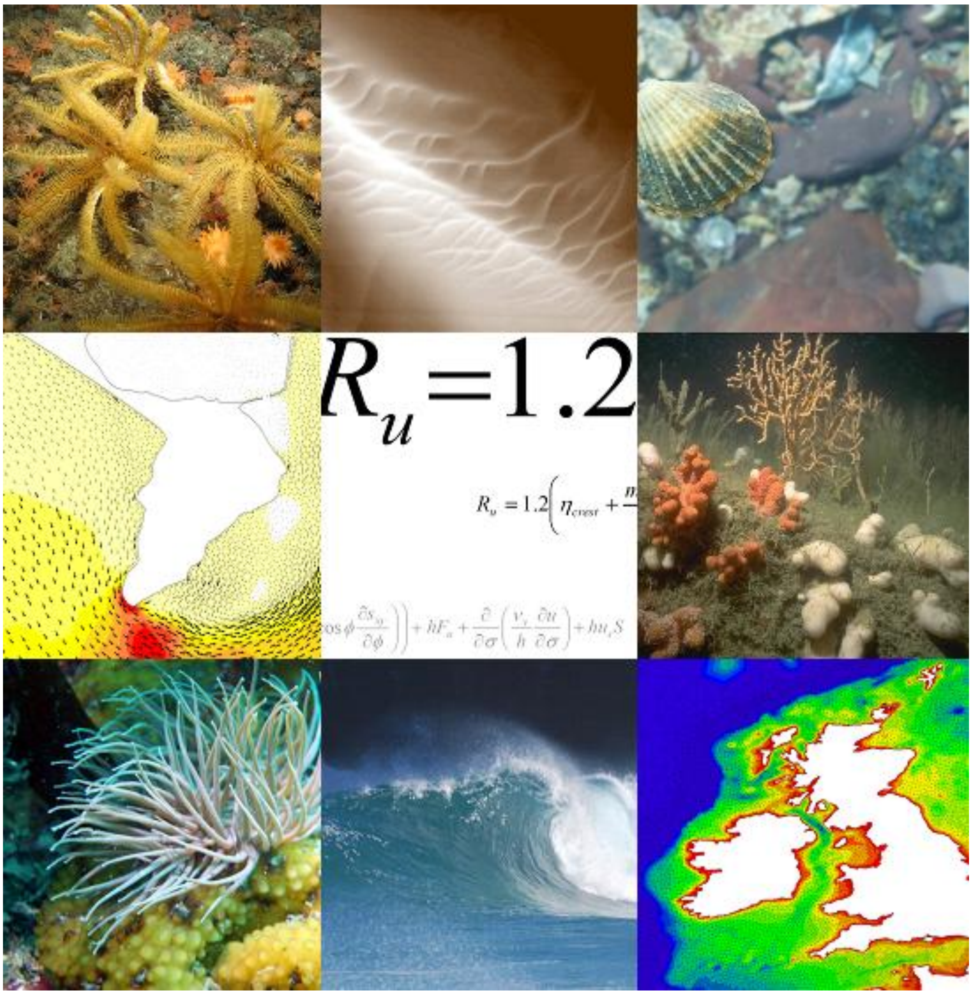

Project Title: Accessing and developing the required biophysical datasets and data layers for Marine Protected Areas network planning and wider marine spatial planning purposes

Report No 16: Task 2C. Mapping of Protected Habitats

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Executive Summary

The UK is committed to the establishment of a network of Marine Protected Areas (MPAs) to help conserve marine ecosystems and marine biodiversity. MPAs can be a valuable tool to protect species and habitats and can also be used to aid implementation of the ecosystem approach to management, which aims to maintain the 'goods and services' produced by the healthy functioning of the marine ecosystem that are relied on by humans.

A consortium[1] led by ABPmer were commissioned (Contract Reference: MB0102) to develop a series of biophysical data layers to aid the selection of Marine Conservation Zones (MCZs) in England and Wales under the Marine and Coastal Access Act 2009 and the equivalent MPA measures in Scotland. Such data layers may also be of use in taking forward marine planning in UK waters. The overall aim of the project was to ensure that the best available information was used for the selection of MPAs in UK waters, and that the data layers produced were easily accessed and utilized by those with responsibility for selecting sites.

The Marine and Coastal Access Act 2009 allows for the designation of MCZs for biological, geological and geomorphological features of interest. To deliver this requirement, the project was divided into a number of discrete tasks, one of which (2C) included the production a series of data layers showing the distribution of priority protected habitats.

These data layers were produced by the collation of existing data from a wide range of sources and represent the largest UK-wide data collation exercise undertaken in recent years. Once collated, the data was entered into a standard structure and is displayed as ESRI Shapefiles for inclusion in standard GIS and mapping packages including ArcGIS, MapInfo and Google Earth. In addition, the spatial referencing system was standardized and the distributions clipped to the MCZ project boundaries for England and jurisdiction boundaries for Scotland, Wales and Northern Ireland. Once in the standard format the underlying data tables were quality assured to check valid information was entered in each of the attributes. Alongside the spatial data, each derived data layer has a metadata record to assist in the discovery and reuse of the outputs.

A confidence assessment was produced for each data layer. The confidence assessment was based on the volume of data acquired and the information provided by experts and organizations, and took account of datasets that were not available or not in a suitable format.

The habitats covered by this report were agreed at the start-up of the contract and included: blue mussel beds, coastal saltmarsh, estuarine rocky habitats, file shell beds, fragile sponge & anthozoan communities on subtidal rocky habitats, intertidal boulder communities, mud habitats in deep water, peat and clay exposures, *Sabellaria alveolata* reefs, saline lagoons, serpulid reefs, sheltered muddy gravels, subtidal chalk, subtidal sands and gravels, tide-swept channels, carbonate mounds,

[1] ABPmer, MarLIN, Cefas, EMU Limited, Proudman Oceanographic Laboratory (POL) and Bangor University.

cold-water coral reefs, deep-sea sponge aggregations, intertidal mudflats, littoral chalk communities, maerl beds, *Modiolus modiolus* beds, *Sabellaria spinulosa* reefs, seagrass beds, seamounts, carbonate reefs, *Musculus discors* beds, subtidal mixed muddy sediments, intertidal *Mytilus edulis* beds on mixed and sandy sediments, coral gardens, sea pen and burrowing megafauna communities and *Ostrea edulis* beds.

Maps for a selection of the habitats were reproduced within this document as image files to allow visualization of the distribution of a representative range of habitats.

Where possible, it was the aspiration of the contract to make the derived data layers generated from this project freely available. Due to the range of data sources this was not always possible. Nevertheless, all derived data will be made available to Government Departments and Public Bodies for non-commercial purposes according to the restriction of use document.

A large data collation and aggregation exercise of this kind encountered several issues. In particular, the need to harmonize disparate data formats and the negotiation with a variety of data providers to allow the widest possible release of the resulting layers. In addition, the work highlighted the importance of cataloguing and storing datasets with an appropriate level of metadata.

The report also identified future considerations to improve access to marine data, which include the need to further promote and adopt the standards and specification developed through the Marine Environmental and Data Information Network (MEDIN) programme and to ensure that organizations comply with EU legislation such as the INSPIRE Directive.

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1. Introduction

1.1 Project Background

1.1 The UK is committed to the establishment of a network of Marine Protected Areas (MPAs) to help conserve marine ecosystems and marine biodiversity. MPAs can be a valuable tool to protect species and habitats and can also be used to aid implementation of the ecosystem approach to management, which aims to maintain the 'goods and services' produced by the healthy functioning of the marine ecosystem that are relied on by humans.

1.2 As a signatory of OSPAR[2], the UK is committed to establishing an ecologically coherent network of well managed MPAs. The UK is already in the process of completing a network consisting of Special Areas of Conservation (SACs) and Special Areas of Protection (SPAs), collectively known as Natura 2000 sites to fulfil its obligations under the EC Habitats Directive (92/43/EEC). Through provisions in the Marine and Coastal Access Act 2009, a network of Marine Conservation Zones (MCZs) can be designated in England and Welsh territorial waters and UK offshore waters. The Scottish Government is also considering equivalent Marine Protected Areas (MPAs) in Scotland. These sites are intended to help to protect areas where habitats and species are threatened, and to protect areas of representative habitats. For further information on the purpose of MCZs and the design principles to be employed see [http://www.defra.gov.uk/marine/biodiversity/marine-bill/guidance.htm Defra, 2009].

1.3 MCZ selection will be undertaken via a participatory stakeholder engagement approach. Four Regional MCZ Projects have been established to lead this process, and have been identified as the principle 'customer' of any WebGIS system established. The Regional MCZ Projects were established during the latter half of 2009, and were expected to be fully functional by early 2010. The full stakeholder engagement process was anticipated to begin in February 2010, continuing until the end of 2011. A formal public consultation is expected in 2012.

1.4 Under the Marine and Coastal Access Act 2009, the UK government is committed to conserve, and promote the recovery of a wide range of habitats and species through the establishment of an ecologically coherent network of well managed MPAs. Five of the seven network design principles listed in the Ministerial Statement (2010)[3] cannot be fulfilled without the following knowledge.

1) Representativity – the range of marine habitats and species are represented through protecting all major habitat types and associated biological communities present in our marine area.
2) Replication – replication of major habitats through the network.
3) Viability – self-sustaining, geographically dispersed component sites of sufficient size to ensure species and habitats persistence through natural cycles of variation.

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[2] Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic

[3] Defra Ministerial Statement on the Creation of a Network of Marine Protected Areas. London: Defra, 2010.

4) Adequacy – the network is of adequate size to deliver its ecological objectives and ensure the ecological viability and integrity of populations, species and communities.
5) Connectivity – to maximize and enhance the linkages among individual MPAs.

1.5 The selection of MPAs should be based on the best available data. This data will be a range of data types including biological, physical and oceanographic characteristics and socio-economic data (such as the location of current activities). To ensure such data are easily available to those who would have responsibility for selecting sites, Defra and its partners[4] commissioned a consortium lead by ABPmer and partners to take forward a package of work. The consortium were tasked with the development of the following new Geographical Information System (GIS) data layers:

- geological and geomorphological features;
- listed habitats and species
- selected non-native species;
- fetch and wave exposure;
- marine diversity layer;
- benthic productivity; and
- residual current flow.

1.6 In addition to the development of data layers, there is a need to ensure such information can be easily accessed given the participatory nature of the MCZ process that is currently being planned. Hence, all derived data products would be made available for use by the MCZ Regional Projects and to the Devolved Administrations for their equivalent processes.

1.7 This report provides a detailed description of the development of the priority species with limited mobility data layer, the steps taken to collate the data, standardise, undertake quality assurance and output the resulting layers in an accessible format.

1.8 Relevant datasets are held by a wide variety of organizations and individuals with a regional or species-specific bias to the data. Through large collation exercises, these datasets can be standardised and made widely available for future projects, greatly reducing the time taken to collate data and improving the long-term availability and visibility of important datasets.

1.2 Aims and Objectives

1.9 The aims of this element of the project were to produce spatially referenced tables and associated GIS layers showing the distribution of priority habitats.

1.10 The habitats covered by this report are: blue mussel beds, coastal saltmarsh, estuarine rocky habitats, file shell beds, fragile sponge & anthozoan communities on subtidal rocky habitats, intertidal boulder communities, mud habitats in deep water, peat and clay exposures, *Sabellaria alveolata* reefs, saline lagoons, serpulid reefs, sheltered muddy gravels, subtidal chalk, subtidal sands and gravels, tide-swept channels, carbonate mounds, cold-

[4] Joint Nature Conservation Committee (JNCC), Countryside Council for Wales (CCW), Natural England (NE), Scottish Government (SG), Department of Environment Northern Ireland (DOENI) and Isle of Man Government.

water coral reefs, deep-sea sponge aggregations, intertidal mudflats, littoral chalk communities, maerl beds, *Modiolus modiolus* beds, *Sabellaria spinulosa* reefs, seagrass beds, seamounts, carbonate reefs, *Musculus discors* beds, subtidal mixed muddy sediments, intertidal *Mytilus edulis* beds on mixed and sandy sediments, coral gardens, sea pen and burrowing megafauna communities and *Ostrea edulis* beds.

1.11 The full habitat list and corresponding legislation that they fall under is listed in Appendix B.

1.3 Format of the Report

1.12 The report comprises three main sections:

- Section 1 details the approach and methodology used to derive the layers;
- Section 2 shows the results and outlines guidance for use and interpretation, and
- Section 3 outlines issues encountered during data collation and layer generation production and sets out future considerations.

1.13 In addition, the Appendices provide further contextual information.

2. Adopted Approach and Methodology

2.1 Collation of Data and Information

2.1 Data was requested from all the major holders of marine biodiversity data for the target species identified in Appendix B. Additional records for the species were sought through direct contact with authors, specialists, recording schemes, societies and organisations known to have carried out work on target species, or who were likely to hold records and information on their distribution. Their details are included in Appendix B.

2.2 The data collated from the statutory agencies and major databases (such as the UKOOA holdings) and the National Biodiversity Network (NBN) were augmented by a literature search for each species on the list, utilising the resources of the National Marine Biological Library (NMBL) and other online literature search tools.

2.3 The data collation was undertaken simultaneously for Limited Mobility Benthic Species (2B), Habitats (2C), Non-native species (2D) and the Biodiversity Layer (2F). In total, over 120 individuals from 68 organizations were initially contacted of which 107 provided data to the project. The resulting number of species records was over 2 million.

2.4 Publications containing relevant information were collected and records extracted. These records (and their originating publication) were then entered into Marine Recorder where permissions allowed. Where permission was not granted for Marine Recorder upload, or there was risk of duplication, some records were imported directly into the species layers. The risk of duplication was caused by access to the latest records from organizations such as Seasearch which had not yet been entered into Marine Recorder. Entry by MarLIN would therefore result in multiple entries for the same record when MarLIN holdings were uploaded to the NBN.

2.5 In addition to requests for data for the MB0102 project, the data providers were asked to give permission for wider dissemination and archiving in DASSH, the MEDIN Data Archive Centre (DAC) for biodiversity data. Where it was agreed, the requests enabled the derived data layers to be more widely available and ensured that data became available from a central point for future projects.

2.6 Once extracted, species and habitat data were joined by the field “survey_key” to filter out data where both the species and biotope information had been entered for a survey. Any species records matching with biotope data were removed to avoid duplication of information. This left only species records not included in biotope surveys. These additional species records were then classified by biotope certainty (see Table 1 for definitions). Only records tagged as “Species present, biotope certain” or “Species present, biotope likely” were displayed in the layers.

2.7 The methods used for the mapping of each habitat differed depending on its definition. The definitions are shown in Appendix 2 and the methods are described in section 2.

Table 1. Biotope certainty classification used for species records in biogenic habitats

Code	Meaning
Species present, biotope certain*	Biotope determination certain
Species present, biotope likely*	Biotope likely to be present (species abundance and habitat indicative) although insufficient evidence to confirm as a biotope record.
Species present, biotope possible	Habitat suitable and species present, but cannot confirm from data whether biotope is present or not.
Species present, biotope unlikely	Biotope unlikely to be present (species abundance and habitat indicative) although insufficient evidence to confirm as not being a biotope record.
Species present, not forming biotope	Certain indication that biotope is not present
Biotope present, insufficient habitat info	For certain biogenic habitats such as *Mytilus edulis* beds the biogenic reef was confirmed but there was insufficient habitat info to confirm whether it was on a hard or sediment substratum and therefore whether it was a protected or non-protected habitat.
Species present, insufficient abundance info	Species present and habitat appropriate but data lacking abundance data to allow confirmation of biotope presence
Species present, insufficient habitat info	Species present and abundance appropriate, but data lacking habitat data to allow confirmation of biotope presence

*****Only records in these categories (displayed in bold) are included in the layers.

2.2 Quality Assurance

2.8 Progress of datasets through Marine Recorder into the archive used for the contract was monitored using a MS Access database to ensure that QA standards were adhered to during data input. A record of publication and data sources used was stored in an Endnote database. The bibliography has been included in this report. Details of the points of contact and specialists consulted during the data acquisition phase of the project were also logged in the same Access database. The details of individuals and organizations contacted are all available in Appendix D of this report.

2.9 After initial data entry, all data and metadata were validated and verified to ensure the data met appropriate standards. The standards used included those established by the Join Nature Conservation Committee (JNCC) and DASSH (the Archive for Marine Species and Habitat Data) in its role as a Marine Environmental Data and Information Network (MEDIN) Data Archive Centre (DAC). Data validation was carried out independently of the member of staff responsible for data entry.

2.10 Once draft data layers were complete they were sent to the Project Steering Group, the MCZ Regional Projects, experts and regional groups for comment and the layers were amended according to suggestions made.

2.3 Analysis and Datalayer Development

2.3.1 Detailed Methodology

2.11 The detailed methodology adopted for the production of each habitat layer is outlined below. A short description of the habitat is provided, together with the biotopes that comprise the habitat. The full definitionof each habitat is provided in Appendix B.

2.12 If and when species records could be used as a proxy for habitat records is shown. Any issues encountered when applying the definition to data layer production are highlighted. A list of the issues encountered with the habitat definitions can be found in Appendix D

2.3.2 File Shell Beds

2.13 **BAP Description (2008) -** "dense populations of *Limaria hians* where nests coalesce into a carpet over the sedimentary substratum

2.14 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code	MNCR 04.05 biotope code	MNCR 97 biotope code
A5.434	SS.SMX.IMX.Lim	SS.IMX.FaMx.Lim

2.15 **Species data -** *Limaria hians* records were selected from the species data collated for the project. Records where beds were indicated in the description were marked as 'biotope certain' and those where nests were identified were marked as 'biotope likely'.

2.3.3 Blue Mussel Beds

2.16 **BAP Description (2008) -** "this habitat includes intertidal and subtidal beds of the blue mussel *Mytilus edulis* on a variety of sediment types and in a range of conditions from open coasts to estuaries, marine inlets and deeper offshore habitats. The habitat only covers 'natural' beds on a variety of sediment types, and excludes artificially created mussel beds, and mussel beds which occur on rock and boulders."

2.17 In addition, mussel crumble were excluded from the data layer

2.18 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes	MNCR 04.05 biotope codes	MNCR 97 biotope codes
A2.72, A2.721 A2.7211 A2.7212 A2.7213 A2.212 A5.625	LS.LBR.LMus LS LBR.LMus.Myt LS.LBR.LMus.Myt.Mx LS.LBR.LMus.Myt.Sa LS.LBR.LMus.Myt.Mu LS.LSa.St.MytFab SS.SBR.SMus.MytSS	LR.SLR.Mx LR.SLR.Mx.MytX LS.LMX.MytFab SS.IMX.EstMx.MytV

2.19 **Species data -** *Mytilus edulis* records were selected from the species data collated for the project. The descriptive text for each record was searched and all records containing the keywords; bedrock, rock, vertical, concrete, reef, boulders, gully (or ies), cave, wreck, pier, limestone, wall and piling, were removed. Records of mussel crumble, seed and juveniles were also removed. The remaining records were then sifted and assigned a 'biotope certainty'. Any further records from artificial or hard substrata, or from commercial mussel beds encountered during this process were removed. All records of *Mytilus* from sediment were retained but only those records satisfying the biotope criteria, classed as 'biotope certain' or 'species present, biotope likely' were plotted.

2.20 **Definition issues -** there were difficulties differentiating between commercial beds and natural beds occurring in areas of commercial extraction. An additional data layer of known shellfishery Several Orders was produced to highlight commercial areas and beds in these areas were removed.

2.21 In addition, it has been shown that there is considerable hybridization between *M. edulis* and *M. galloprovincialis,* and that hybridization is substantial in south western UK and Ireland and has been occurring over considerable evolutionary time (this needs a reference). The concept of blue mussels as a species group rather than a species is not reflected in the current definition.

2.3.4 Intertidal *Mytilus edulis* Beds on Mixed Sandy Sediments

2.22 **OSPAR Definition -** "National Marine Habitat Classification for UK & Ireland code: LS.LMX.LMus.Myt.Mx and LS.LMX.LMus.Myt.Sa Sediment shores characterised by beds of the mussel *Mytilus edulis* occur principally on mid and lower shore mixed substrata (mainly cobbles and pebbles on muddy sediments) but also on sands and muds."

2.23 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A2.7211, A2.7212	LS.LBR.LMus.Myt.Mx, LS.LBR.LMus.Myt.Sa;	Sub-biotopes for sand, mud and mixed sediments only introduced in later versions so the MNCR 97 code LR.SLR.Mx.MytX was not included.

2.24 **Species data -** the species data from blue mussel beds, (see section 2.2), which has a broader definition, was refined for use in this habitat. Data was sorted by depth to remove sublittoral records and by sampling method to remove trawls, underwater video and day grabs. Searches in the record description were made to remove occurrences of *Mytilus* on mud (although sandy mud was retained).

2.25 **Definition issues -** In addition to the blue mussel bed definition issues (see 2.2.2), the OSPAR definition is slightly contradictory in that it encompasses only the sand and mixed sediment biotope codes but mentions muds in the description.

2.3.5 *Musculus discors* Beds

2.26 **NERC Act Definition -** *Musculus discors* "occasionally forms extensive, dense aggregations covering upward-facing rock surfaces. **The beds are found on** *moderately expos*ed and moderately tide-swept bedrock, boulders and cobbles in slightly silty conditions. There is also often a layer of pseudofaeces, which forms a thick, silty matrix amongst the mussels."

2.27 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code:	MNCR 04.05 biotope code:	MNCR 97 biotope code:
A4.242	CR.MCR.CMus.Mdis	CR.MCR.M.Mus

2.28 **Species data -** *Musculus discors* records were selected from the species data collated for the project. Records that indiciated the presence of beds in the description were were identified and cross-referenced against existing biotope data.

2.3.6 *Modiolus modiolus* Beds

2.29 For this habitat, the BAP and OSPAR definitions are equivalent.

2.30 **OSPAR Definition -** "although *M. modiolus* is a widespread and common species, horse mussel beds (with typically 30% cover or more) are more limited in their distribution. *Modiolus* beds are found on a range of substrata, from cobbles through to muddy gravels and sands, where they tend to have a stabilising effect, due to the production of byssal threads."

2.31 **BAP Definition (2008) -** *"M. modiolus* can occur as relatively small, dense beds of epifaunal mussels carpeting steep rocky surfaces, as in some Scottish sealochs, but it is more frequently recessed at least partly into mixed or muddy sediments in a variety of tidal regimes. In some sea lochs and open sea areas, extensive expanses of seabed are covered in scattered clumps of semi-recessed *M. modiolus* on muddy gravels. In a few places in the UK, beds are more or less continuous and may be raised up to several metres above the surrounding seabed by an accumulation of shell, faeces, pseudofaeces and sand. In some areas of very strong currents extensive areas of stony and gravelly sediment are bound together by more or less completely recessed *M. modiolus*, creating waves or mounds with steep faces up to one metre high and many metres long"

2.32 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes	MNCR 04.05 biotope codes	MNCR 97 biotope codes
A5.621 A5.622 A5.623 A5.624	SS.SBR.SMus.ModT SS.SBR.SMus.ModMx SS.SBR.SMus.ModHAs SS.SBR.SMus.ModCvar	CR.MCR.M.ModT SS.CMX._.ModMx CR.SCR.Mod.ModHAs CR.SCR.Mod.ModCvar

2.33 **Species data -** *Modiolus modiolus* records were selected from the species data collated for the project. Records that indiciated the presence of *Modiolus* beds in their description were identified and were cross-referenced against existing biotope data.

2.3.7 *Ostrea edulis* Beds

2.34 **OSPAR definition – "**beds of the oyster *Ostrea edulis* occurring at densities of 5 or more per m^2 on shallow mostly sheltered sediments (typically 0-10m depth, but occasionally down to 30m). There may be considerable quantities of dead oyster shell making up a substantial portion of the substratum."

2.35 **Biotope data -** the following codes were searched for and extracted from the polygon and point biotope geodatabases.

EUNIS 2004 code:	MNCR 04.05 biotope code:	MNCR 97 biotopes code:
A5.435	SS.SMx.IMx.Ost	SS.IMX.Oy.Ost

2.36 **Species data -** *Ostrea edulis* records were extracted along with the characterising species for this biotope and records with references to 'beds' in the description were identified and cross-referenced against existing biotope data.

2.37 **Definition issues -** there is some contradiction in the OSPAR definition, which defined a quantitative limit 5 or more oysters per square metre, while the the JNCC definition of the SS.SMx.IMx.Ost habitat does not.

2.38 Based on quantitative survey data (University Marine Biological Station Millport, 2007), the abundance of the Loch Ryan beds (and all other beds known in Scotland) would disqualify them from the OSPAR definition. Nevertheless, they are likely to be (and have previously been) identified as SS.SMx.IMx.Ost in a non-quantitative survey and, therefore, are likely to qualify as *Ostrea edulis* beds.

2.3.8 Maerl Beds

2.39 **BAP definition (2008) -** "Maerl beds typically develop where there is some tidal flow, such as in the narrows and rapids of sea lochs, or the straits and sounds between islands. Beds may also develop in more open areas where wave action is sufficient to remove fine sediments, but not strong enough to break the brittle maerl branches. Live maerl has been found at depths of 40 m but beds are typically much shallower, above 20 m and extending up to the low tide level."

2.40 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A5.51, A5.511, A5.5111, A5.5112, A5.512, A5.513, A5.514.	SS.SMp.Mrl, SS.SMp.Mrl.Pcal, SS.SMp.Mrl.Pcal.R, SS.SMp.Mrl.Pcal.Nmix, SS.SMp.Mrl.Lgla, SS.SMp.Mrl.Lcor, SS.SMp.Mrl.Lfas.	SS.IGS.Mrl, SS.IGS.Mrl.Phy, SS.IGS.Mrl.Phy.R, SS.IGS.Mrl.Phy.HEc, SS.IGS.Mrl.Lgla, SS.IMX.MrlMx.Lcor, SS.IMX.MrlMx.Lfas, SS.IMX.MrlMx.Lden

2.41 **Species data -** species records for *Phymatolithon calcareum*, *Lithothamnion glaciale, Lithothamnion corallioides* and *Lithophyllum fasciculatum* were extracted from the species data collated for the project. Records where maerl beds were indicated in the record description were identified and cross-referenced against existing biotope data, and additional records were extracted.

2.3.9 *Sabellaria alveolata* Reefs

2.42 **BAP Description -** *"Sabellaria alveolata* reefs are formed by the honeycomb worm *Sabellaria alveolata*, a polychaete which constructs tubes in tightly packed masses with a distinctive honeycomb-like appearance. These reefs can be up to 30 or even 50 cm thick and take the form of hummocks, sheets or more massive formations. Reefs are mainly found on the bottom third of the shore but may reach the mean high water of neap tides and extend into the shallow subtidal in places. They do not seem to penetrate far into low salinity areas. Reefs form on a variety of hard substrata, from pebbles to bedrock, in areas with a good supply of suspended sand grains from which the animals form their tubes, and include areas of sediment when an attachment has been established."

2.43 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code:	MNCR 04.05 biotope code:	MNCR 97 biotopes code:
A2.711 A5.612	LS.LBR.Sab LS.LBR.Sab.Salv SS.SBR.PoR.SalvMx	LR.MLR.Sab LR.MLR.Sab.Salv

2.44 **Species data -** species records for *Sabellaria alveolata* were extracted from the species data collated for the project. Records where beds were indicated in the record description were identified and cross-referenced against biotope data. Records of this species on rock were identified and removed.

2.3.10 *Sabellaria spinulosa* Reefs

2.45 **BAP Description (2008) -** *"Sabellaria spinulosa* reefs comprise of dense subtidal aggregations of this small, tube-building polychaete worm. *Sabellaria spinulosa* can act to stabilise cobble, pebble and gravel habitats, providing a consolidated habitat for epibenthic species."

2.46 **OSPAR Definition -** "the tube-building polychaete *Sabellaria spinulosa* can form dense aggregations on mixed substrata and on rocky habitats. In mixed substrata habitats, comprised variously of sand, gravel, pebble and cobble, the *Sabellaria* covers 30% or more of the substrata and needs to be sufficiently thick and persistent to support an associated epibiota community which is distinct from surrounding habitats. On rocky habitats of bedrock, boulder and cobble, the *Sabellaria* covers 50% or more of the rock and may form a crust or be thicker in structure. In some areas, these two variations of reef type may grade into each other."

2.47 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code:	MNCR 04.05 biotope code:	MNCR 97 biotope code:
A5.611	SS.SBR.PoR.SspiMx CR.MCR.CSab*	CR.MCR.CSab.Sspi **

*OSPAR only
**includes some records from rock so only applied under OSPAR classification.

2.48 **Species data -** species records for *Sabellaria spinulosa* were extracted from the species data collated for the project. Records where reefs were indicated in the description were identified and cross-referenced against biotope data to extract additional records. Records of 'reefs' on rock were identified and labelled only with the OSPAR classification.

2.3.11 Serpulid Reefs

2.49 **BAP Description (2008) -** "The worms can also aggregate into clumps or 'reefs' up to 1m across. The species has a worldwide distribution (except for polar seas) in sheltered sites but the reef form has been reported from very few locations."

2.50 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code:	MNCR 04.05 biotope code:	MNCR 97 biotope code:
A5.613	SS.SBR.PoR.Ser	CMS.Ser

2.51 **Species data -** *Serpula vermicularis* records were extracted from the species data. Records where reefs were indicated in the description were identified and cross-referenced against biotope data.

2.3.12 Seagrass Beds

2.52 The BAP and OSPAR definitions for this habitat are not equivalent.

2.53 **BAP Description (2008)** – "seagrass beds develop in intertidal and shallow subtidal areas on sands and muds. They may be found in marine inlets and bays but also in other areas, such as lagoons and channels, which are sheltered from significant wave action."

2.54 **OSPAR Definition -** "*Zostera* beds"

2.55 **Biotope data -** The following codes were searched for and extracted from the polygon and point biotope geodatabases with BAP and OSPAR designated habitats distinguished in the designation field. This data was cross-referenced against the seagrass atlas (Green & Short, 2003).

EUNIS 2004 codes:	**MNCR 04.05 biotope codes:**	**MNCR 97 biotope codes:**
A2.61*, A2.611, A2.6111, A2.616*, A5.53*, A5.533, A5.5331, A5.5332, A5.5333, A5.5334, A5.534*, A5.5343*, A5.545	LS.LMp.LSgr*, LS.LMp.LSgr.Znol, SS.SMp.SSgr, SS.SMp.SSgr.Zmar, SS.SMp.SSgr.Rup*	LS.LMS.ZOS, LS.LMS.ZOS.Znol, SS.IMS.Sgr*, SS.IMS.Sgr.Zmar, SS.IMS.Sgr.Rup *,

* BAP only, all non-starred codes are included in both BAP and OSPAR definitions.

2.56 **Species data -** *Zostera noltii*, *Zostera marina*, *Zostera angusifolia* or *Ruppia maritima* beds were identified from species datasets and added to the biotope layer where they provided additional distribution data.

2.57 **Definition issues -** The BAP definition includes *Ruppia maritima* (beaked tasselweed) beds in the biotope list but not in the descriptive text. The description also includes *Zostera angustifolia* which is no longer recognised as a valid species.

2.3.13 Coastal Saltmarsh

2.58 **BAP Description -** "Coastal saltmarshes in the UK (also known as 'merse' in Scotland) comprise the upper, vegetated portions of intertidal mudflats, lying approximately between mean high water neap tides and mean high water spring tides. For the purposes of this action plan, however, the lower limit of saltmarsh is defined as the lower limit of pioneer saltmarsh vegetation (but excluding seagrass *Zostera* beds) and the upper limit as one metre above the level of highest astronomical tides to take in transitional zones."

2.59 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A2.5, A2.51, A2.511, A2.511, A2.512, A2.513, A2.514, A2.515, A2.516, A2.517, A2.518, A2.519, A2.51A, A2.51B, A2.52, A2.521, A2.522, A2.523, A2.524, A2.525, A2.526, A2.527, A2.528, A2.529, A2.53, A2.531, A2.531, A2.532, A2.533, A2.534, A2.535, A2.536, A2.537, A2.538, A2.539, A2.53A, A2.53B, A2.53C, A2.53D, A2.54, A2.541, A2.542, A2.542, A2.542, A2.543, A2.544, A2.545, A2.546, A2.547, A2.548, A2.55, A2.551, A2.551, A2.552, A2.553, 2.554 A2.555,A2.556,A2.557, A2.558	LS.LMp.Sm, LS.LMp.Sm.SM28, LS.LMp.Sm.SM24, LS.LMp.Sm.SM28, LS.LMp.Sm.SM25, LS.LMp.Sm.SM21, LS.LMp.Sm.SM23, LS.LMp.Sm.SM22, LS.LMp.Sm.SM26, LS.LMp.Sm.SM27, LS.LMp.Sm.SM23, LS.LMp.Sm.SM7, LS.LMp.Sm.SM22, LS.LMp.Sm.SM18, LS.LMp.Sm.SM15, LS.LMp.Sm.SM20, LS.LMp.Sm.SM19, LS.LMp.Sm.SM17, LS.LMp.Sm.SM16, LS.LMp.Sm.SM16, LS.LMp.Sm.SM13, LS.LMp.Sm.SM26, LS.LMp.Sm.SM14, LS.LMp.Sm.SM10, LS.LMp.Sm.SM9, LS.LMp.Sm.SM9, LS.LMp.Sm.SM8, LS.LMp.Sm.SM27, LS.LMp.Sm.SM5, LS.LMp.Sm.SM6, LS.LMp.Sm.SM5, LS.LMp.Sm.SM4, LS.LMp.Sm.SM12, LS.LMp.Sm.SM11, LS.LMp.Sm.SM7	LS.LMU.Sm, LS.LMU.Sm.SM28, LS.LMU.Sm.SM24, LS.LMU.Sm.SM28, LS.LMU.Sm.SM25, LS.LMU.Sm.SM21, LS.LMU.Sm.SM23, LS.LMU.Sm.SM22, LS.LMU.Sm.SM26, LS.LMU.Sm.SM27, LS.LMU.Sm.SM23, LS.LMU.Sm.SM7, LS.LMU.Sm.SM22, LS.LMU.Sm.SM18, LS.LMU.Sm.SM15, LS.LMU.Sm.SM20, LS.LMU.Sm.SM19, LS.LMU.Sm.SM17, LS.LMU.Sm.SM16, LS.LMU.Sm.SM16, LS.LMU.Sm.SM13, LS.LMU.Sm.SM26, LS.LMU.Sm.SM14, LS.LMU.Sm.SM10, LS.LMU.Sm.SM9, LS.LMU.Sm.SM9, LS.LMU.Sm.SM8, LS.LMU.Sm.SM27, LS.LMU.Sm.SM5, LS.LMU.Sm.SM6, LS.LMU.Sm.SM5, LS.LMU.Sm.SM4, LS.LMU.Sm.SM12, LS.LMU.Sm.SM11, LS.LMU.Sm.SM7

2.60 **Species data** - a number of saltmarsh areas were identified from species datasets, e.g. *Spartina anglica*, and added to the biotope layer where they provided additional distribution data.

2.3.14 Saline Lagoons

2.61 **BAP description -** "Lagoons in the UK are essentially bodies, natural or artificial, of saline water partially separated from the adjacent sea. They retain a proportion of their seawater at low tide and may develop as brackish, full saline or hyper-saline water bodies."

2.62 **SNH Description (2007)**

1. *isolated saline lagoons* completely separated from the sea by a barrier of rock or sediment to above mean high water spring tide (as JNCC, 1996);

2. *percolation saline lagoons* separated from the sea by a barrier of shingle, pebbles and small boulders, through which seawater exchange takes place;
3. *sluiced saline lagoons* where seawater exchange is modified by human interference (e.g. a pipeline under a road, or a system of flaps or valves);
4. *silled saline lagoons* (as JNCC, 1996); and
5. *saline lagoon inlets* with a restricted connection to the sea where there is no sill, or a sill below mean low water spring tide.

2.63 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes:	**MNCR 04.05 biotope codes:**	**MNCR 97 biotope codes:**
A3.34, A3.342, A3.344, A3.341, A3.343, A5.54, A5.542, A5.541, A5.31, A5.41, A5.21	IR.LIR.Lag, IR.LIR.Lag.AscSpAs, IR.LIR.Lag.FcerEnt, IR.LIR.Lag.FChoG, IR.LIR.Lag.ProtFur, SS.SMp.Ang, SS.SMp.Ang.A12, SS.SMp.Ang.S4, SS.SMu.SMuLS, SS.SMx.SMxLS, SS.SSa.SSaLS	IR.SIR.Lag, IR.SIR.Lag.FChoG, IR.SIR.Lag.AscSAs, IR.SIR.Lag.PolFur, IR.SIR.Lag.FcerEnt, SS.SMp.Ang, SS.SMp.Ang.A12, SS.SMp.Ang.S4

2.64 Records of littoral and sublittoral sub-biotopes from specialist summaries were included in the data layers e.g. the MNCR areas summaries of saline lagoons in Scotland.

2.3.15 Deep-Sea Sponge Aggregations

2.65 **OSPAR Definition** - "Deep sea sponge aggregations are principally composed of sponges from two classes: Hexactinellida and Demospongia. They are known to occur between water depths of 250-1300m (Bett & Rice, 1992), where the water temperature ranges from 4-10°C and there is moderate current velocity (0.5 knots). Deep-sea sponge aggregations may be found on soft substrata or hard substrata, such as boulders and cobbles which may lie on sediment."

2.66 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code:	**MNCR 04.05 biotope code:**	**MNCR 97 biotopes code:**
A6.62, A6.621	-	-

2.67 **Species data** - species searches for *Pheronema carpenteri* and *Geodia* sp. were made on NBN, OBIS, GBIF, and in the literature. Any records found in UK territorial limits were entered into the geodatabase.

2.68 There are currently a number of project groups working on deep sea species and habitat characterisation. These projects include research undertaken at the University of Plymouth, Marine Scotland and the Scottish Association of Marine Science (SAMS). Much of the data identified was not available for use in the MB0102 project.

2.69 **Physiographic data** - as data on this habitat is so scarce a predictive layer based on depth was created. Using a raster depth layer supplied by ABPMer, areas of seabed in the UK territorial limits,at depths greater than 250 metres were identified. Hence, areas where deep sea sponge aggregations could exist were defined.

2.70 **Definition issues** - it was difficult from the description of a sponge aggregation to define the criteria for an aggregation. Mapping would have been easier with more information on when a group of sponges counts as an aggregation and when it does not. This habitat is difficult to map with any certainty without further refinement of the guidance.

2.3.16 Carbonate Mounds

2.71 **OSPAR Definition** - "Carbonate mounds are distinct elevations of various shapes, which may be up to 350m high and 2km wide at their base (van Weering *et al.*, 2003). They occur offshore in water depths of 500-1100m with examples present in the Porcupine Seabight and Rockall Trough (Kenyon *et al,* 2003). Carbonate mounds may have a sediment veneer, typically composed of carbonate sands, muds and silts."

2.72 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code:	MNCR 04.05 biotope code:	MNCR 97 biotope code:
A6.75	-	-

2.73 Only one published survey (Roberts *et al,* 2008) has data for carbonate mounds in UK territorial waters, although it is likely that more may be discovered as further comprehensive surveys of the UK's deep sea habitats are conducted.

2.3.17 Carbonate Reefs

2.74 **NERC Act 2006 Definition** - "Carbonate reefs (correctly termed Methane Derived Authigenic Carbonate, or MDAC, reefs) have been created by the deposition of calcium carbonate, formed by the reaction of natural gas (methane) escaping from the seabed mixing with saltwater. The reefs are constantly developing with the continued release of natural gas from the seabed. Four such reefs have been found in shallow water (< 10m) in the northern section of Cardigan Bay, within the Pen Llŷn a'r Sarnau SAC. Similar reefs of this type are generally found in a far greater depth of water (>500 m)."

2.75 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code:	MNCR 04.05 biotope code:	MNCR 97 biotopes code:
A6.75	-	-

2.76 In addition, the two known carbonate reefs were extracted from the Methane Derived Authigenic Carbonate layer produced for this contract.

2.77 The SEA 6 project collected relevant data (Multibeam of Texel 11 and Sidescan sonar of Holdens Reef), which is now held by the British Geological Society (BGS). The SEA 6 data gives greater detail of these features but it was not possible to access the data for this project.

2.3.18 Cold Water Coral Reefs

2.78 The OSPAR and BAP definitions are equivalent.

2.79 **OSPAR and BAP definitions** - "*Lophelia pertusa*, a cold water, reef-forming coral, has a wide geographic distribution ranging from 55°S to 70°N, where water temperatures typically remain between 4-8°C. These reefs are generally subject to moderate current velocities (0.5 knots). The majority of records occur in the north-east Atlantic. "

2.80 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code:	MNCR 04.05 biotope code:	MNCR 97 biotopes code:
A5.63, A5.631	SS.SBR.Crl.Lop	COR._.Lop

2.81 **Species data** - *Lophelia* records were taken from the OSPAR *Lophelia* database and from additional published literature. A number of research projects were identified which include new records of this species but it is not possible to access this data until the research has been published. Both certain and uncertain reefs were mapped and this was identified in the status field using with or certain or biotope likely.

2.3.19 Coral Gardens

2.82 **OSPAR definition** - "The main characteristic of a coral garden is a relatively dense aggregation of colonies or individuals of one or more coral species. Coral gardens can occur on a wide range of soft and hard seabed substrata. For example, soft-bottom coral gardens may be dominated by solitary scleractinians, sea pens or certain types of bamboo corals, whereas hard-bottom coral gardens are often found to be dominated by gorgonians, stylasterids, and/or black corals."

2.83 **Biotope data** - No biotope codes are currently defined for this habitat

2.84 **Species data** - Searches were made in the literature for records of coral garden type communities including stylasterid corals, gorgonian corals and antipatharian corals. Records of clusters of coral garden species were identified from the literature, although the current ambiguity of the habitat description made it hard to be certain about the correct identification of coral gardens. Much of the data identified is not available for use in the MB0102 project so potential areas where this habitat is likely to occur was identified using depth criteria.

2.85 Considerable data has been collected for deep sea habitats.However much of this work is in the process of publication and has not been available for this project. Studies from University of Plymouth, and Fisheries Research Services and from Spanish researchers should add to the knowledge of this habitat upon publication.

2.86 **Physiographic data** - as data on this habitat is so scarce a predicitive layer based on depth was created. Using a raster depth layer supplied by ABPmer, seabed in UK territorial waters at depths greater than 250m were identified and the areas where coral garden habitat could exist were defined.

2.87 **Definition issues** - the description for this habitat is quite vague and contains no biotope codes making it very difficult to distinguish a 'coral garden' habitat from the limited (often only presence/absence) species information available. For this development of the data layer, occurrences of gorgonian and antipatharian corals, which may or may not indicate the presence of a coral garden, were noted and recorded. A layer was also defined by depth to indicate the potential areas in which coral gardens might occur, as they may be found on many deep sea substrata. This habitat is impossible to map with any certainty without considerable refinement of the guidance.

2.3.20 Seamounts

2.88 **OSPAR definition** - "seamounts are defined as undersea mountains, with a crest that rises more than 1,000 metres above the surrounding sea floor (Menard, 1964 in Rogers, 1994). Seamounts can be a variety of shapes but are generally conical with a circular, elliptical or more elongate base."

2.89 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 code:	MNCR 04.05 biotope code:	MNCR 97 biotopes code:
A6.72	-	-

2.90 **Feature data** – data from a literature search and the OSPAR database was collated and enterered into the geodatabase.

2.3.21 Fragile Sponge and Anthozoan Communities on Subtidal Rocky Habitats

2.91 **BAP description (2008)** - "These communities are found on bedrock which is locally sheltered but close to tide-swept or wave exposed areas. They are dominated by large, slow growing species such as branching sponges and sea fans. The branching sponges include species such as *Axinella dissimilis*, *Axinella damicornis*, *Axinella infundibuliformis*, *Homaxinella subdola* and to a lesser extent *Raspailia* and *Stelligera* species."

2.92 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.;

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A4.131, A4.1311, A4.1312 A4.133, A4.211, A4.2111, A4.2112	CR.HCR.XFa.ByErSp, CR.HCR.XFa.ByErSp.Eun, CR.HCR.XFa.ByErSp.DysAct, CR.HCR.XFa.SwiLgAs, CR.MCR.EcCr.CarSwi, CR.MCR.EcCr.CarSwi.Aglo, CR.MCR.EcCr.CarSwi.LgAs	CR.MCR.XFa.ErSPbolSH, CR.MCR.XFa.ErSSwi, CR.MCR.XFa.ErSEun

2.93 **Species data** - characterisitc species for this habitat; *Axinella damicornis*, *Axinella infundibuliformis*, *Homaxinella subdola, Raspailia* sp, *Stelligera* sp, *Pentapora foliacea, Dysidea fragilis* and *Actinothoe sphyrodeta* were identified from the species data and mapped. The distribution of the characteristic species was then cross-referenced with the biotope data to exclude duplicates before mapping these additional data with the status field defined as 'biotope likely' or 'biotope certain'.

2.3.22 Intertidal Underboulder Communities

2.94 **BAP description (2008)** - "This habitat is found from the mid-shore down to the extreme lower shore, and encompasses areas of boulders (greater than 256 mm diameter) that support a diverse underboulder community. The underboulder habitat, along with fissures, crevices and any interstitial spaces between adjacent boulders, forms a series of microhabitats that add greatly to the biodiversity of a shore."

2.95 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer..

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A1.2142, A3.2112, A1.153	LR.MLR.BF.Fser.Bo, IR.MIR.KR.Ldig.Bo, LR.HLR.FT.FserX.T*	LR.MLR.BF.Fser.Fser.Bo IR.MIR.KR.Ldig.Ldig.Bo LR.SLR.FX.FserX.T

*included in additional biotope data from Wales

2.96 **Definition issues** - this habitat is quite difficult to map as it may occur on a number of unspecified intertidal biotopes and is therefore reliant on this feature being noted in survey descriptions (where descriptions are available). Additional biotope data developed by Countryside Concil for Wales (CCW) has been included but it is likely that such data for the rest of the UK is missing. The identification and clarification of further biotopes that this habitat may occur in and, if required, suffixing biotope occurrences with the '*.Bo' code would assist future mapping greatly.

2.3.23 Littoral Chalk Communities

2.97 **OSPAR definition** - "The erosion of chalk exposures on the coast has resulted in the formation of vertical cliffs and gently-sloping intertidal platforms with a range of micro-habitats of biological importance. Supralittoral and littoral fringe chalk cliffs and sea caves support various algal communities unique to this soft rock type"

2.98 **BAP description (2008)** - Equivalent to the OSPAR definition given above.

2.99 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A1.126, A1.441, B3.114, B3.115, A1.2143, A3.2113*	LR.HLR.FR.Osm, LR.FLR.CvOv.ChrHap, LR.FLR.Lic.Bli, LR.FLR.Lic.UloUro, LR.MLR.BF.Fser.Pid, IR.MIR.KR.Ldig.Pid*	LR.MLR.R.Osm, LR.L.Chr, LR.L.Bli, LR.L.UloUro, LR.MLR.BF.Fser.Pid

*BAP only

2.100 As some of the biotope data includes substrata other than chalk, the biotope data was compared with the descriptions and geological data (see below) and points where non-chalk substrata were indicated were removed.

2.101 **Geological data** - terrestrial areas with chalk bedrock were identified using the British Geological Survey Solid Geology GIS layer,. Areas where this corresponded with coastline were identified as potential chalk coastline.

2.102 **Definition issues** - although the definition suggests that the biotopes found on chalk are unique several of the existing biotopes defining littoral chalk communities do not differentiate between chalk and similar soft rock substrata such as soft limestone. This means littoral chalk communities cannot be extracted without reference geological data. IR.MIR.KR.Ldig.Pid in the BAP is a sublittoral biotope rather than an intertidal biotope.

2.3.24 Sea Pen and Burrowing Megafauna Communities

2.103 This habitat definition overlaps slightly with the BAP habitat Mud habitats in deep water.

2.104 **OSPAR Definition** – "plains of fine mud, at water depths ranging from 15-200m or more, which are heavily bioturbated by burrowing megafauna with burrows and mounds typically forming a prominent feature of the sediment surface. The habitat may include conspicuous populations of seapens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. The burrowing crustaceans present may include *Nephrops norvegicus*, *Calocaris macandreae* or *Callianassa subterranea*."

2.105 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer..

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A5.361, A5.3611, A5.362	SS.SMu.CFiMu.SpnMeg, SS.SMu.CFiMu.SpnMeg.Fun, SS.SMu.CFiMu.MegMax	SS.CMU._.SpMeg, SS.CMU._.SpMeg.Fun

2.3.25 Estuarine Rocky Habitats

2.106 **BAP Description** - "This habitat encompasses rocky habitats in estuaries, extending from supralittoral lichens down to the subtidal circalittoral. Estuarine rocky habitats incorporate substrata types such as bedrock and stable boulders. Generally rias, fjords and fjards are the most relevant types of inlet for rocky estuarine habitats."

2.107 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer..

EUNIS 2004 codes	MNCR 04.05 biotope codes	MNCR 97 biotope codes
A3.363,	IR.LIR.IFaVS.HarCon,	IR.SIR.EstFa.HarCon,
A1.45,	LR.FLR.Eph,	LR.MLR.Eph,
A2.431,	LR.FLR.Eph.BLitX,	LR.SLR.FX.Blit,
A1.451,	LR.FLR.Eph.Ent,	LR.MLR.Eph.Ent,
A1.452,	LR.FLR.Eph.EntPor,	LR.MLR.Eph.EntPor,
A1.32,	LR.LLR.FVS,	LR.SLR.FX.AscX.mac,
A1.325,	LR.LLR.FVS.Ascmac,	LR.SLR.F.Asc.VS,
A1.324,	LR.LLR.FVS.AscVS,	LR.SLR.F.Fcer,
A1.327,	LR.LLR.FVS.Fcer,	LR.SLR.FX.FcerX,
A1.326,	LR.LLR.FVS.FserVS,	LR.SLR.F.Fserr.VS
A1.322,	LR.LLR.FVS.FspiVS,	
A1.323,	LR.LLR.FVS.FvesVS,	
A1.321	LR.LLR.FVS.PelVS	

2.108 Some of the biotopes are found outside estuarine habitats so all data was clipped to the JNCC estuaries layer provided as part of the contract.

2.109 It was not possible to produce a geological map of estuarine habitats in the scope of this project.

2.3.26 Intertidal Mudflats

2.110 The BAP description is broader than the OSPAR Definition.

2.111 **BAP Description** - "Mudflats are sedimentary intertidal habitats created by deposition in low energy coastal environments, particularly estuaries and other sheltered areas. Their sediment consists mostly of silts and clays with a high organic content. Towards the mouths of estuaries where salinity and wave energy are higher the proportion of sand increases."

2.112 **OSPAR definition** - "Intertidal mud typically forms extensive mudflats in calm coastal environments (particularly estuaries and other sheltered areas), although dry compacted mud can form steep and even vertical faces, particularly at the top of the shore adjacent to salt marshes. The upper limit of intertidal mudflats is often marked by saltmarsh, and the lower limit by Chart Datum. Sediments consist mainly of fine particles, mostly in the silt and clay fraction (particle size less than 0.063 mm in diameter), though sandy mud may contain up to 80% sand (mostly very fine and fine sand), often with a high organic content."

2.113 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer..

EUNIS 2004 codes	MNCR 04.05 biotope codes	MNCR 97 biotope codes
A2.24*, A2.241*, A2.242*, A2.243*, A2.244*, A2.245*, A2.3, A2.31, A2.311, A2.312, A2.313, A2.32, A2.321, A2.322, A2.3221, A2.3222, A2.3223, A2.323, A2.324, A2.325, A2.3251, A2.33, A2.34, A2.7213	LS.LSa.MuSa*, LS.LSa.MuSa.MacAre*, LS.LSa.MuSa.CerPo*, LS.LSa.MuSa.HedMacEte*, LS.LSa.MuSa.BatCare*, LS.LSa.MuSa.Lan*, LS.LMu, LS.LMu.MEst, LS.LMu.MEst.NhomMacStr, LS.LMu.MEst.HedMac, LS.LMu.MEst.HedMacScr, LS.LMu.UEst, LS.LMu.UEst.NhomStr, LS.LMu.UEst.Hed, LS.LMu.UEst.Hed.Str, LS.LMu.UEst.Hed.Cvol, LS.LMu.UEst.Hed.Ol, LS.LMu.UEst.Tben	LS.LMS.MS*, LS.LMS.MS.MacAre*, LS.LMS.MS.MacAre.Mare*, LS.LMS.MS.PCer*, LS.LMS.MS.BatCor*, LS.LGS.S.Lan*, LS.LMU, LS.LMU.SMu, LS.LMU.SMu.HedMac, LS.LMU.SMu.HedMac.Are, LS.LMU.SMu.HedMac.Pyg, LS.LMU.SMu.HedMac.Mare, LS.LMU.Mu.HedScr, LS.LMU.Mu, LS.LMU.Mu.HedOl

*BAP only

2.114 Definition issues - The OSPAR description is broader than the habitats defined by the EUNIS codes as it does not include muddy sand communities.

2.3.27 Mud Habitats in Deep Water

2.115 This habitat is broader then the OSPAR habitat Seapens and burrowing megafauna communities.

2.116 **BAP description** – “Mud habitats in deep water (circalittoral muds) occur below 20-30 m in many areas of the UK's marine environment, including marine inlets such as sea lochs. The relatively stable conditions associated with deep mud habitats often lead to the establishment of communities of burrowing megafaunal species where bathyal species may occur with coastal species. The burrowing megafaunal species include burrowing crustaceans such as *Nephrops norvegicus* and *Callianassa subterranea*. The mud habitats in deep water can also support seapen populations and communities with *Amphiura* spp.”

2.117 **Biotope data** - The following codes were searched for and extracted from the polygon and point biotope geodatabases;

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A5.35 A5.351, A5.352, A5.353, A5.354, A5.3541, A5.355, A5.361, A5.3611, A5.362, A5.36, A5.363, A5.37, A5.371, A5.372, A5.373, A5.374, A5.3741, A5.375, A5.376, A5.377, A5.7211	SS.SMu.CSaMu SS.SMu.CSaMu.AfilMysAnit, SS.SMu.CSaMu.ThyNten, SS.SMu.CSaMu.AfilNten, SS.SMu.CSaMu.VirOphPmax, SS.SMu.CSaMu.VirOphPmax.Has, SS.SMu.CSaMu.LkorPpel, SS.SMu.CFiMu, SS.SMu.CFiMu.SpnMeg, SS.SMu.CFiMu.SpnMeg.Fun, SS.SMu.CFiMu.MegMax, SS.SMu.CFiMu.BlyrAchi, SS.SMu.OMu, SS.SMu.OMu.AfalPova, SS.SMu.OMu.ForThy, SS.SMu.OMu.StyPse, SS.SMu.OMu.CapThy, SS.SMu.OMu.CapThy.Odub, SS.SMu.OMu.LevHet, SS.SMu.OMu.PjefThyAfil, SS.SMu.OMu.MyrPo, SS.SMu.IFiMu.Beg	SS.CMU._.SpMeg, SS.CMU._.SpMeg.Fun, SS.CMU, SS.CMU.BriAchi, COS.AmpPar, COS.ForThy, COS.Sty' SS.CMU.Beg

2.118 **Geological data** - areas classified as 'Mud' were identified using the British Geological Survey DigSBS250 GIS layer. Areas greater than 20m depth were identified using a bathymetry raster supplied by ABPmer. Corresponding 'Mud' areas below 20m were identified as 'Mud habitats in deep water'.

2.3.28 Peat and Clay Exposures

2.119 **BAP description** - "This habitat includes littoral and sublittoral examples of peat and clay exposures, both of which are soft enough to allow them to be bored by a variety of piddocks, particularly *Pholas dactylus*, *Barnea candida* and *Barnea parva*. Peat and clay exposures with either existing or historical evidence of piddock activity are unusual communities of limited extent, adding to the biodiversity interest where they occur. These unique and fragile habitats are irreplaceable, arising from former lake bed sediments and ancient forested peatland (or 'submerged forests'). Depending on erosion at the site, both clay and peat can occur together or independently of each other."

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A1.127, A1.223, A4.231, A4.23	LR.HLR.FR.RPid, LR.MLR.MusF.MytPid, CR.MCR.SfR.Pid, CR.MCR.SfR (possibly)	LR.MLR.R.RPid LR.MLR.MytPid CR.MCR.SfR.Pid Some records possibly in (IR._.FaSwV.AlcByH.Hia)

2.120 **Species data** - characterisitc species for this habitat; *Pholas dactylus, Barnea candida* and *Barnea parva* were identified from the species data and mapped against the geological information (below). The distribution of these characteristic species was then cross-referenced with the biotope data to exclude duplicates before mapping these additional data with the status field defined as ‘biotope likely’.

2.121 **Additional data –** A predictive layer was created from data provided by English Heritage where certain attributes such as ‘peat exposure’ and ‘exposed peat beds’ were selected. Other points were removed if described as ‘underlying’ or if they occurred above the mean high water mark.

2.3.29 Sheltered Muddy Gravels

2.122 **BAP description** - “Sheltered muddy gravel habitats occur principally in estuaries, rias and sea lochs, in areas protected from wave action and strong tidal streams. In fully marine conditions on the lower shore this habitat can be extremely species-rich because the complex nature of the substratum supports a high diversity of both infauna and epifauna. However, good quality examples of this habitat are very scarce.”

2.123 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status ‘biotope certain’ or ‘biotope likely’ (Table 1) were used in the data layer.

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A2.41, A2.411, A2.4111, A2.4112, A2.4113, A2.4114, A2.4115, A2.42, A2.421, A5.432, A5.433, A5.435	LS.LMx.GvMu, LS.LMx.GvMu.HedMx, LS.LMx.GvMu.HedMx.Mac, LS.LMx.GvMu.HedMx.Scr, LS.LMx.GvMu.HedMx.Str, LS.LMx.GvMu.HedMx.Cir, LS.LMx.GvMu.HedMx.Cvol, LS.LMx.Mx, LS.LMx.Mx.CirCer, SS.SMx.IMx.SpavSpAn, SS.SMx.IMx.VsenAsquAps, SS.SMx.IMx.Ost	SS.IMX.FaMx.VsenMtru, SS.IMX.Oy.Ost

2.124 **Geological data** - Areas classified as ‘Gravel sand and silt’, ‘Gravelly mud’, ‘Gravelly muddy sand’, ‘Muddy gravel’, ‘Muddy sandy gravel’, ‘Slightly gravelly mud’ and ‘Slightly gravelly sandy mud’ were identified from British Geological Survey DigSBS250 GIS layer. Areas where wave exposure is classified as less than 3 (sheltered) were identified from the draft wave exposure layer (resulting from MB0102 2E.6b). Areas where maximum tidal bed shear stresses less than 30 Nm^2 were identified from the draft maximum tidal bed shear stresses raster (resulting from MB0102 2E.3). The remaining areas less than 2kms from shore were designated sheltered muddy gravels.

2.3.30 Subtidal Chalk

2.125 **BAP description** - “A characteristic of chalk coasts, in contrast to many harder rocky coasts of western and northern Britain is the geomorphological structure in which, because of subaerial and marine erosion, a vertical cliff face abuts an extensive foreshore (a wave eroded platform) often extending several hundreds of metres seawards. This is of significance in the formation of subtidal chalk sea caves and reefs habitats and the occurrence of the associated communities / biotopes."

2.126 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A3.2113, A3.218, A4.23, A4.231, A4.232, A4.233	IR.MIR.KR.Ldig.Pid, IR.MIR.KR.HiaSw, CR.MCR.SfR, CR.MCR.SfR.Pid, CR.MCR.SfR.Pol, CR.MCR.SfR.Hia	IR.MIR.KR.Ldig.Pid, IR.FaSwV.AlcByH.Hia, CR.MCR.SfR.Pol

2.127 The above biotope records were matched against the geological data to exclude records on other soft rocks such as clays and limestones.

2.128 **Geological data** - Terrestrial areas with chalk bedrock were identified using the British Geological Survey Solid Geology GIS layer. Areas where this corresponded with coastline were identified as potential chalk coastline. A 10km buffer was created from this and then clipped so that only coastal areas were left. Areas less than 3m below chart datum were identified using the bathymetry layer supplied ABPmer, and the 10km buffer created previously was then clipped to those areas less than 3m below chart datum.

2.3.31 Subtidal Mixed Muddy Sediments

2.129 **NERC Act 2006 Definition** - "These habitats incorporate a range of sediments which form a muddy matrix. They include heterogeneous muddy gravelly sands and also mosaics of cobbles and pebbles embedded in or lying on mixtures of sand, gravel and mud. These habitats (it would be inaccurate to refer to them in the singular) are often extremely species-rich because of the complex nature of the substratum which supports a high diversity of life both within and on the sediment surface."

2.130 **Biotope data** - the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes	MNCR 04.05 biotope codes	MNCR 97 biotope codes
A5.433, A5.441, A5.4411, A5.443, A5.451, A5.445	SS.SMx.IMx.VsenAsquAps, SS.SMx.CMx.ClloMx, SS.SMx.CMx.ClloMx.Nem, SS.SMx.CMx.MysThyMx, SS.SMX.Omx.PoVen, SS.SMx.CMx.OphMx,	SS.IMX.FaMx.VsenMtru

2.131 The biotope SS.SMp.KSwSS.LsacR was not included in the analysis as it includes other substrata in addition to mixed muddy sediments.

2.132 **Geological data** - 'Gravelly muddy sand', 'Muddy gravel, 'Muddy sandy gravel' and 'Slightly gravelly muddy sand' were extracted from the British Geological Survey DigSBS250 GIS layer, based on the NERC report Order No. 833 (An atlas of selected marine habitats and species listed on Section 42 of the NERC Act 2006),. , Areas where wave exposure is greater than 4 (moderately exposed – extremely exposed) were removed based on the wave exposure layer resulting from MB0102 (2E.6b). Areas extracted from the BGS layer were then queried against the results of filtered exposure layer, to identify areas of sub tidal mixed muddy sediments.

2.3.32 Subtidal Sands and Gravels

2.133 **BAP description -**"Subtidal sands and gravel sediments are the most common habitats found below the level of the lowest low tide around the coast of the United Kingdom. The sands and gravels found to the west of the UK (English Channel and Irish Sea) are largely shell derived, whereas those from the North Sea are largely formed from rock material. "

2.134 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A5.1,		SS.IGS.FaS
A5.13,	SS.SCS,	SS.IGS.FaS.Mob
A5.135,	SS.SCS.CCS,	SS.IGS.FaS.NcirBat
A5.132,	SS.SCS.CCS.Blan,	SS.IGS.FaS.ScupHyd
A5.134,	SS.SCS.CCS.MedLumVen,	SS.IGS.FaS.Lcon
A5.133,	SS.SCS.CCS.Nmix,	SS.IGS.FaS.FabMag
A5.131,	SS.SCS.CCS.Pkef,	SS.IGS.EstGS
A5.12,	SS.SCS.CCS.PomB,	SS.IGS.EstGS
A5.126,	SS.SCS.ICS,	SS.IGS.EstGS.MobRS
A5.125,	SS.SCS.ICS.CumCset,	SS.IGS.EstGS.Ncir
A5.122,	SS.SCS.ICS.Glap,	SS.IGS.EstGS.NeoGam
A5.124,	SS.SCS.ICS.HchrEdw,	SS.IGS.FaG,
A5.123,	SS.SCS.ICS.HeloMsim,	SS.IGS.FaG.HalEdw
A5.127,	SS.SCS.ICS.MoeVen,	SS.CGS
A5.121,	SS.SCS.ICS.SLan,	SS.CGS._.Ven,
A5.14,	SS.SCS.ICS.SSh,	SS.CGS._.Ven.Neo,
A5.141,	SS.SCS.OCS,	SS.CGS._.Ven.Bra,
A5.142,	SS.SCS.OCS.GlapThyAmy,	CR.ECR.EFa.PomByC,
A5.2,	SS.SCS.OCS.HeloPkef,	SS.CMS._.AfilEcor,
A5.25,	SS.SSa,	SS.IMU.MarMu.TubeAP,
A5.252,	SS.SSa.CFiSa,	SS.IMS.FaMS.EcorEns,
A5.251,	SS.SSa.CFiSa.ApriBatPo,	SS.IGS.FaS.FabMag
A5.26,	SS.SSa.CFiSa.EpusOborApri,	
A5.261,	SS.SSa.CMuSa,	
A5.262,	SS.SSa.CMuSa.AalbNuc,	
A5.23,	SS.SSa.CMuSa.AbraAirr,	
A5.231,	SS.SSa.IFiSa,	
A5.233,	SS.SSa.IFiSa.IMoSa,	
A5.232,	SS.SSa.IFiSa.NcirBat,	
A5.234,	SS.SSa.IFiSa.ScupHyd,	
A5.24,	SS.SSa.IFiSa.TbAmPo,	
A5.243,	SS.SSa.IMuSa,	
A5.241,	SS.SSa.IMuSa.AreISa,	
A5.242,	SS.SSa.IMuSa.EcorEns,	
A5.244,	SS.SSa.IMuSa.FfabMag,	
A5.27,	SS.SSa.IMuSa.SsubNhom,	
A5.271,	SS.SSa.OSa,	
A5.272,	SS.SSa.OSa.MalEdef,	
A5.22,	SS.SSa.OSa.OfusAfil,	
A5.221,	SS.SSa.SSaVS,	
A5.222,	SS.SSa.SSaVS.MoSaVS	
A5.223,	SS.SSa.SSaVS.NcirMac,	
A5.11	SS.SSa.SSaVS.NintGam	

2.135 **Geological layer -** ‘Sand’, ‘Gravel', ‘Sandy gravel’, ‘Gravely sand’, 'Muddy sand', ‘Slightly gravelly sand’ and ‘Slightly gravelly muddy sand’ were extracted from the British Geological Survey DigSBS250 GIS layer, based on the NERC report Order No. 833 (An atlas of selected marine habitats and species listed on Section 42 of the NERC Act 2006),

2.3.33 Tide Swept Communities

2.136 **BAP description -** "In this habitat action plan, the term 'tidal rapids' is used to cover a broad range of high energy environments including deep tidal streams and tide-swept habitats. The JNCC`s Marine Nature Conservation Review (MNCR) defined rapids as 'strong tidal streams resulting from a constriction in the coastline at the entrance to, or within the length of, an enclosed body of water such as a sea loch. Depth is usually shallower than five metres. In deeper situations, defined in this plan as being more than five metres, tidal streams may generate favourable conditions for diverse marine habitats (eg the entrances to fjordic sea lochs, between islands, or between islands and the mainland, particularly where tidal flow is funnelled by the shape of the coastline). Wherever they occur, strong tidal streams result in characteristic marine communities rich in diversity, nourished by a constantly renewed food source brought in on each tide."

2.137 **Biotope data -** the following biotopes were extracted from the polygon and point biotope geodatabases. As stated in section 2.6, only records with assigned the status 'biotope certain' or 'biotope likely' (Table 1) were used in the data layer.

EUNIS 2004 codes:	MNCR 04.05 biotope codes:	MNCR 97 biotope codes:
A5.5211	SS.SMp.KSwSS.LsacR.CbPb, LR.HLR.FT, LR.HLR.FT.FserTX , IR.MIR.KR.LhypT, IR.MIR.KR.LhypTX, IR.MIR.KT, CR.HCR.FaT, CR.MCR.CFaVS	IR.MIR.SedK.EphR

2.138 **Geophysical data** - The Maximum Tidal Bed Shear Stress layer (resulting from MB0102 2E.3) from ABPmer was used to identify an, exposure of >1.8 Nm^{-2} ('moderate' and greater bed stress shear; EUNIS-UK classification), which was then extracted from the raster layer. Assuming that current at depth is approximately half that of the surface (Hiscock, 1975) and using the Maximum Current Magnitude layer (resulting from MB0102 2E.2), areas of surface current of magnitudes greater than 3 knots (a 1.5 multiplication of modeled sea bed currents) were extracted from the raster. Areas with corresponding tidal bed stress greater than 1.8 Nm^{-2} and maximum current magnitude greater than 3 knots on the surface were classified as potential tide swept communities.

2.139 **Definition issues** - tide swept communities are found outside tidal channels. Therefore, a broader habitat than the definition has been mapped, although it is currently unclear if additional biotopes should be included in this broader definition. The parameters for tidal exposure required to provide suitable conditions for this community were developed in order to enable a predicted area of habitat to be mapped.

3. Derived Data Layers for Priority Habitats

3.1 Use of the Point, Polygon and Predicted Layers

3.1 All data layers for a habitat should be viewed together for the known and predicted coverage.

3.2 For each habitat, two layers were produced; a) point habitat and species data and b) polygon habitat data. For some habitats, additional geophysical layers were produced to assist in the identification of potential areas of the habitat and in order to comply with licensing issues.

3.3 For the 2C habitat layers, the different sources of data meant that various data layers were produced. These layers consist of point biotope records, polygon derived biotope records and in some cases an additional predicted layer. The predicted layers are in most cases quite crude and should be interpreted with caution but they may assist in highlighting areas where there may be gaps in the current biotope data. It is recommended that the layers for each priority habitat be interpreted together. Figure 1 illustrates the layers for the subtidal chalk habitat displayed together.

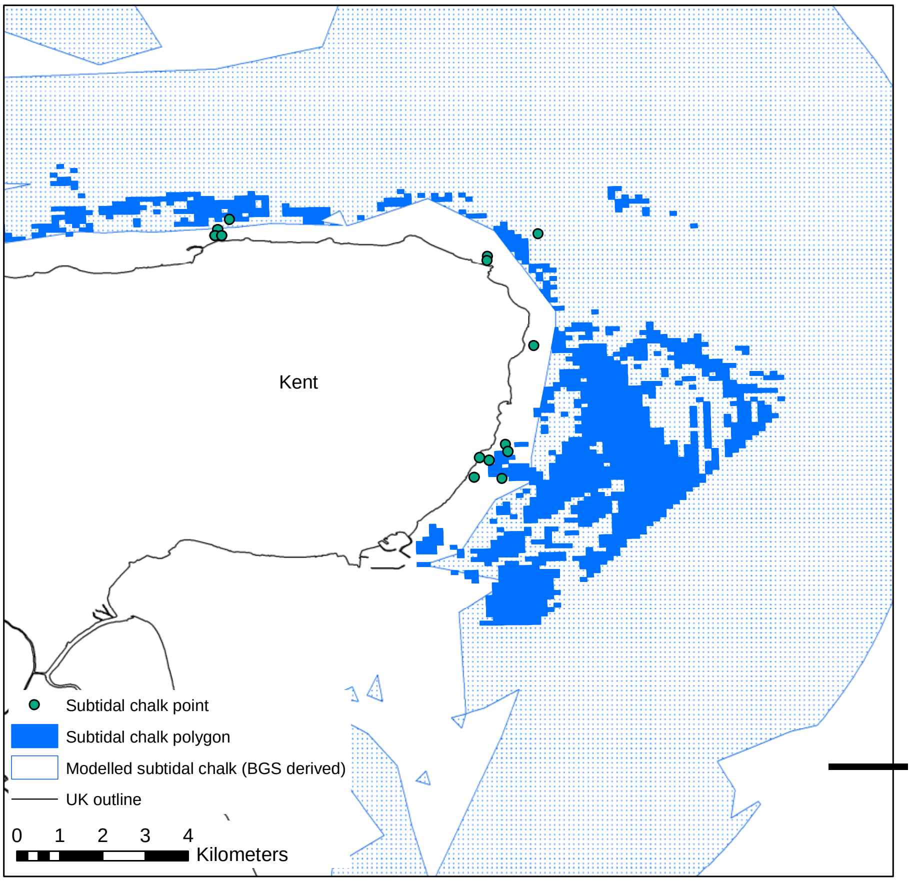

Figure 1. An example of a point and polygon layer, as well as a British Geographical Survey derived modelled layer for subtidal chalk.

3.2 Co-ordinate Precision

3.4 Those records that are provided as points in these layers may require interpretation using the co-ordinate precision field. The precision may affect how a record displays particularly for those at 10km resolution, as they may appear offshore for intertidal or intertidal for a sublittoral species. For the habitat layers very few records have poor co-ordinate precision.

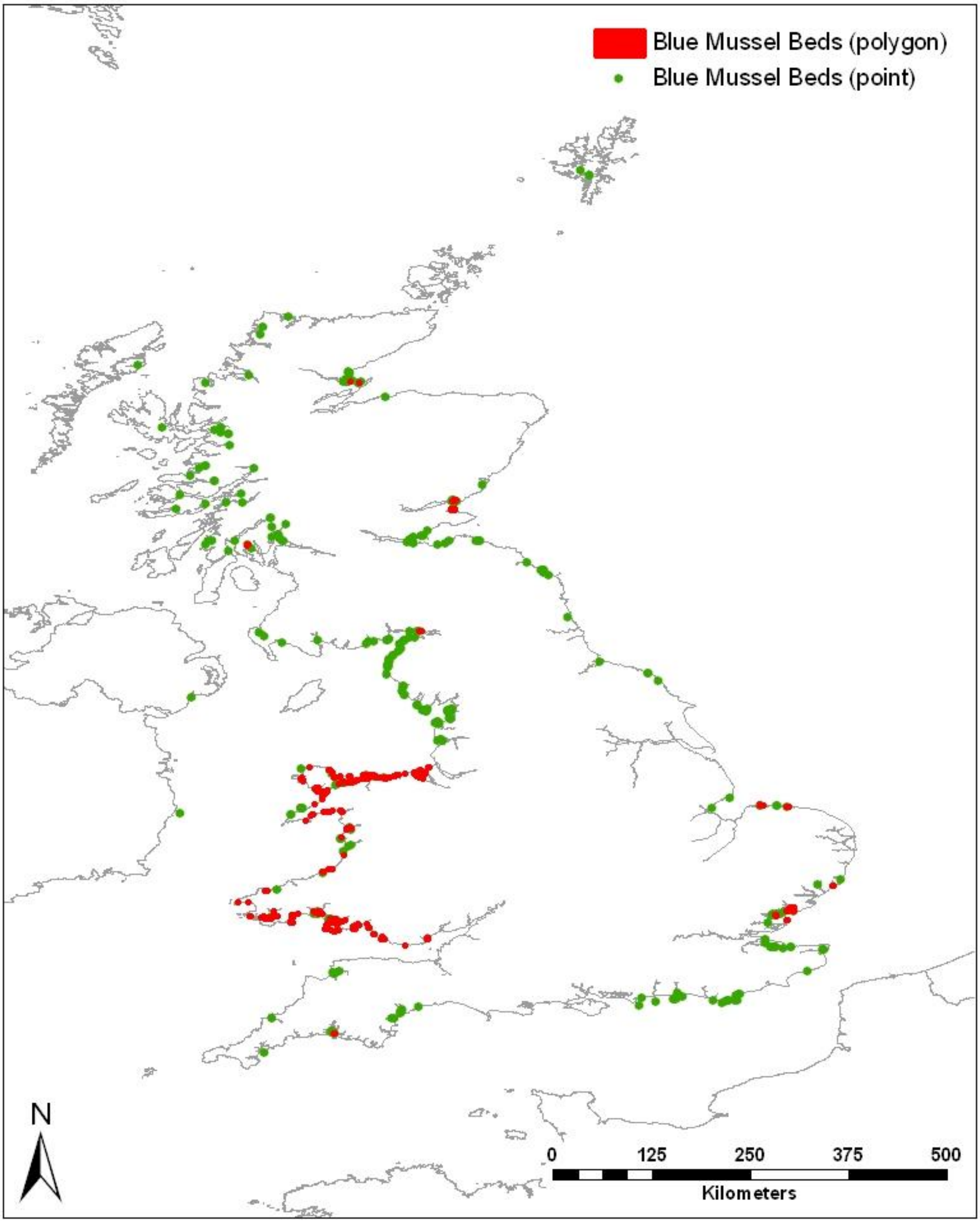

Figure 2. Final derived data layer for blue mussel beds.

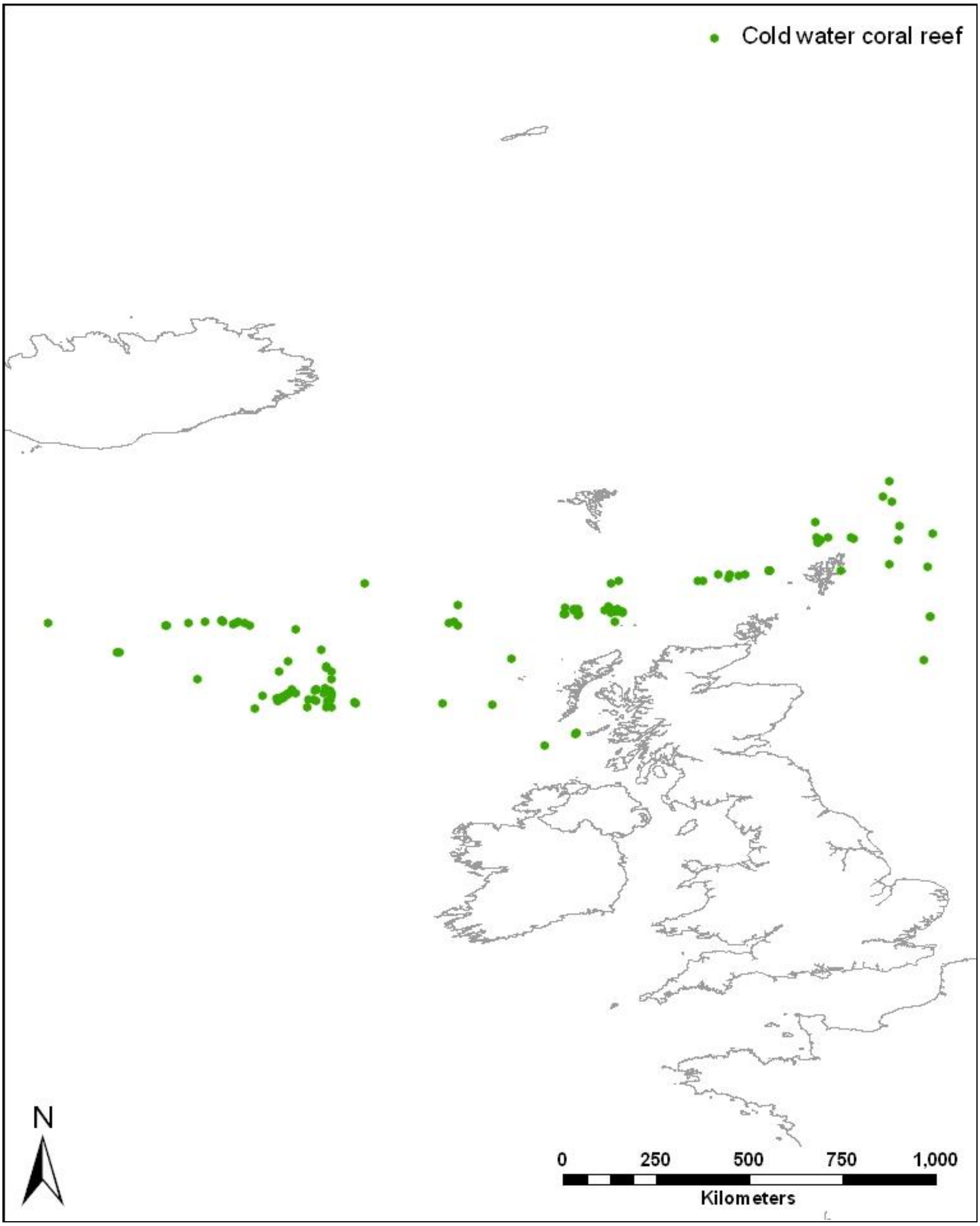

Figure 3. Final derived data layer for cold water coral reef.

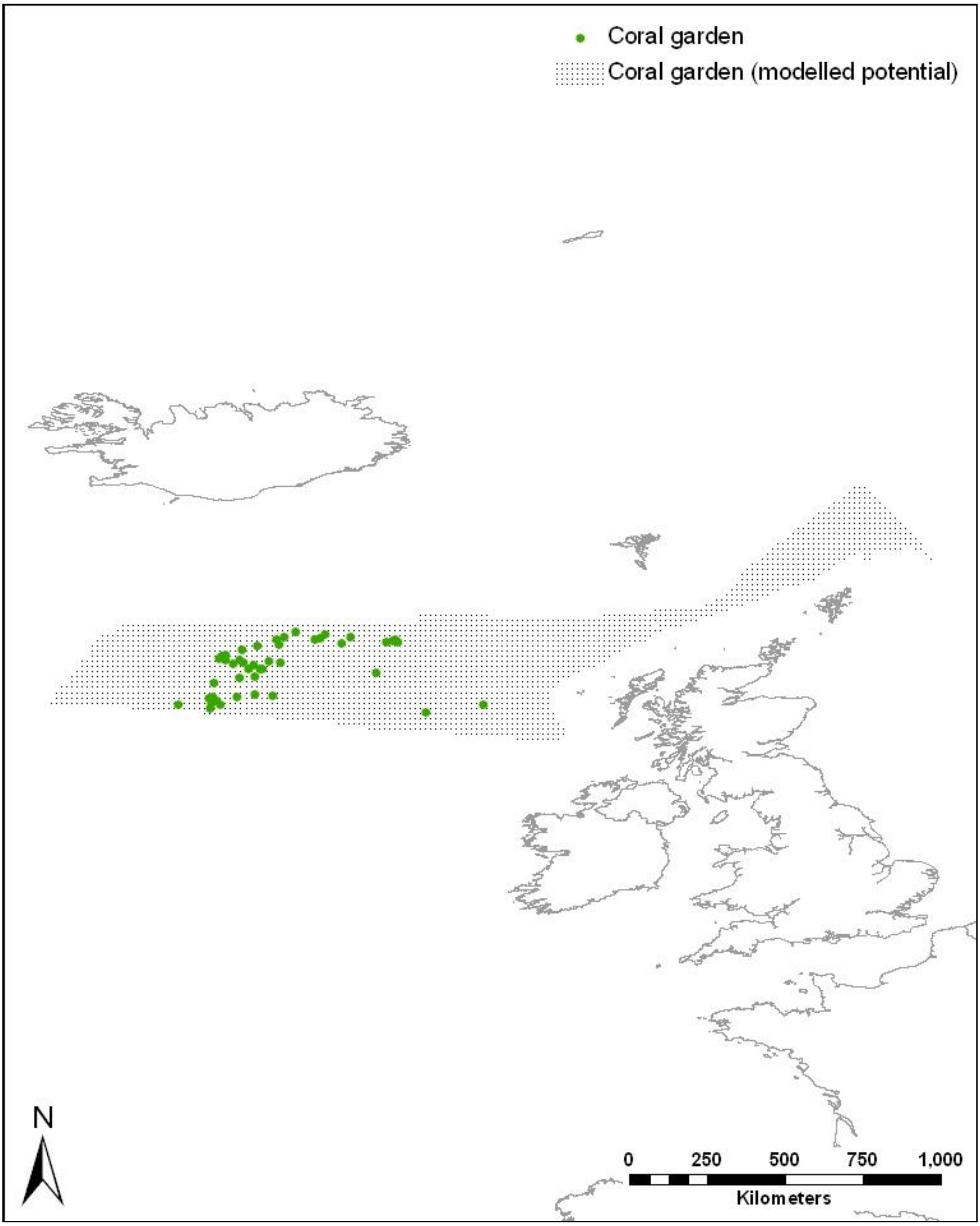

Figure 4. Final derived data layer for coral garden.

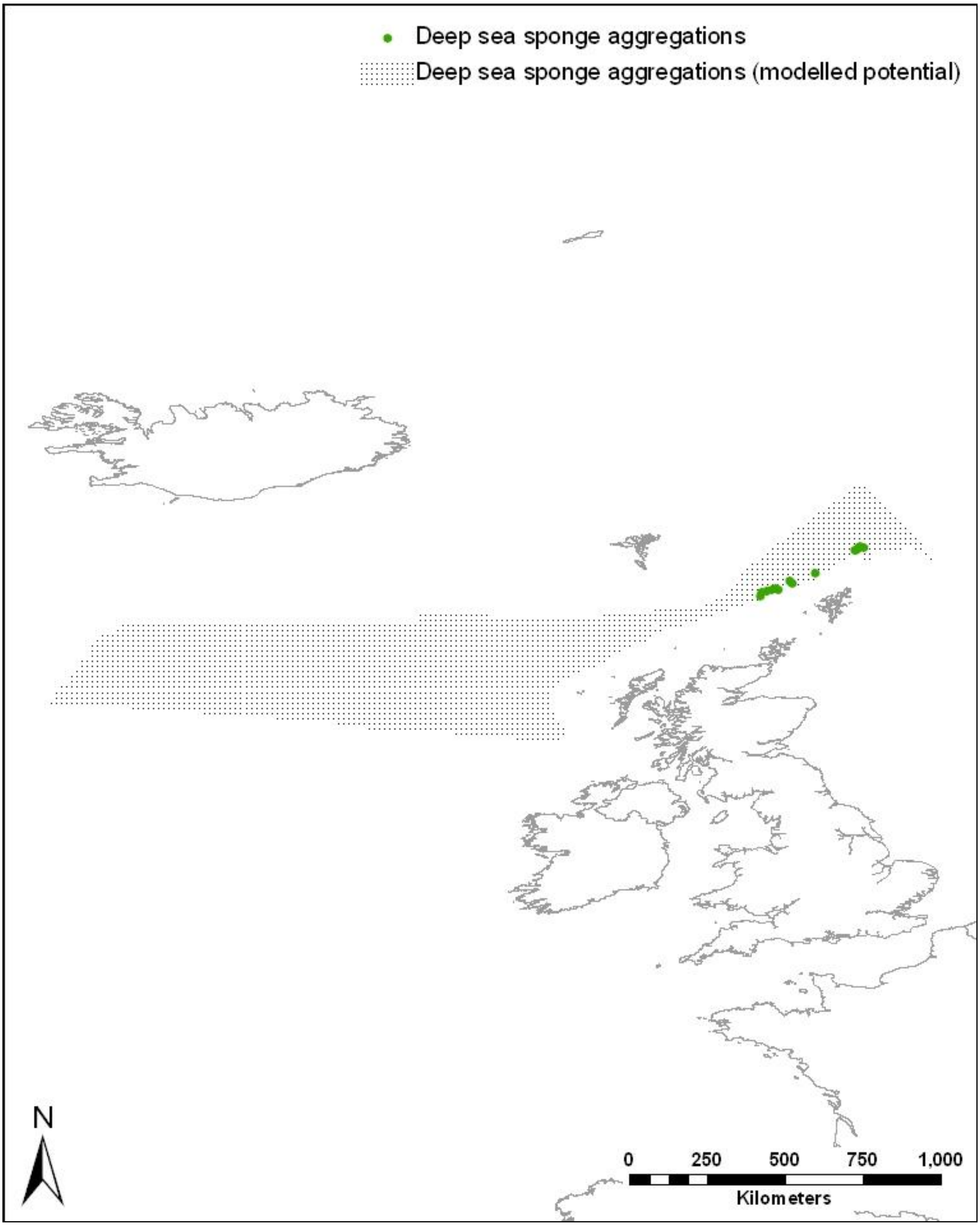

Figure 5. Final derived data layer for deep sea sponge aggregations.

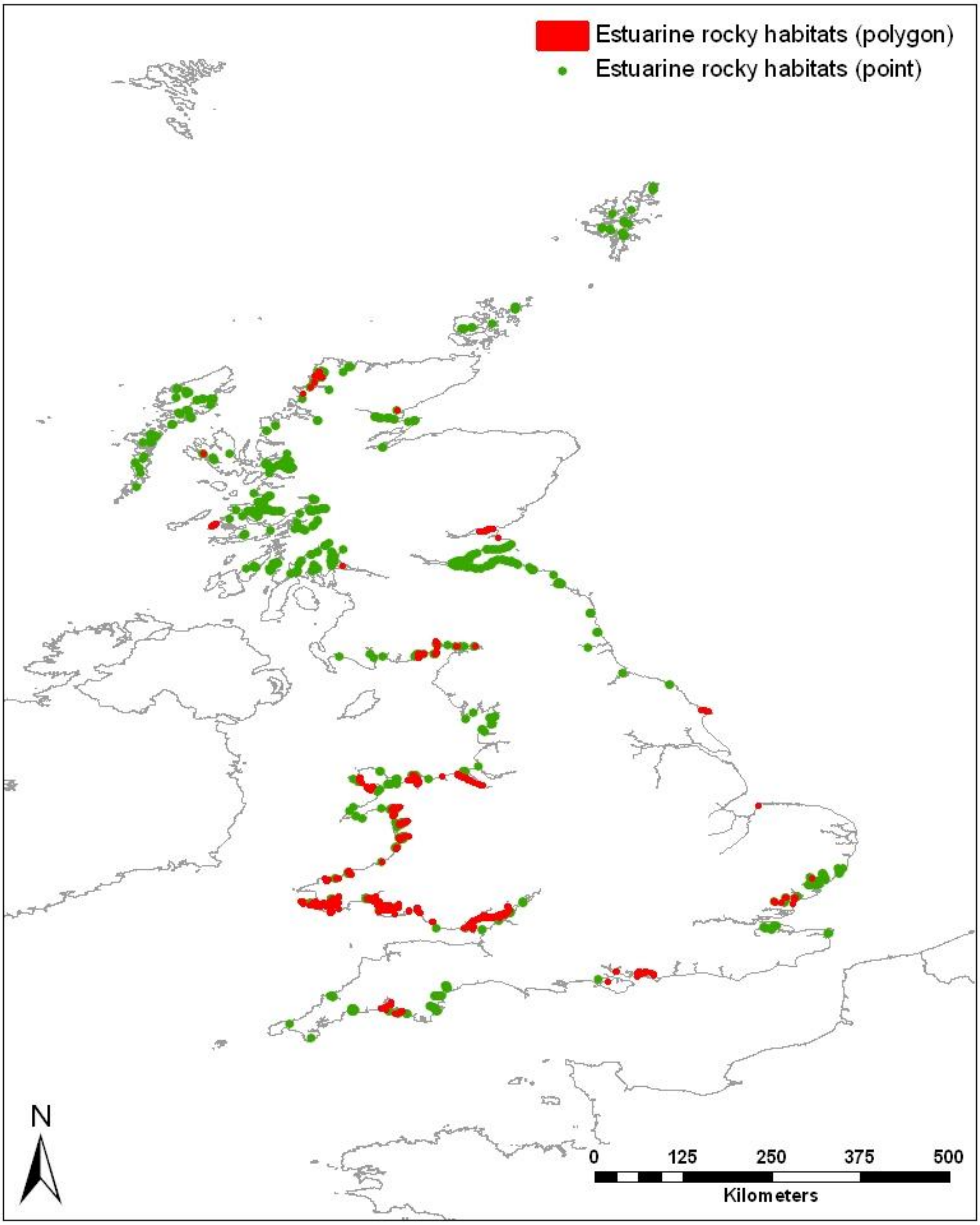

Figure 6.. Final derived data layer for estuarine rocky habitat.

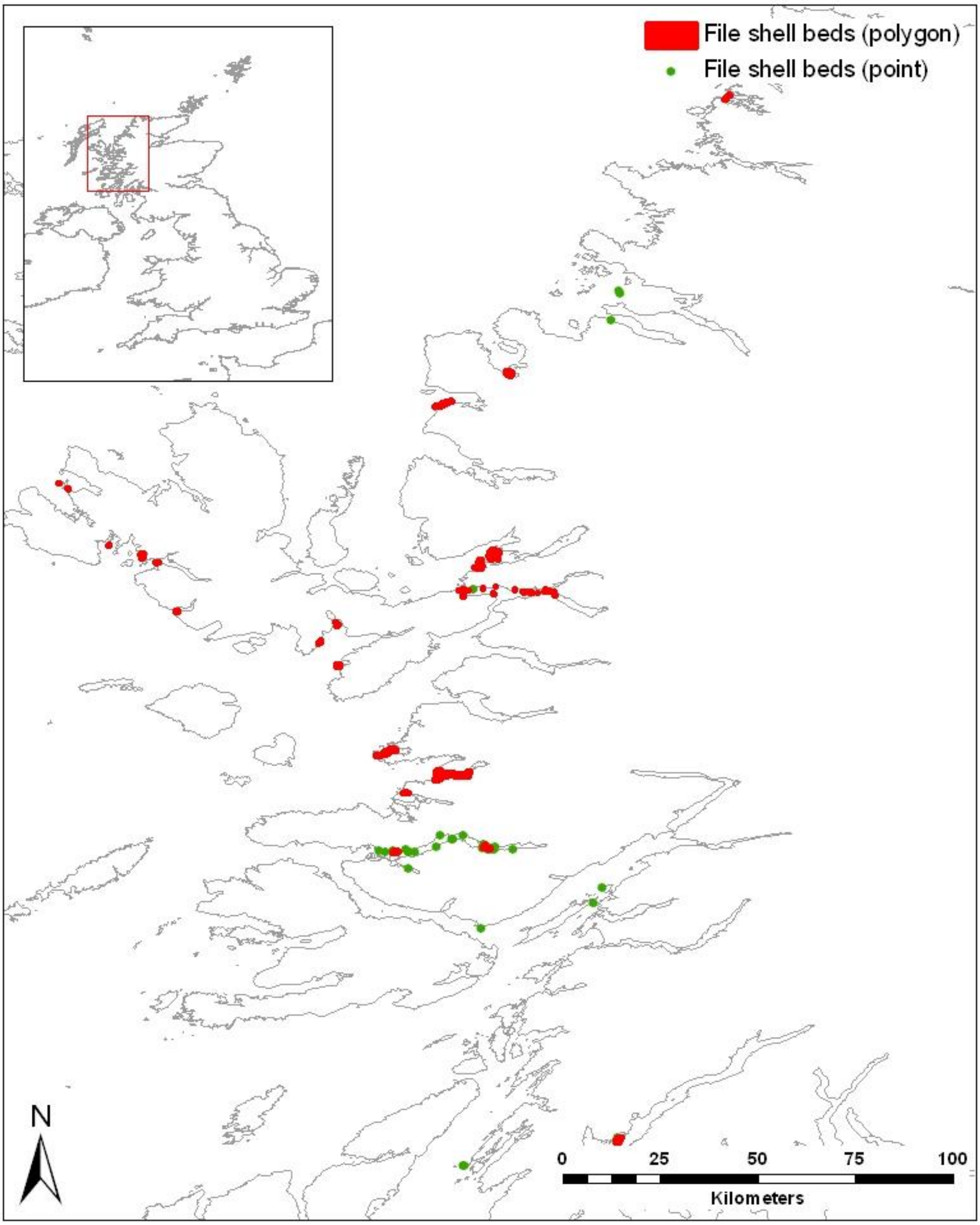

Figure 7. Final derived data layer for file shell bed.

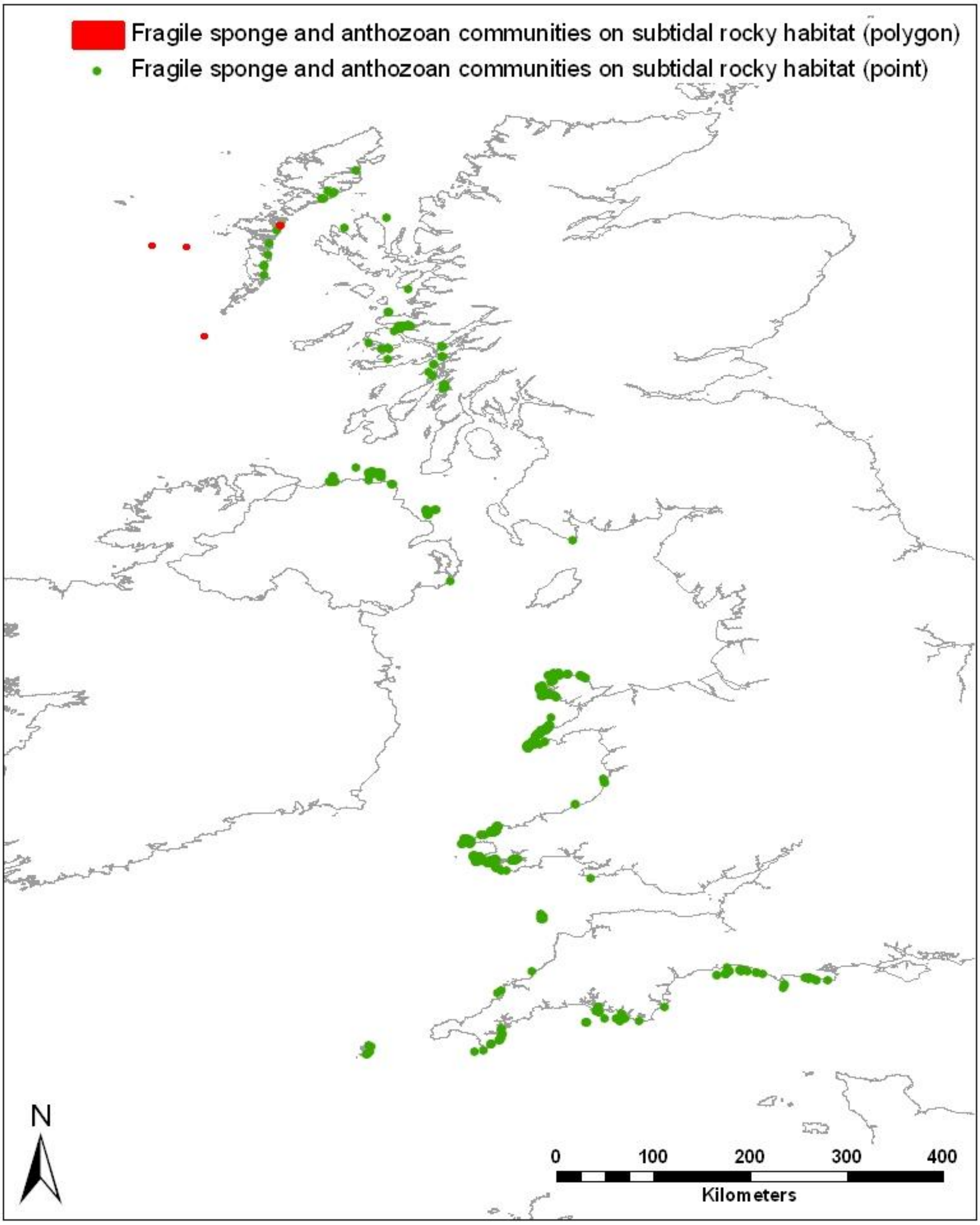

Figure 8. Final derived data layer for fragile sponge and anthozoan communities on subtidal rocky habitat.

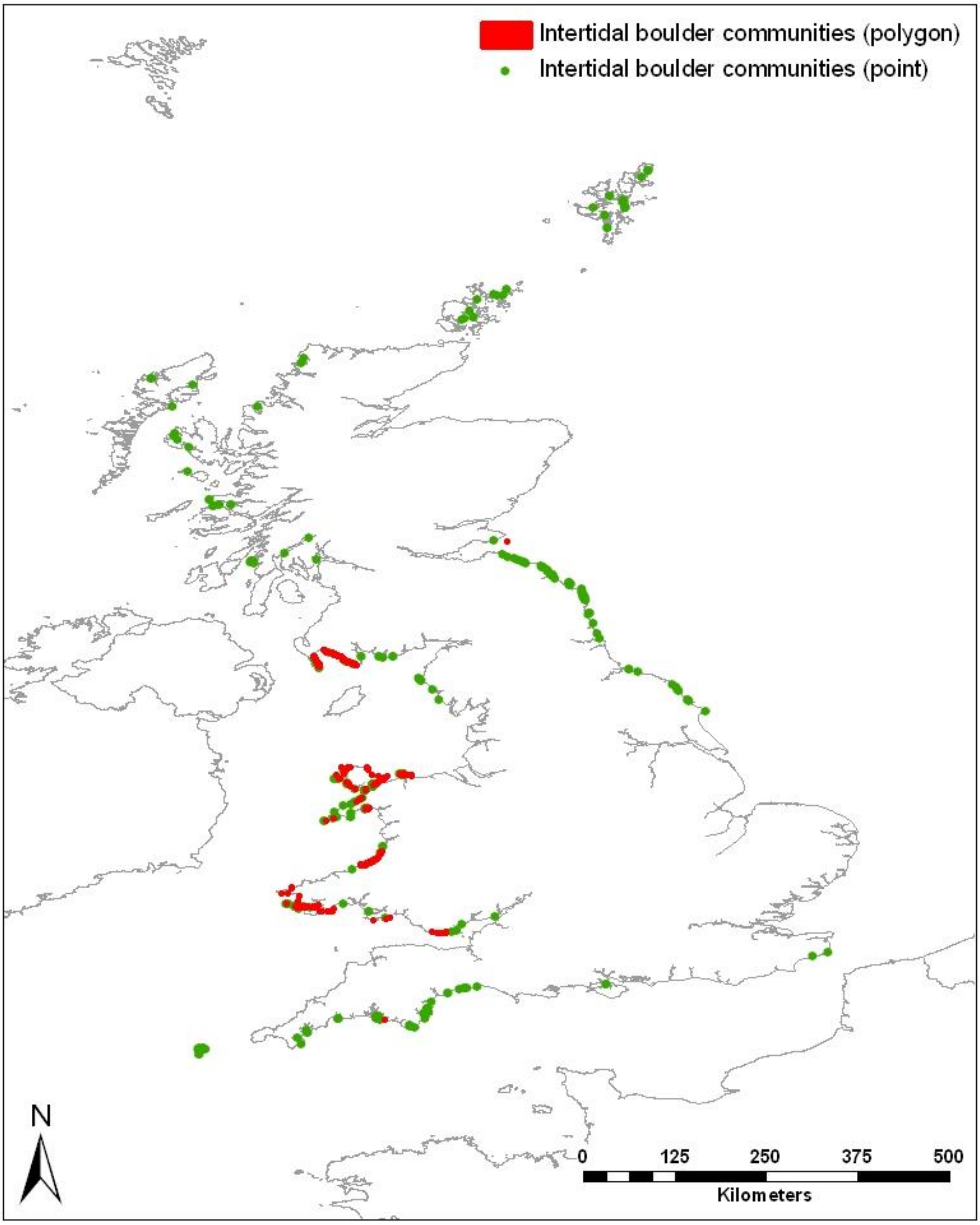

Figure 9. Final derived data layer for intertidal boulder communities.

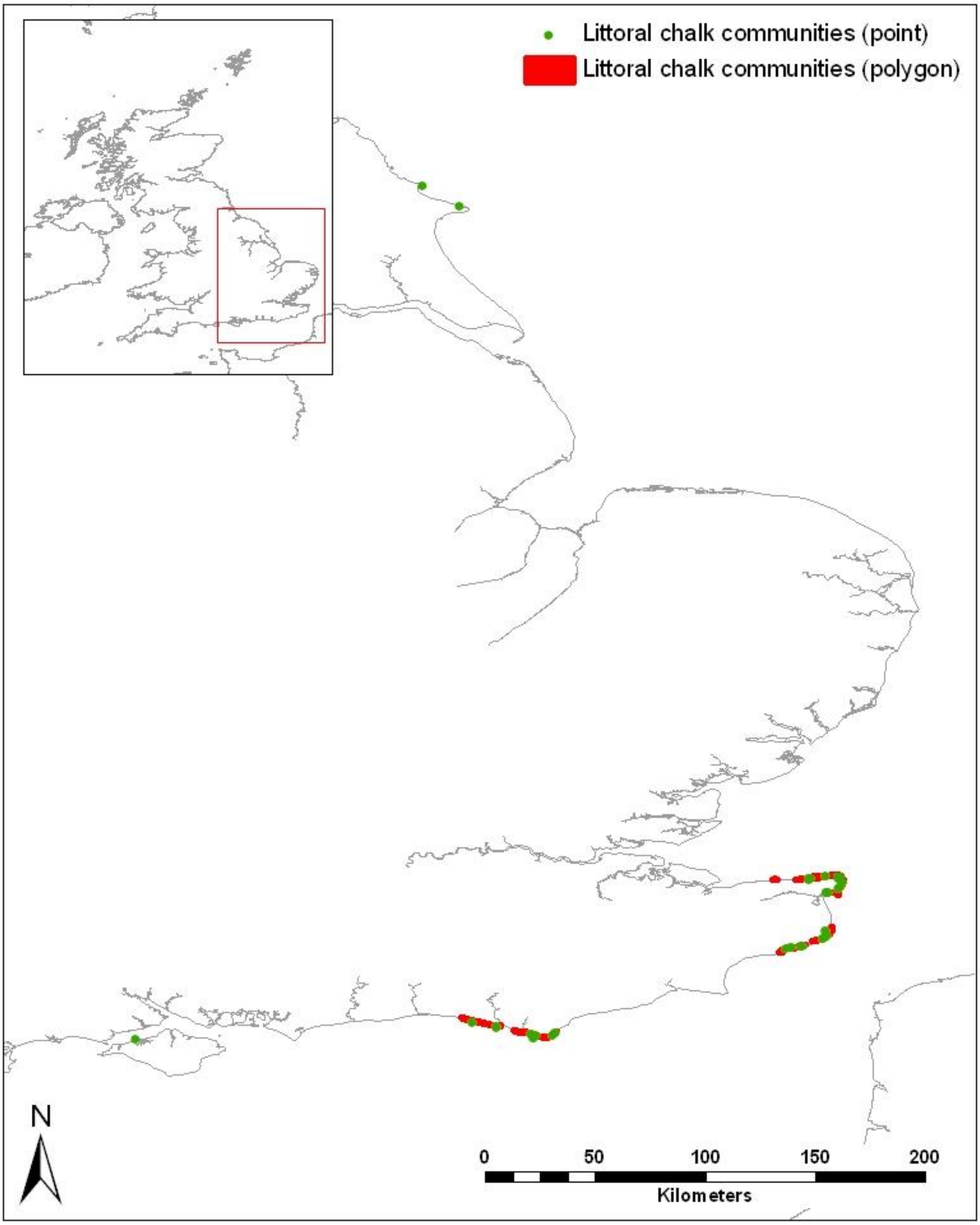

Figure 10. Final derived data layer for littoral chalk communities.

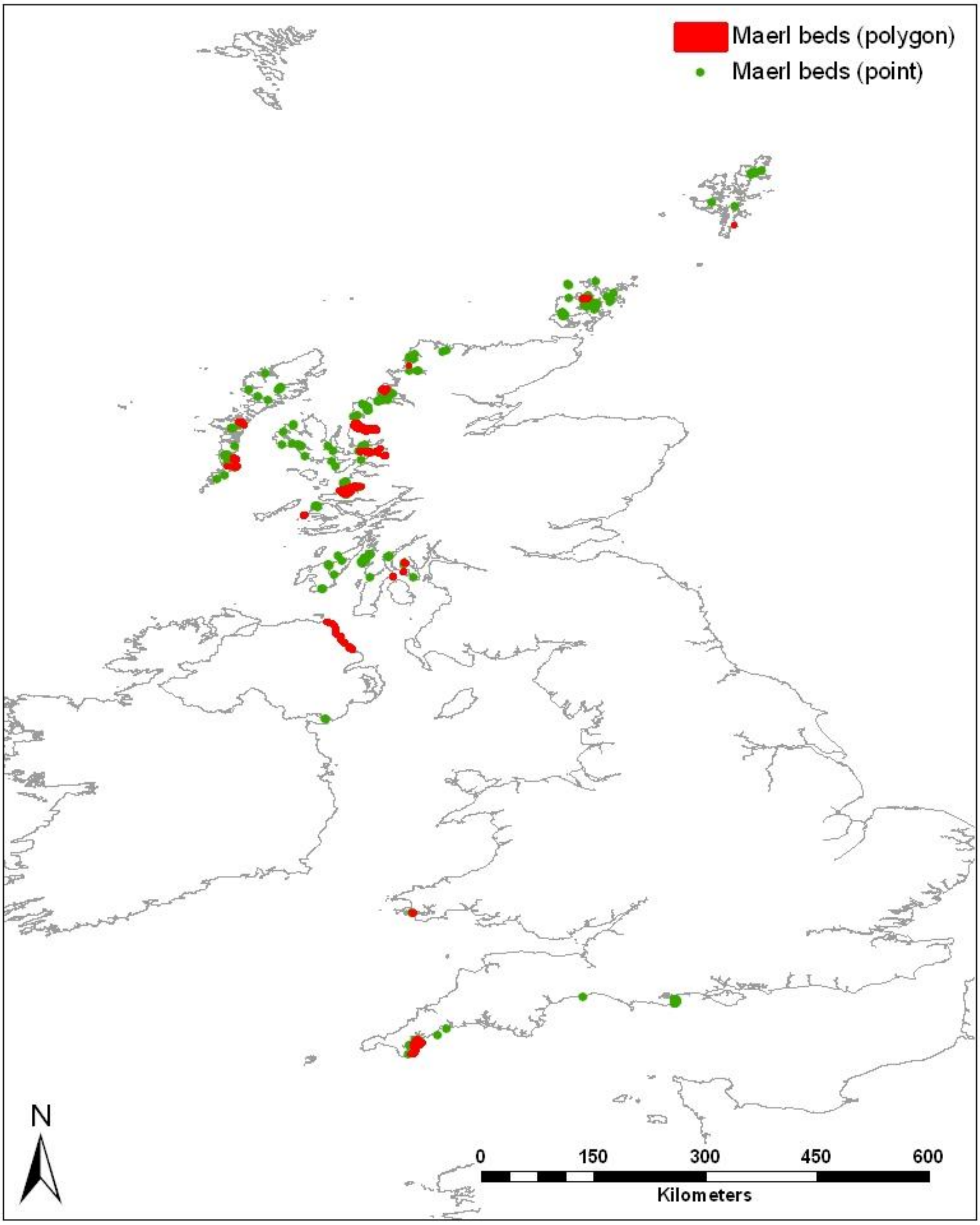

Figure 11. Final derived data layer for maerl beds.

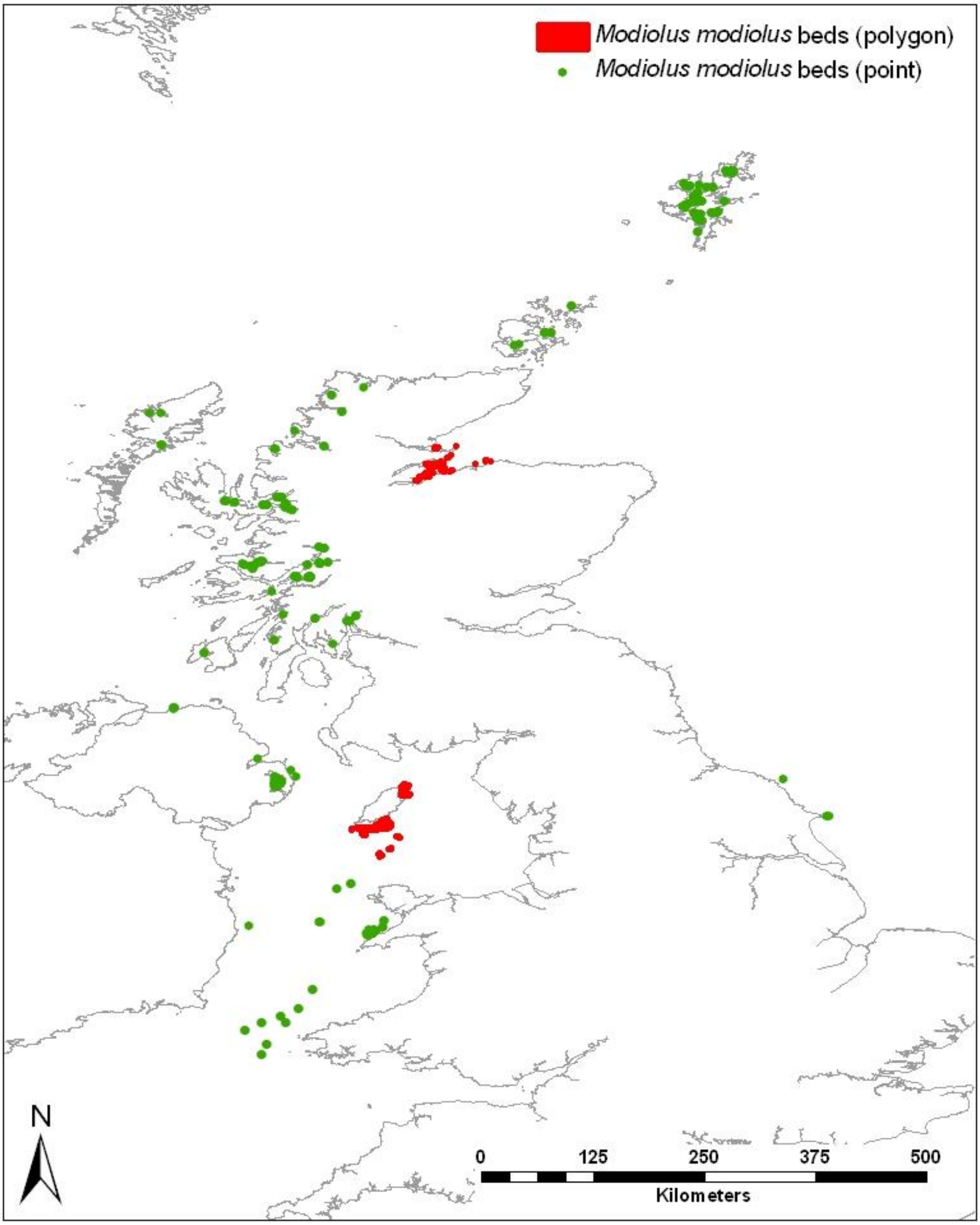

Figure 12. Final derived data layer for *Modiolus modiolus* beds.

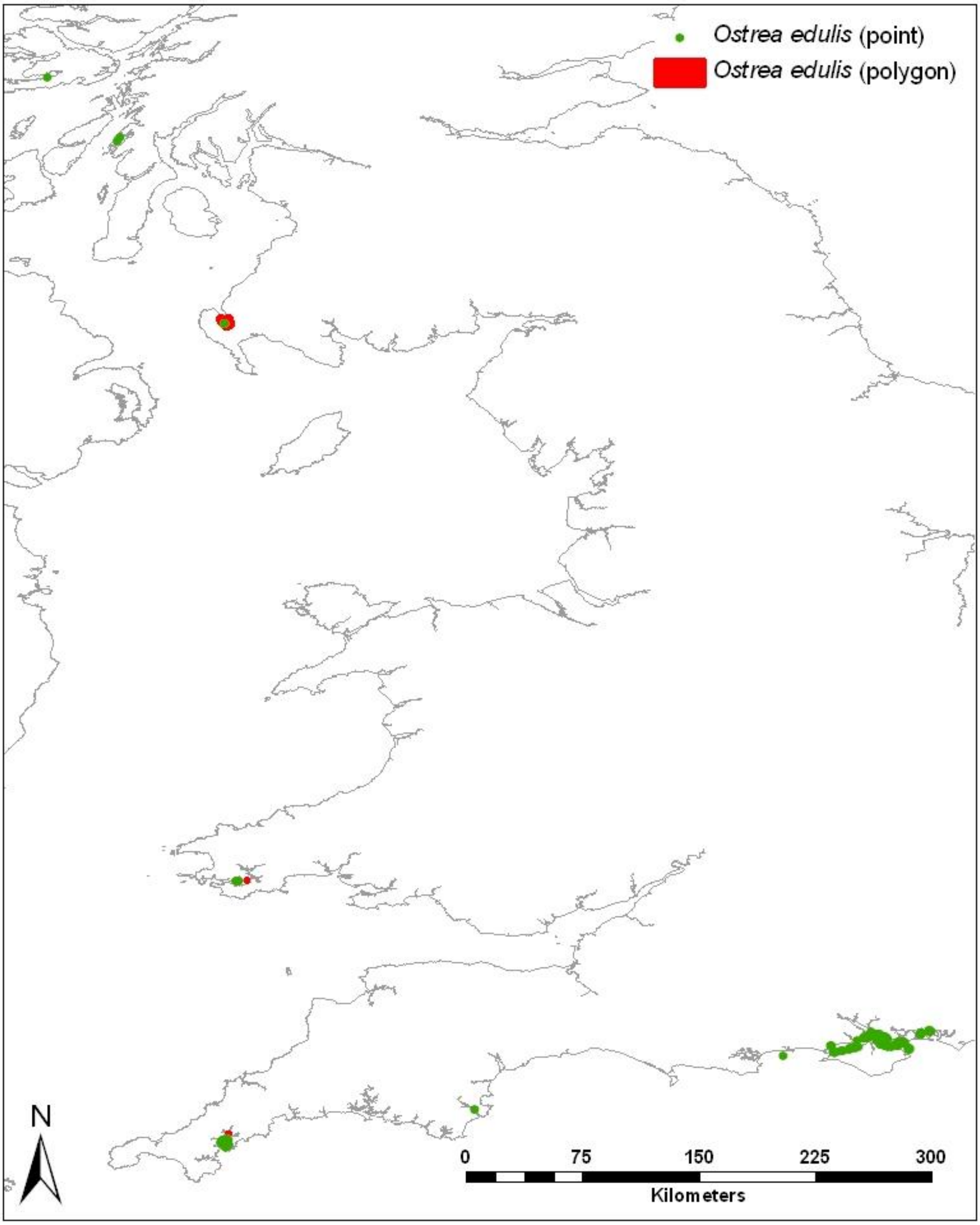

Figure 13. Final derived data layer for *Ostrea edulis.*

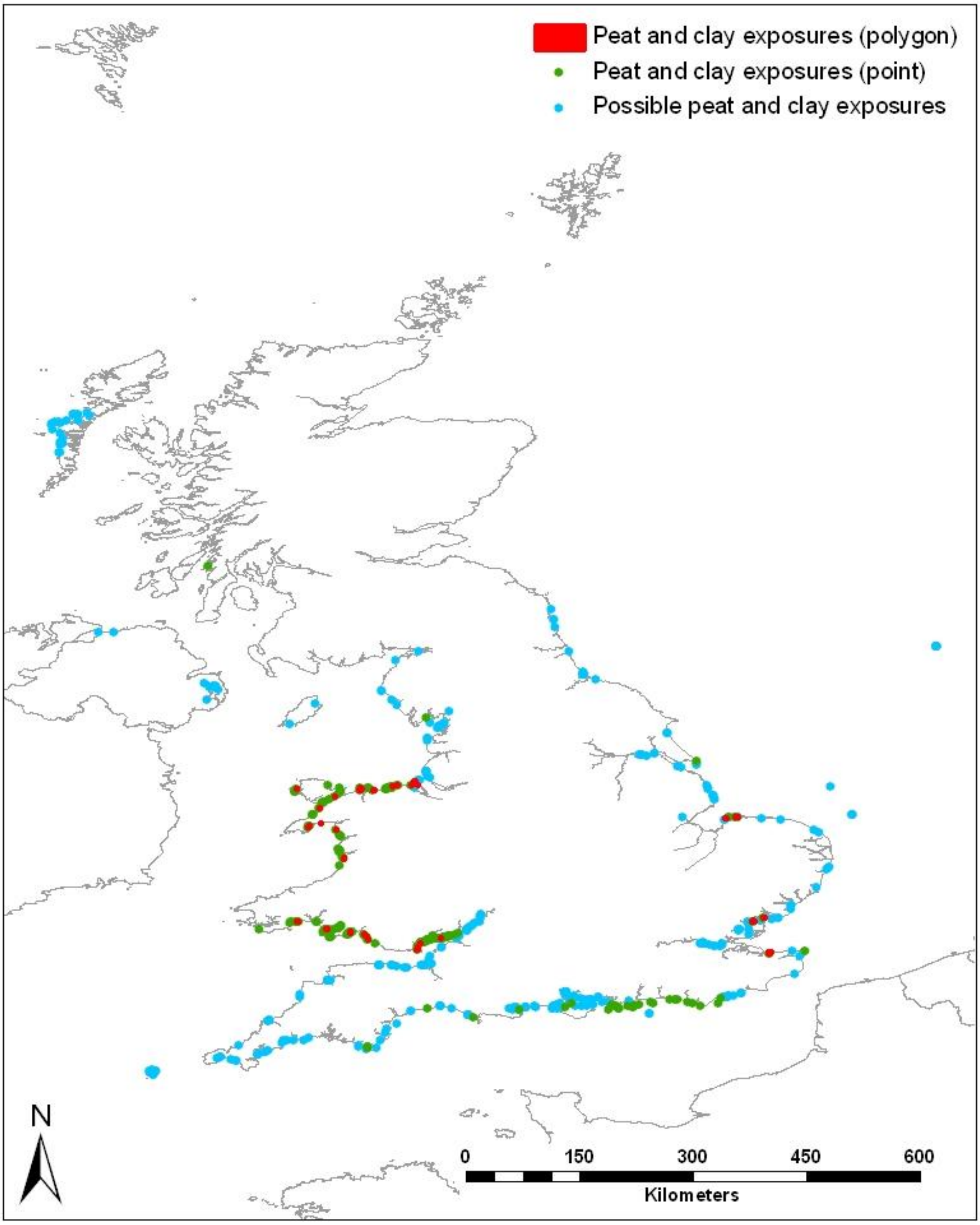

Figure 14. Final derived data layer for peat and clay exposures.

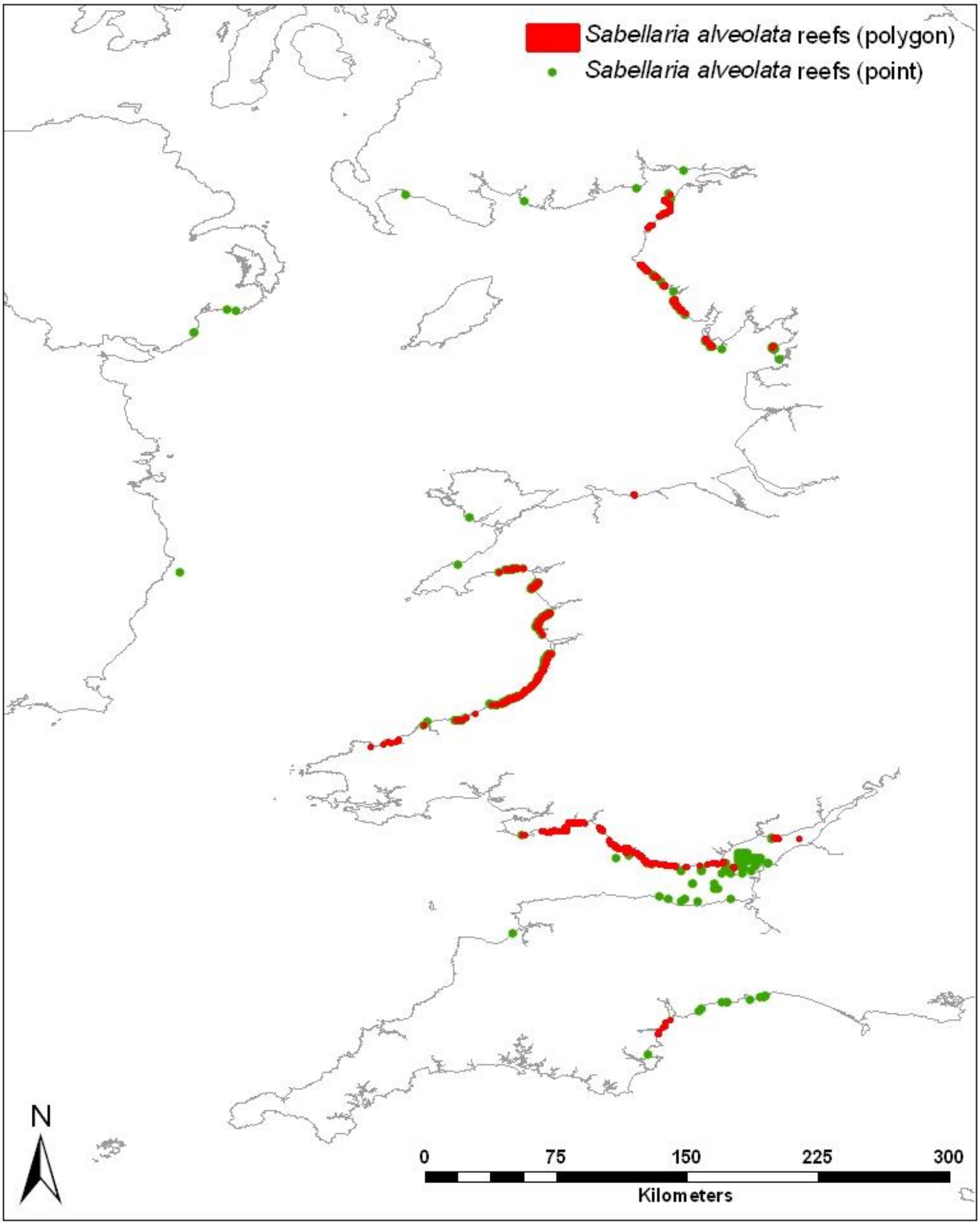

Figure 15. Final derived data layer for *Sabellaria alveolata.*

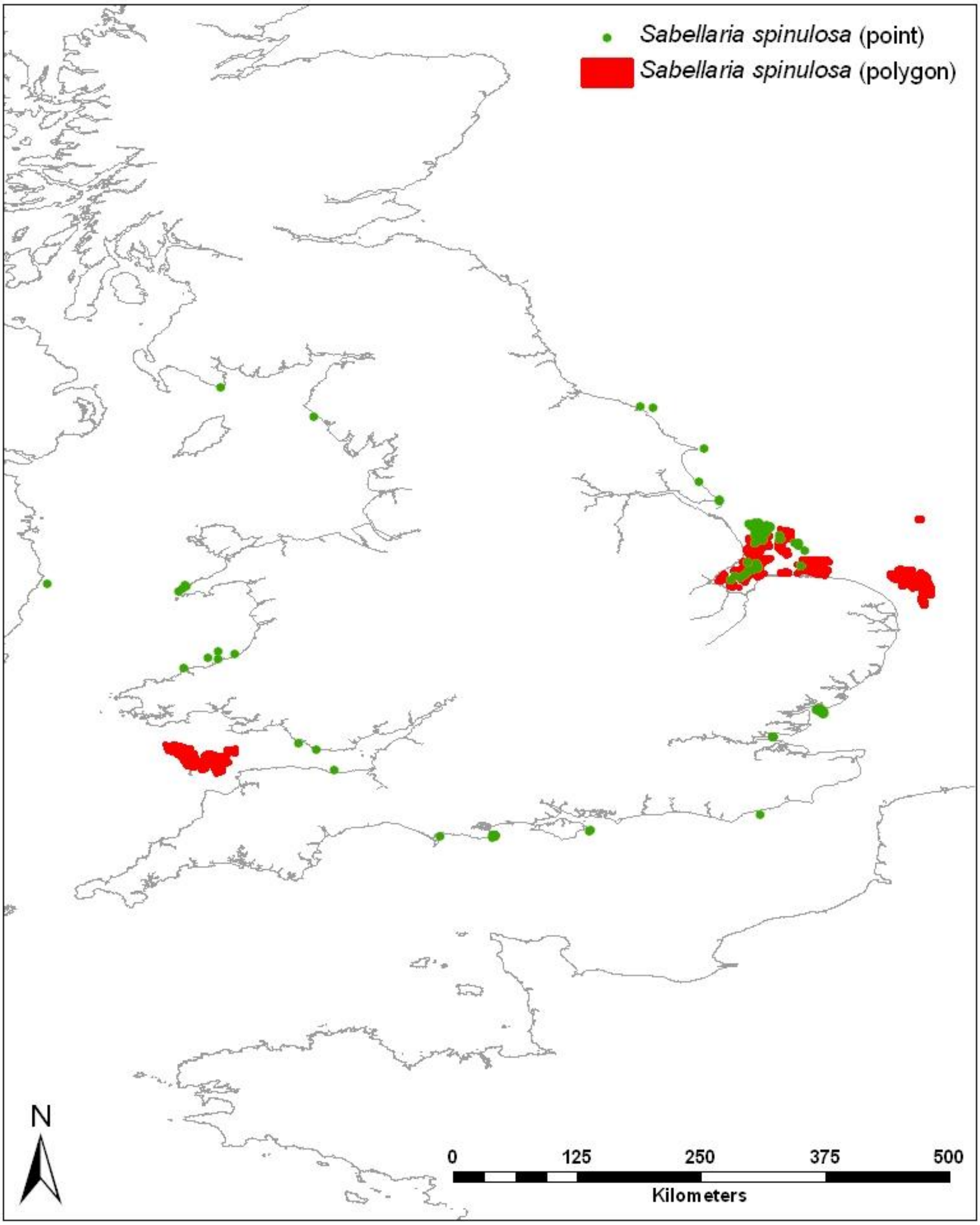

Figure 16. Final derived data layer for *Sabellaria spinulosa.*

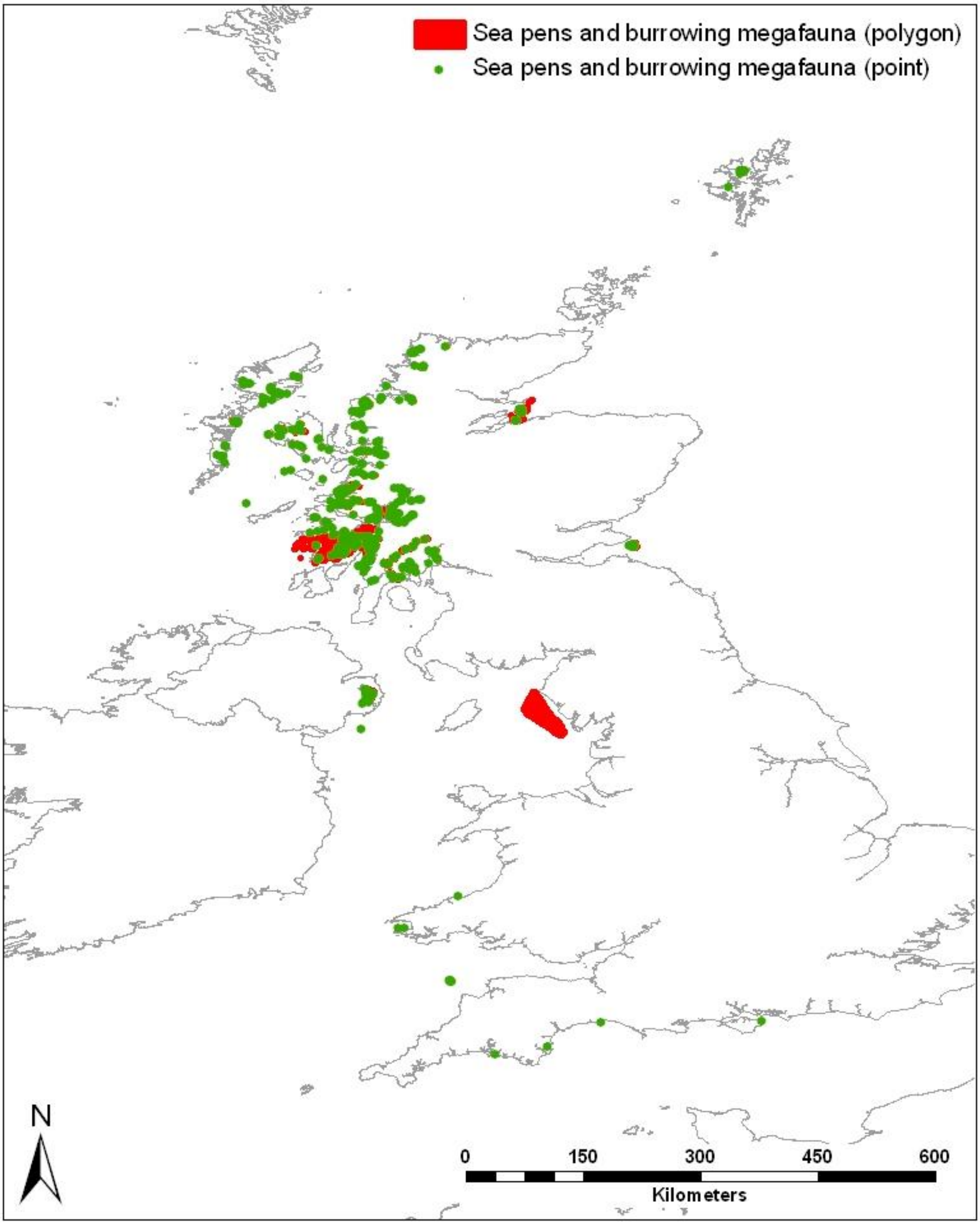

Figure 17. Final derived data layer for sea pens and burrowing megafauna.

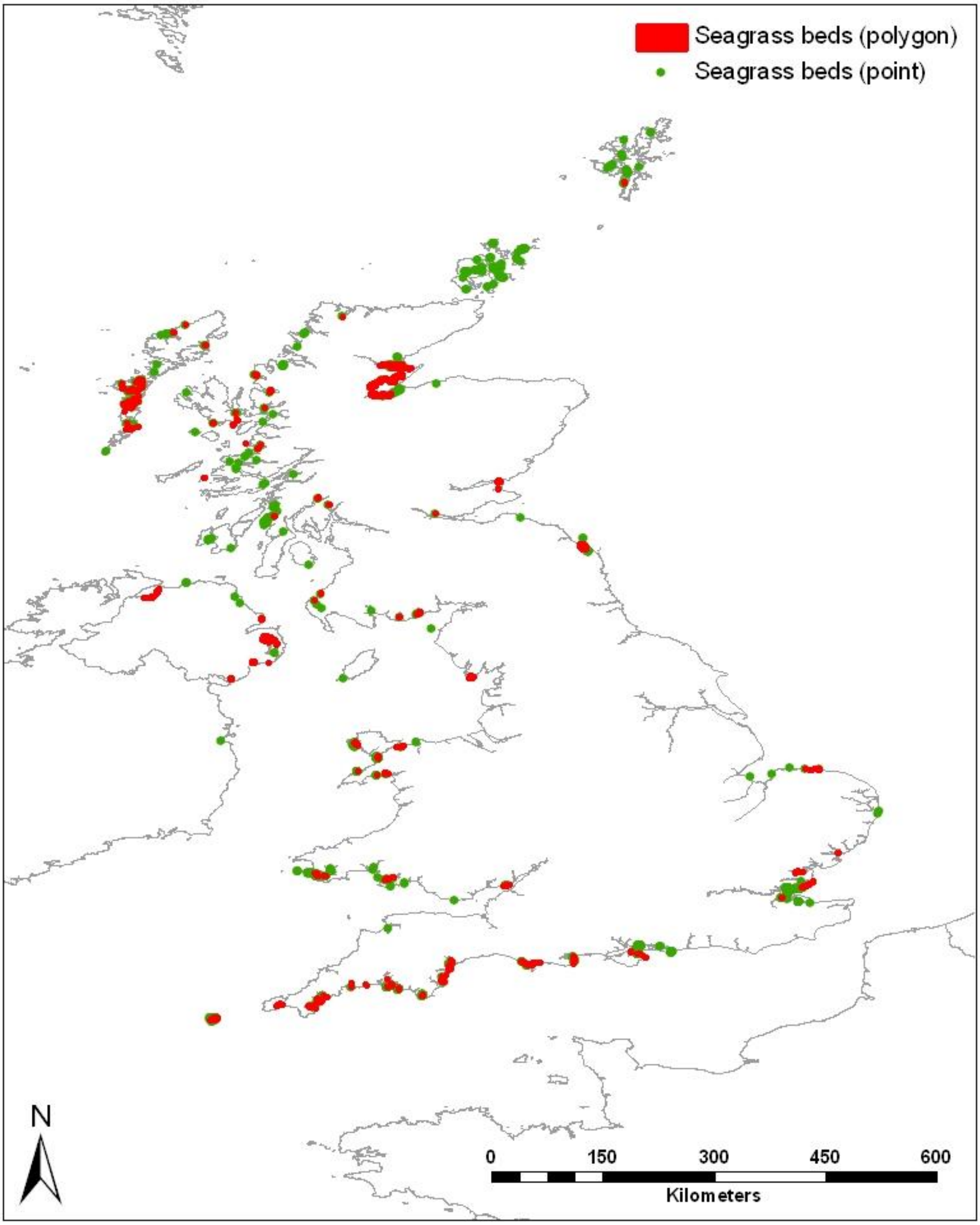

Figure 18. Final derived data layer for seagrass beds.

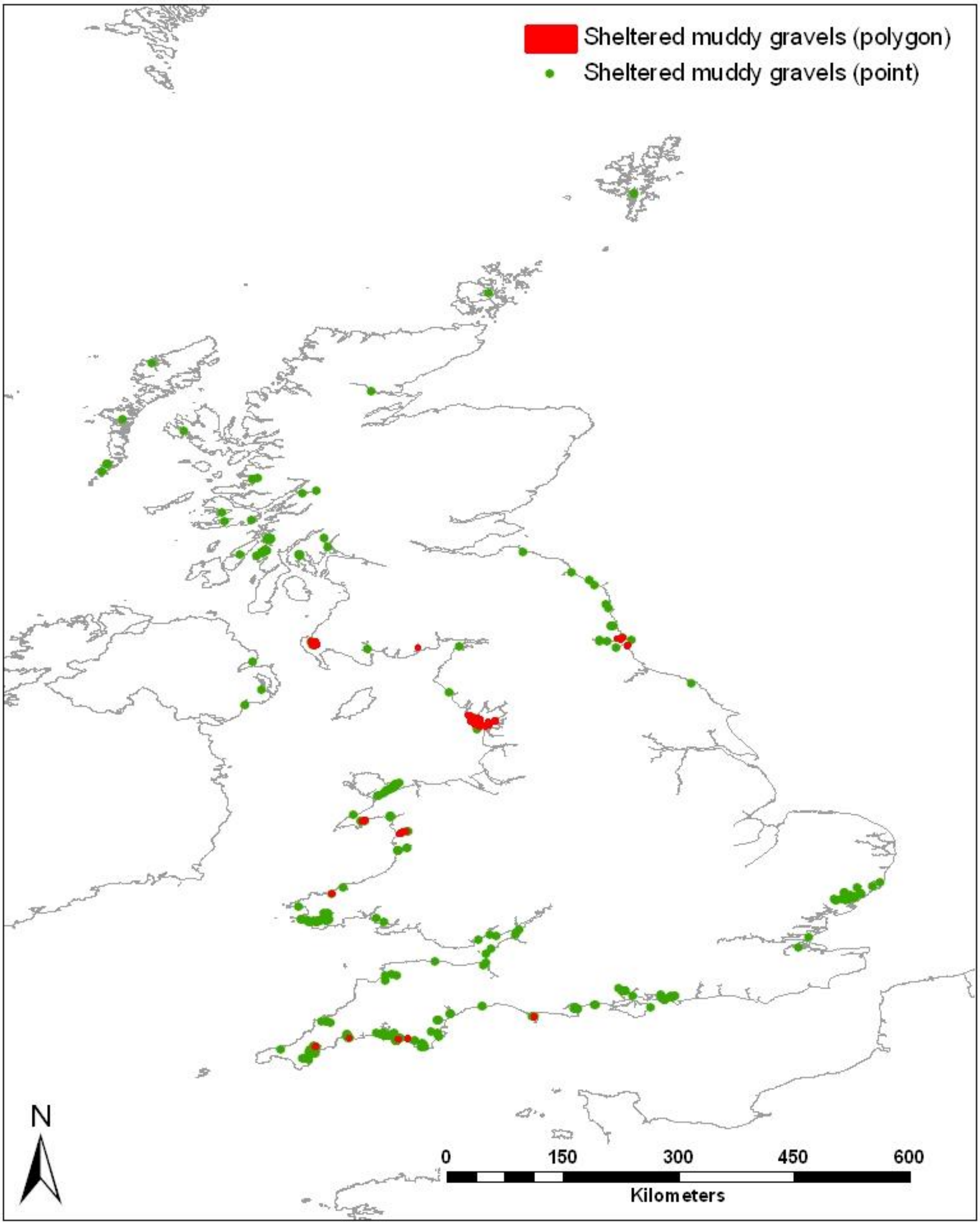

Figure 19. Final derived data layer for sheltered muddy gravels.

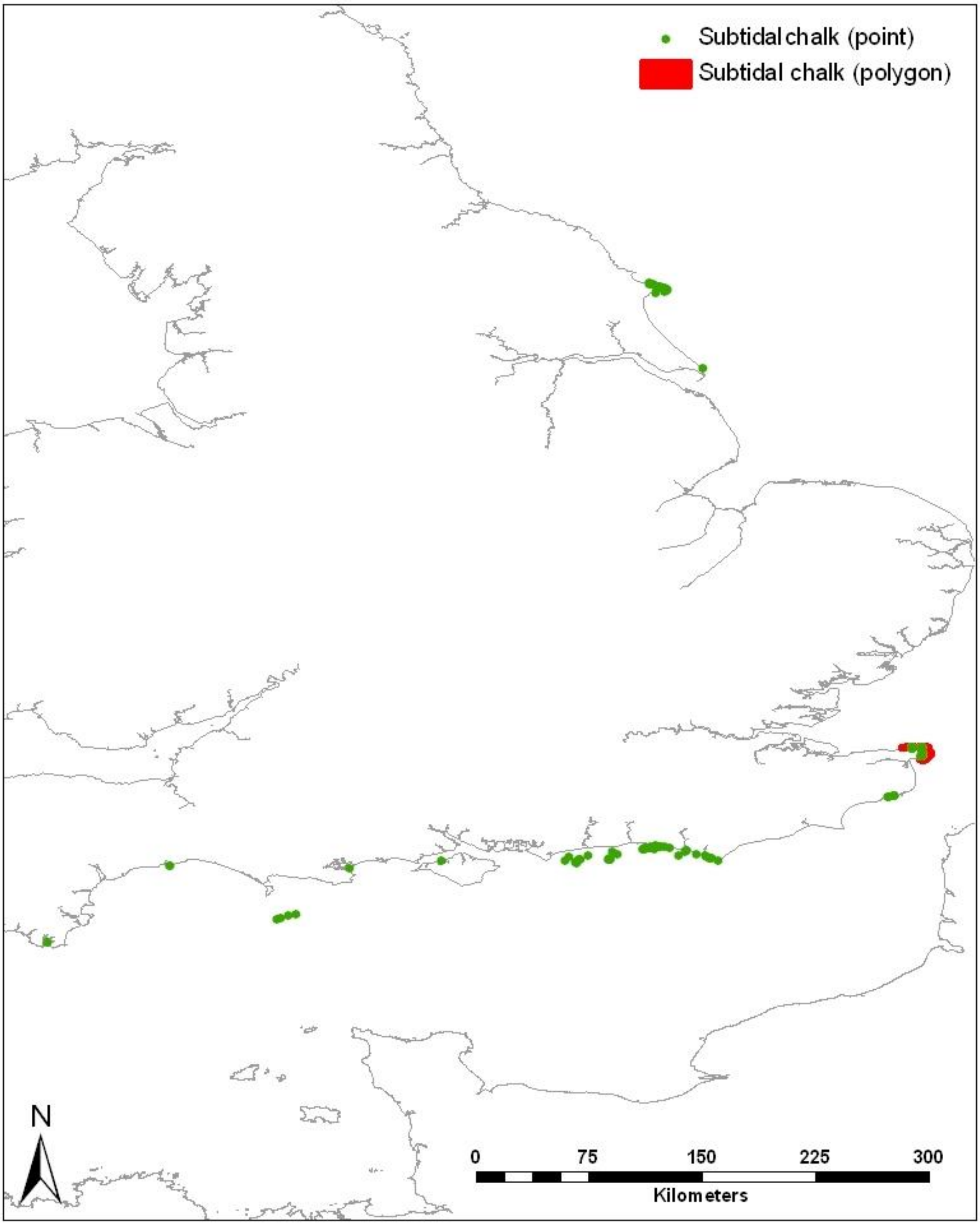

Figure 20. Final derived data layer for subtidal chalk.

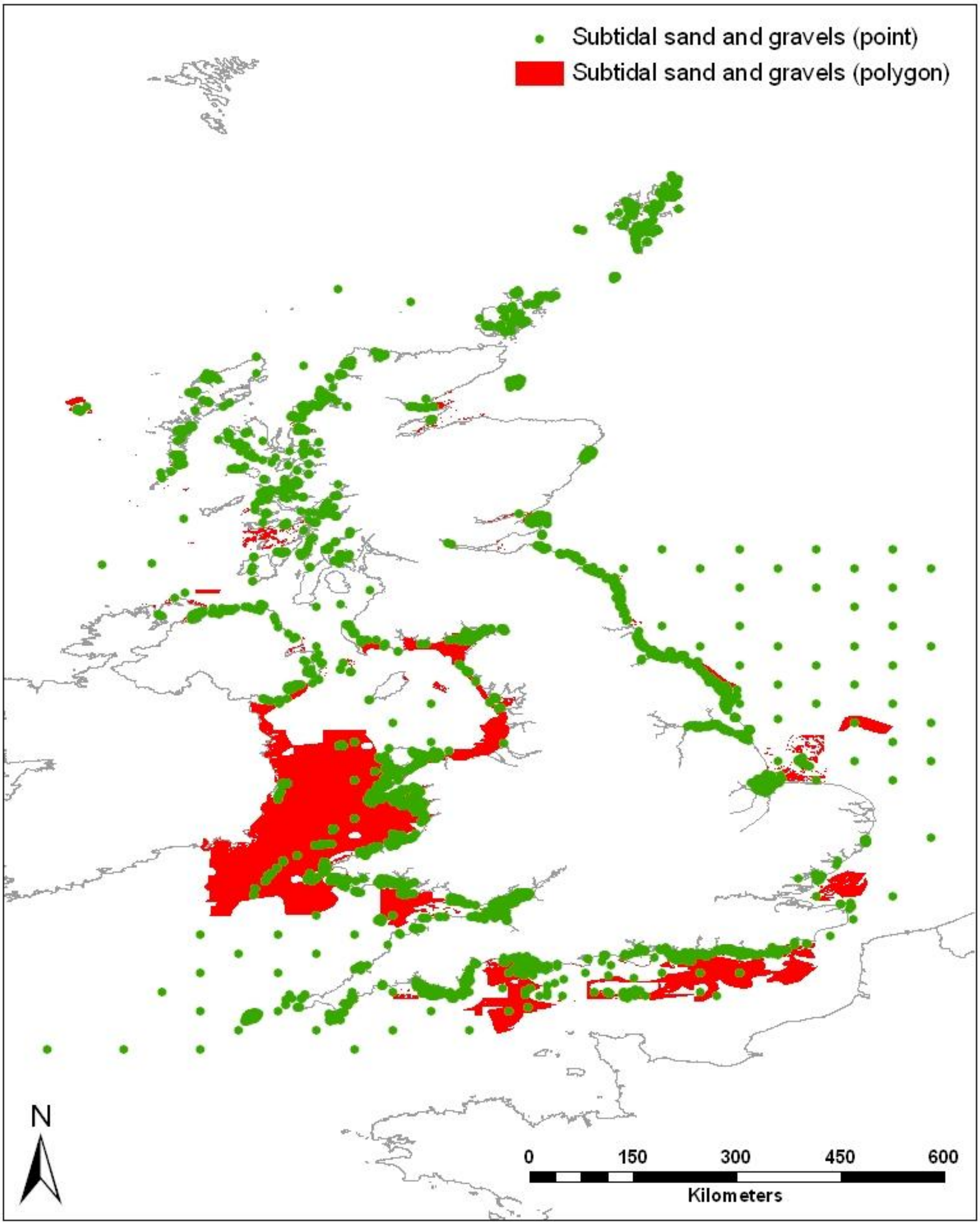

Figure 21. Final derived data layer for subtidal sand and gravels.

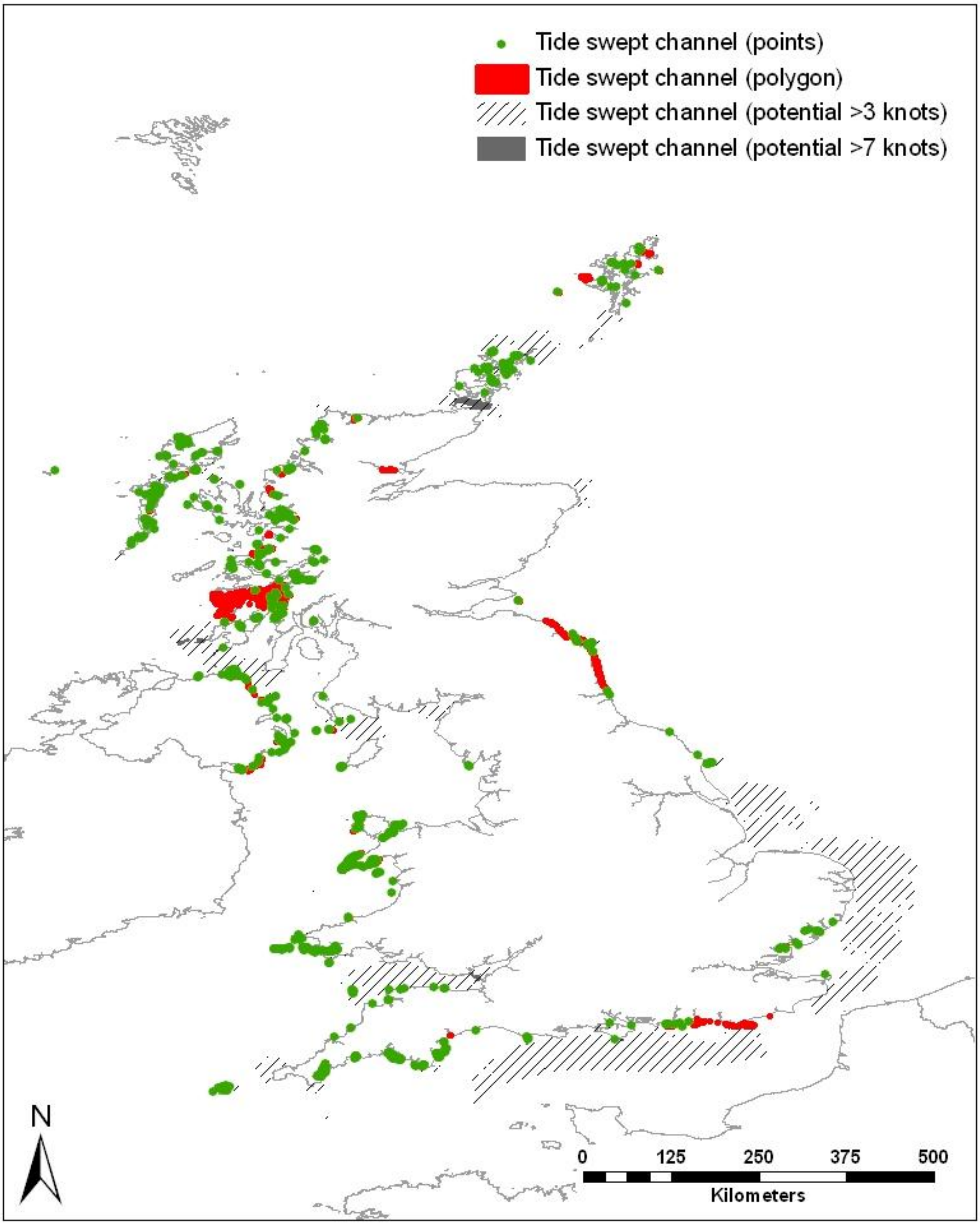

Figure 22. Final derived data layer for tide swept channel.

3.3 Permissions and Reuse

3.5 The habitats (2C) layers are provided only for the uses set out by Defra in the Restrictions of Use document, included here as Appendix E. The original data providers should be contacted for any uses outside the 'Accessing and developing the required biophysical datasets and data layers for Marine Protected Areas network planning and wider marine spatial planning purposes' contract remit and associated license document. Where possible, permission has additionally been cleared for data to be disseminated publicly.

3.6 The derived data layers resulting from the MB0102 project will be made available through the MEDIN DAC network, with metadata available through the MEDIN portal available from the MEDIN website[5].

3.4 Example Maps

3.7 A series of images have been produced within this report from the resulting data layers to show the distribution of those habitats listed in Table 2 of the Marine Conservation Zone Project Ecological Network Guidance draft document[6]. These demonstrate the outputs from the project GIS but do not include the GIS functionality to allow the user to zoom, pan and query the data points.

[5] http://www.oceannet.org/
[6] http://www.jncc.gov.uk/pdf/MPA_100514_ENG_v9.0r.pdf

4. Issues and Further Considerations

4.1 The project represented one of the largest data collation exercises ever undertaken for marine species and identified a number of issues related to access, collation and onward dissemination of data gathered from a wide variety of sources. The data providers recognised the importance of the project and were keen to be involved.

4.2 The collation of large volumes of data from disparate providers highlighted a number of issues which are discussed below.

4.1 Ease of Access and Supply of Data

4.3 A number of organisations holding key datasets were very slow to respond to data requests in spite of repeated attempts. We conclude that these organisations should review their data dissemination policies in order to ensure compliance with the 20 day limit specified in the UK's Environmental Information Regulation (EIR) and the EU's Information for Spatial Information in Europe (INSPIRE) legislation.

4.4 Although many data providers believed they had given most of their data, even providers with good, central, point data storage still had issues with the archiving of GIS polygon layers. It also appears that large volumes of data are held at regional level, often with incomplete cataloguing. It is hoped that organisations will soon develop complete INSPIRE compliant metadata catalogues, as this contract has shown that regional and local data is vital for use at a national level. In some cases, reports had been separated from the raw or derived data meaning that data had to be digitised to allow inclusion in the data layers at a less accurate level than would have been possible with the original data.

4.5 During the data collation, we encountered two organisations who felt that their data had previously been misused, either by being given to contractors without permission or by being published prior to publication by the original authors. These instances have made the suppliers unwilling to share their data again. We suggest that guidance should be developed on the collation, storage and reuse of third party data (i.e. that not collected under contract) to ensure the optimum flow of data between organisations and the protection of the IPR of data providers. The guidance could be developed based on the existing work of organisations such as the National Biodiversity Network (NBN) or the Marine Environmental Data and Information Network (MEDIN).

4.6 Biotope data is missing or patchy in many areas of the UK and it is particularly difficult to access reliable maps of subtidal biotopes. Much of the data that exists for subtidal biotope mapping is extrapolated from acoustic survey methods such as RoxAnn. There are a number of problems in determining biotopes using these methods, including the inability to distinguish live from dead shell in biogenic reef habitats such as *Modiolus modiolus* and difficulty in achieving high level biotope distinctions. It is, therefore, recommended that the habitat maps produced are considered indicative rather than comprehensive until more high quality data becomes available.

4.7 In the next 24 months, a number of biotope and habitat mapping projects will be underway such as the Dorset and Kent Wildlife Trusts intertidal and subtidal biotope mapping projects and the Environment Agency' Saltmarsh Survey. We therefore anticipate a considerable volume of up to date and accurate biotope data becoming available and recommend the update of these maps once this data is released. Table 2 below has details of habitat information that was not available within the scope of this project.

Table 2. Habitat information not included within the datalayers.

Source	Data
Kent, Dorset and Hampshire Wildlife Trusts	Intertidal biotope mapping available in 2010
Environment Agency	Saltmarsh mapping, draft data was included but a more comprehensive dataset will become available
Deep sea biotopes	Considerable amounts of data are being worked on by the academic sector and will become available once published
Queens University Belfast	*Modiolus* distribution Northern Ireland (available 2010)
Seasearch	Biotope data available for years 2009 and onwards.
Seasearch Devon and Cornwall	Biotope data retrofitted to historic surveys.
DTI/BERR	SEA data Multibeam of Texel 11 and sidescan sonar of Holdens Reef complex (historical but unavailable).
AFBI	Raithlin sublittoral habitat map. Blue mussel bed distribution
University of North Wales	Potential distribution of deep sea corals
Natural England	Salcombe Kingsbridge Estuary intertidal survey Lynher estuary *Ostrea edulis* records Mersey estuary saltmarsh distribution North West England intertidal boulder communities distribution Sefton coast peat and clay exposures Holy Island oyster bed Norfolk seagrass bed distribution Norfolk tide swept channels distribution Norfolk intertidal mytilus edulis bed distribution Norfolk subtidal mixed muddy sediment distribution Norfolk offshore *Modiolus modiolus* bed distribution Norfolk *Nucella lapillus* distribution Norfolk *Crassostrea gigas* distribution
COWRIE	Thanet *Sabellaria spinulosa* distribution

4.2 Data Formatting Issues and Standards

4.8 The provision of data without relevant report references or metadata of any kind resulted in difficulties in collating information to populate the survey table. Where GIS layers were provided there was often insufficient information relating to the projection of the original data. Both OSGB36 and WGS84 are widely used and can lead to inaccuracies in the spatial rendering of the data points. In addition, the lack of metadata greatly increases the level of QA that is required.

4.9 Much of the data arrived in a variety of formats. While transformation between electronic formats is (in most cases) simple, when data were late arriving it made incorporation into the project outputs difficult.

4.10 When comparing the species within the habitats of the supplied datasets against the World Register of Marine Species, there was a typically a 70-80% correlation. Many mismatches were due to changes in taxonomy since the creation of the original dataset. However typographical errors and inconsistent naming conventions (such as the use of 'indet', 'crusts' etc) also meant matches had to be manually entered. Again, this is a time consuming process and one that can be avoided if data providers are able to adopt existing standards for the supply of data.

4.3 Defining Habitats and Boundaries

4.11 The BAP and OSPAR definitions of some habitats are unclear, which made mapping difficult. Descriptions of the difficulties are included in Section 2 within each habitat.

4.12 Problematic definitions included;

- blue mussel beds,
- intertidal *Mytilus edulis* beds on mixed and sandy sediments,
- *Ostrea edulis* beds,
- seagrass beds,
- deep sea sponge-aggregations,
- coral gardens,
- intertidal underboulder communities,
- littoral chalk communities,
- Intertidal mudflats and
- tide swept communities.

4.13 Full details of the problems with definitions are in Section 2 and summarised in Appendix D.

4.14 It is recommended that the relevant agencies revisit the definition of these habitats in order to inform more accurate mapping and simplify data acquisition. Particular attention should be paid to defining parameters that are more precise to aid translation of historic and non-standard data types.

4.15 The UK Territorial limit currently does not include the areas of shared responsibility between Northern Ireland and the Republic of Ireland for which Northern Ireland has a statutory responsibility (and which includes Strangford and Carlingford Loughs).

4.16 Many of the overlaps identified in the priority habitat (2C) layers are as a result of several different component biotopes being identified at a given location (see Figure 23 for an example). Where multiple biotopes were recorded for a single habitat polygon the information was retained, as this information may be required for analyses at a later date. Merging of data would result in loss of resolution (reducing biotopes to habitats), at worst, preventing, and at best highly complicating, subsequent deeper analyses.

4.17 These data layers constitute the best available knowledge at the current date, but provide an incomplete picture, and this must be taken into consideration in their application. Further reduction in data quality would only act to reduce the applicability of these layers, both for MCZ Regional Projects and their potential subsequent wider use in spatial planning.

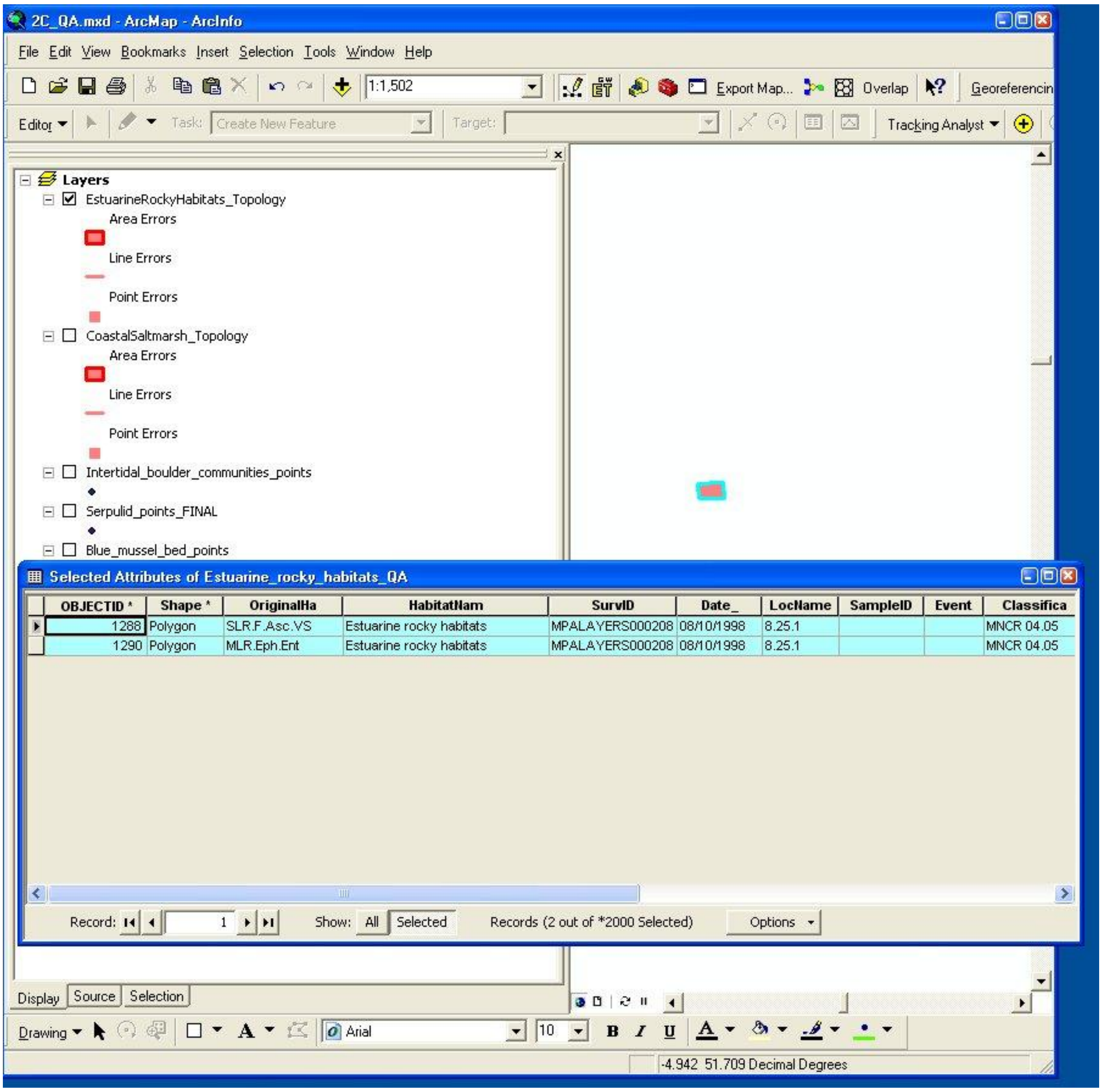

Figure 23 – Example of multiple biotopes being plotted as a single habitat.

4.4 Future Considerations

4.18 It is hoped that the issues raised in this data collection and mapping exercise will assist organisations in developing their data management systems for easier data flow.

4.19 Many of the issues are being addressed though the work of MEDIN, which is developing data specifications, standards and metadata standards to simplify and harmonise the exchange of marine data and metadata.

4.20 The work detailed in this report is an important first step at broadening the availability of data for key species. Carefully defined pathways for marine data flow and the adoption of MEDIN standards and specifications will facilitate the update of these derived data products and provide a solid foundation for future marine data management.

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Appendix A. Data sources used

Full information is available in the survey table provided with the datalayers.

Survey data source
1950's - 1999 Modiolus beds Isle of Man
1970-2009 JNCC Saline Lagoons Layer
1986 Preliminary Appraisal of the Intertidal Seagrass Resource in the Moray Firth
2001 - 2002 NVC Survey of Saltmarsh and Other Habitats in the Essex Estuaries European Marine Site
2001 English Nature Humber to Pennines Team SSSI NVC Survey
2001 Spalding Associates Ltd NVC Saltmarsh Survey
2001-2002 Plymouth Area Intertidal Biotope Mapping
2002 NE Biotope mapping of NBN Priority Habitats
2005 Ambios Survey of Lyme Bay Biotopes
2005 CCW study of the Milford Haven Maerl Bed
2006 Biotope Mapping of the Sound of Barra
2006 Loch Teacuis cited in Dodd, J.,*et al*, 2009).
2006 Lyme Bay Biotope Mapping
2007-2008 EA Sea Area Saltmarsh Surveys
Benthic Biodiversity in the Southern Irish Sea 2: South-West Irish Sea Survey (SWISS)
Biotope Mapping and Survey of the Treshnish Isles Candidate Special Area of Conservation (cSAC) - intertidal biotopes
Biotope survey of the north Norfolk coast cSAC, Hunstanton to Thornham
Broad Scale Biotope Mapping of the Isle of May cSAC: intertidal biotopes
Broad scale habitat mapping of intertidal and subtidal coastal areas, Loch Maddy - lifeforms in the outer, central and inner areas
Broadscale intertidal survey, Loch Laxford cSAC, 2001.
Broadscale mapping of habitats in the Firth of Tay and Eden Estuary, Scotland

Survey data source
Broadscale Mapping of Strangford LoughÆs Subtidal Habitats: The Application of an Evolving Technology
Broadscale mapping of sublittoral habitats in Loch Sunart, Scotland
Broadscale remote survey and mapping of sublittoral habitats and their associated biota in the Firth of Lorn: biotopes
CCW priority habitat polygon layers
Flamborough Head cSAC intertidal biotope map
JNCC Seamount Distribution Layer
Littoral biotope mapping and data capture exercise for the Essex Estuaries candidate Marine Special Area of Conservation
Loch Duich lifeforms map
Map of offshore benthic communities of the Irish Sea
Mapping Inshore Coral Habitats: the MInCH project
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Mapping the distribution of benthic biotopes of Loch Maddy. Lifeforms
MNCR Area Summaries - Cardigan Bay and north Wales; scar
MNCR Area Summaries - Inlets in eastern England
MNCR Area Summaries - Inlets in eastern England
MNCR Area Summaries - Lagoons in mainland Scotland and the Inner Hebrides
MNCR Area Summaries - Liverpool Bay and the Solway Firth; Wigtown and Kirkcudbright Bays
Moray Firth benthic biotope map
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Northern Ireland broadscale habitat mapping: Annalong and Kilkeel
Sound of Arisaig cSAC: lifeforms map of open coast
Sound of Arisaig cSAC: Loch Ailort lifeforms map
Sound of Arisaig cSAC: Loch Ceann Traigh lifeforms map
Sound of Arisaig cSAC: North Channel, Loch Moidart lifeforms map
The Solway Firth: broad scale habitat mapping
Northern Ireland broadscale habitat mapping: Annalong and Kilkeel

Survey data source
Sound of Arisaig cSAC: lifeforms map of open coast
Sound of Arisaig cSAC: Loch Ailort lifeforms map
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Acoustic mapping of the seabed of the Menai Strait. Local classification, seperated into acoustic ground characteristics: hard/soft & smooth/rough. South West Menai.
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Acoustic survey & mapping of sublittoral reefs at Flamborough Head. Lifeforms
Aggregate Levy Sustainability Fund (ALSF): grab sample data
An Acoustic Benthic Survey of Loch Ryan
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Biotope survey of the littoral sediments of the north Norfolk coast cSAC.
Broad scale biological mapping of Lundy Marine Nature Reserve with particular reference to reefs.
Broad Scale Biotope Mapping of the Isle of May cSAC: subtidal lifeforms
Broad scale biotope types along Wexford coast, eastern Ireland
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Broad scale biotope types around Dublin coast, Ireland
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Broadscale biological mapping of Morecambe Bay. Lifeforms
Broadscale mapping of sublittoral habitats in the Sound of Barra: south east of South Uist

Survey data source
Broadscale mapping of sublittoral habitats in the Sound of Barra: south west of South Uist
Broadscale mapping of the reefs of Berwickshire and Northumberland. Lifeforms
Broadscale remote survey and mapping of the sublittoral habitats and biota of the Wash, and the Lincolnshire and the north Norfolk coasts - lifeforms and species presence
Broadscale remote survey and mapping of the sublittoral habitats and biota of the Wash, and the Lincolnshire and the north Norfolk coasts - MNCR classification
Broadscale survey and mapping of seabed and shore habitats and biota, Dornoch Firth pSAC - biotopes
Broadscale survey and mapping of seabed and shore habitats and biota, Lochs Duich, Alsh and Long.
Broadscale survey and mapping of seabed biota in Loch Creran, Argyll
Broadscale survey and mapping of the seabed and shore habitats and biota: St Kilda cSAC: subtidal lifeforms
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Devon and Dorset map of *Zostera* beds
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East Malin Head habitat map
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Eastern Solway Firth benthic substrate map
Exe Estuary Habitat Mapping
Facies map Isle of Wight Nab Tower

Survey data source
Facies map of Hastings
Facies map of Varne_Hastings broadscale
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Habitat map of Hempton's Turbot Bank
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Isle of Man sandbank
Isles of Scilly subtidal biotope map
Kimmeridge Bay, Dorset: benthic substrate map
Littoral chalk in East Sussex
Littoral chalk in Kent
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Mapping survey of the eelgrass *Zostera marina* beds of the main channel of the Salcombe/Kingsbridge estuary
Mapping the distribution of benthic biotopes around the Isle of Wight. SE Isle of Wight, Lifeforms
Mapping the distribution of benthic biotopes around the Isle of Wight. SW Isle of Wight, Lifeforms
Mapping the distribution of benthic biotopes around the Thanet coast. Substrate
Mapping the distribution of benthic biotopes in Loch Torridon: substrate close to shore
Mapping the distribution of benthic biotopes in the Summer Isles. Lifeforms

Survey data source
Mapping the distribution of benthic biotopes of Loch Maddy. Small area. Biotopes
Mapping the distribution of maerl in South Uist (Loch Boisdale), Western Isles. Lifeforms at Stuley Island
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MNCR Area Summaries - Inlets in the Bristol Channel and approaches
MNCR Area Summaries - Inlets in the western English Channel
MNCR Area Summaries - Lagoons in Shetland and Orkney
MNCR Area Summaries - Lagoons in the Outer Hebrides
MNCR Area Summaries - Lagoons in the Outer Hebrides
MNCR Area Summaries - Sealochs in north-west Scotland
MNCR Area Summaries - Sealochs in the Clyde Sea
MNCR Area Summaries - Sealochs in the Clyde Sea
MNCR Area Summaries - Sealochs in the Outer Hebrides
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Morecambe Bay map of Zostera beds
North West Pen Llyn peninsula benthic lifeforms map.
Northern Falmouth Bay benthic biotope map
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Northern Ireland broadscale habitat mapping: Ballycastle Bay, Co. Antrim
Northern Ireland broadscale habitat mapping: Ballygally Head
Northern Ireland broadscale habitat mapping: Belfast Lough
Northern Ireland broadscale habitat mapping: Carlingford Lough
Northern Ireland broadscale habitat mapping: Church Bay, Rathlin Island

Survey data source
Northern Ireland broadscale habitat mapping: Dundrum Bay
Northern Ireland broadscale habitat mapping: East Rathlin Island
Northern Ireland broadscale habitat mapping: Islandmagee, Co. Antrim
Northern Ireland broadscale habitat mapping: Larne Lough
Northern Ireland broadscale habitat mapping: Lough Foyle
Northern Ireland broadscale habitat mapping: Lower Strangford Lough
Northern Ireland broadscale habitat mapping: NE Antrim
Northern Ireland broadscale habitat mapping: The Skerries, Co. Antrim
Offshore Reef areas: Blackstone Banks
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Outer Thames Estuary Sandbank Study
Pagham survey
Plymouth Sound and Estuaries substrate map
Plymouth Sound substrate map
Portland Broadscale, Annex 1 Reef survey 2006/7
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Saltmarshes in Wash and North Norfolk Coast
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Sanday sublittoral lifeforms map (reduced lifeforms)
Sarn Badrig (Tremadoc Bay) lifeforms map
Seagrass distribution map for Torbay TCCT 2006 Survey
Shoreham facies interpretation from 2004 sidescan
Skegness Windfarm Environmental Statement
Solent and South Wight: mapping of intertidal and subtidal marine cSACs - littoral habitats, the Solent

Survey data source
Sound of Arisaig cSAC: South Channel, Loch Moidart lifeforms map
Sound of Harris - Biotopes
Southern Falmouth Bay benthic biotope map
St John's Lake intertidal biotope map (Tamar estuary, Plymouth)
St Marys (Northumberland): lifeforms map
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Sublittoral biotope mapping and data capture exercise for the Essex Estuaries candidate Marine Special Area of Conservation
Subsea 7, Conocophilips - Saturn reef sabellaria survey
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Triton Knoll Offshore Wind Farm Video Study
TY070 facies interpretation from 2004 sidescan
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West Malin Head habitat map (Area A)
West Malin Head habitat map (Area B)
Western Solway Firth benthic substrate map
Wight Broadscale, Annex 1 Reef survey 2006/7
Wight Finescale, Annex 1 Reef survey 2006/7
Zostera descriptions North Norfolk Coast - Cley, James McCallum 1997

Appendix B. Habitat list with definitions

A2.2.1 File shell beds (BAP description)

UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008.

Correspondence with existing habitats

Not covered by either OSPAR or Habitats Directive Annex A

Definition

Limaria hians, commonly known as the 'gaping file shell', has been described as the most beautiful British bivalve (Yonge & Thompson, 1976). Individuals have a solid, but thin and delicately ribbed, shell up to 4 cm in length with a prominent gape running along the dorsal side. Even when the valves are closed, long vibrant orange tentacles (fringing the red mantle tissue) protrude (hence 'gaping'). The Limaria form characteristic woven 'nests' or galleries constructed from byssal threads and the animals themselves are rarely seen above the seabed (Hall-Spencer & Moore, 2000).

Limaria hians beds in tide-swept sublittoral muddy mixed sediment (SS.SMX.IMX.Lim) have been recorded from 4-98 m on mixed muddy gravel or sand, coarse sands and muddy maerl in areas with weak to strong tidal streams and across the spectrum of wave exposure (although it is unlikely that dense beds can survive in shallow wave exposed locations) (Connor *et al*. 1997; JNCC, 1999; Hall-Spencer & Moore, 2000b; Tyler-Walters, H. 2003).

File shell beds are characterized by dense populations of *Limaria hians* where nests coalesce into a carpet over the sedimentary substratum. These nests can be built of shell, stones debris and maerl (when present) interlaced by several hundred byssus threads, and lined by mucus, mud and their faeces (Gilchrist, 1896; Hall-Spencer & Moore, 2000b). Nests may be constructed by expansion of smaller burrows, in gravel, shell sand or laminarian holdfasts, or may be simply composed of byssus threads (see Merrill & Turner (1963) and Gilmour (1967) for details). Nests are about the maximum gape of shell in diameter by about twice the length of the animal, with holes for the entrance and exit of water. Nests vary in size and complexity with individual *Limaria hians* being recorded from nests of 2-5 cm diameter, while larger nests of up to 25 cm diameter and 10 cm in length consisted of numerous ventilated holes and galleries (Gilmour, 1967; Tebble, 1976; Hall-Spencer & Moore, 2000). Hall-Spencer and Moore (2000) reported that six of these large nests contained 24-52 small and 25-40 large individuals of *Limaria hians*, with adult individuals occupying single galleries with two ventilation holes, while juveniles occupied complex galleries with multiple ventilation holes. *Limaria hians* can also occur individually or in small numbers, for example in kelp holdfasts, or under stones intertidally (Jason Hall-Spencer, pers comm.).

The biotope occurs at high densities in the Creag Gobhainn area of Loch Fyne (Hall-Spencer & Moore, 2000), is widespread in areas of accelerated tidal streams within Loch Sunart (Howson, 1996; Bates et al. 2004; Mercer et al. 2007) and a number of other sealochs on the west coast of Scotland (Loch Carron, Loch Creran, Loch Alsh, Lochs Broom and lower Loch Linnhe) and within Moross Channel, Mulroy Bay, Ireland (Minchin, 1995).

Biotopes associated with this habitat:

Limaria hians beds in tide-swept sublittoral muddy mixed sediment (SS.SMX.IMX.Lim). Further information & references on this biotope is available from the MarLIN website - www.marlin.ac.uk/biotopes/Bio_Eco_IMX.Lim.htm.

Current and potential threats

- *Fisheries:* Trawling

A2.2.2 Blue mussel beds on sediment (BAP description)

Correspondence with existing habitats

- UK BAP broad habitat: Littoral sediment, Sublittoral sediment
- May be a component part of Annex 1 habitats
- LS.LBR.LMus;LS.LMX.LMus.Myt;LS.LMX.LMus.Myt.Mx;LS.LMX.LMus.Myt.Sa ; LS.LMX.LMus.Myt.Mu; LS.LSa.St.MytFab; SS.SBR.SMus.MytSS

Definition

This habitat includes intertidal and subtidal beds of the blue mussel *Mytilus edulis* on a variety of sediment types and in a range of conditions from open coasts to estuaries, marine inlets and deeper offshore habitats. Blue mussel beds plays an important part of a healthy functioning marine ecosystem, having a role in coastal sediment dynamics, acting as a food source for over-wintering waders, and providing an enhanced area of biodiversity in an otherwise sediment-dominated environment.

Intertidal mussel beds occur on a variety of sediment substrata such as sand, cobbles and pebbles, muddy sand and mud. Mussel aggregations in this habitat are dense, and can support various age classes. The wrack *Fucus vesiculosus* is often present, attached to the cobbles or mussel shells, and the shells themselves are often encrusted with various barnacles and bryozoans. The spaces between the mussels can provide refuges for a diverse community of organisms, prominent amongst which are the winkles *Littorina littorea* and *L. saxatilis* and small shore crabs, *Carcinus maenas*. The infauna of the underlying sediment (except where this is anoxic mud) may feature the gastropod *Hydrobia ulvae,* the bivalves *Macoma balthica* and *Cerastoderma edule,* the isopods *Corophium volutator, Crangon crangon* and *Jaera forsmani* and polychaetes such as the sandmason *Lanice conchilega*, the lugworm *Arenicola marina* and ragworm *Hediste diversicolor*. Further infaunal sampling has indicated a diverse range of nematodes, oligochates and polychaetes.

In the subtidal, dense mussel beds can form on the upper faces of tide-swept sediment dominated substrates, almost to the exclusion of almost all other species. The common starfish *Asterias rubens* is often locally abundant as it feeds on mussels, along with other predators such as the crabs *Necora puber*, *Carcinus* *maenas, Maja squinado* and *Cancer pagurus*. Anemones such as *Sagartiogeton undatus*, the dahlia anemone *Urticina equina* and the daisy anemone *Cereus pedunculatus* can be found on gravel patches and amongst the mussels themselves. The hydroid *Kirchenpaueria pinnata* and others characteristic of strong tides and a little scour, such as *Sertularia argentea* and *Tubularia indivisa*, may also be present. Ascidians such as *Molgula manhattensis* and *Polycarpa* spp. can also feature on subtidal mussel beds, particularly in silty conditions. Infaunal species include the amphipod *Gammarus salinus* and oligochaetes of the genus Tubificoides. The polychaetes *Harmothoe* spp. *Kefersteinia cirrata* and *Heteromastus filiformis* are also characteristic of this habitat.

Note that the habitat only covers 'natural' beds on a variety of sediment types, and excludes artificially created mussel beds, and mussel beds which occur on rock and boulders.

Summary of environmental preferences:

Salinity	Fully marine - reduced
Wave exposure	Exposed to extremely sheltered
Tidal streams	Weak - strong
Substratum	Cobbles and pebbles; mixed sediments; sand; mud
Zone/depth	Mid eulittoral to circalittoral

Blue mussel beds are distributed around the UK coast, both intertidally and sublittorally.

Illustrative biotopes

- LS.LBR.LMus – Littoral mussel beds on sediment
- LS.LBR.LMus.Myt – *Mytilus edulis* beds on littoral sediments
- LS.LBR.LMus.Myt.Mx - *Mytilus edulis* beds on littoral mixed substrata
- LS.LBR.LMus.Myt.Sa - *Mytilus edulis* beds on littoral sand
- LS.LBR.LMus.Myt.Mu - *Mytilus edulis* beds on littoral mud
- LS.LSa.St.MytFab - *Mytilus edulis* and *Fabricia sabella* in littoral mixed sediment
- SS.SBR.SMus.MytSS - *Mytilus edulis* beds on sublittoral sediment

Current and potential threats

- *Commercial fisheries:* Targeted removal of mussels, physical damage and smothering from use of mobile fishing gear.
- *Water Quality: Mytilus edulis* bioaccumulates pollutants in seawater which may lead to sublethal, and in some cases, lethal responses.

- *Coastal developments:* Physical damage and displacement from infrastructure development, dredging, trenching and cable/pipe-laying.
- *Anchoring:* Physical damage can arise from sustained anchoring and mooring chains.
- *Bait digging*: Removal of mussels as fishing bait and physical damage from associated trampling in the intertidal.

A2.2.3 Intertidal *Mytilus edulis* beds on mixed and sandy sediments (OSPAR definition)

EUNIS Code: A2.7211 and A2.7212

National Marine Habitat Classification for UK & Ireland code: LS.LMX.LMus.Myt.Mx and LS.LMX.LMus.Myt.Sa

Definition

Sediment shores characterised by beds of the mussel *Mytilus edulis* occur principally on mid and lower shore mixed substrata (mainly cobbles and pebbles on muddy sediments) but also on sands and muds. In high densities (at least 30% cover) the mussels bind the substratum and provide a habitat for many infaunal and epibiota species. This habitat is also found in lower shore tide-swept areas, such as in the tidal narrows of sealochs. A fauna of dense juvenile mussels may be found in sheltered firths, attached to algae on shores of pebbles, gravel, sand, mud and shell debris with a strandline of fucoids. Mussel beds on intertidal sediments have been reported all along the coast of Europe, particularly in UK, France, Netherlands and Germany.

A2.2.4 *Musculus discors* beds (NERC definition)

Musculus discors beds [Gwelyau *Musculus discors*]

Definition

Musculus discors (which has the common name of ‘green crenella’) is a small bivalve mollusc which only grows to about 12mm in length. Typically, it is found from the lower intertidal to the circalittoral in scattered, gregarious clumps growing epiphytically on the holdfasts of seaweeds and amongst faunal turfs. However, it occasionally forms extensive, dense aggregations covering upward-facing rock surfaces. It is these ‘beds’ which are of interest here.

The beds are found on moderately exposed and moderately tide-swept bedrock, boulders and cobbles in slightly silty conditions. There is also often a layer of pseudofaeces, which forms a thick, silty matrix amongst the mussels. A relatively diverse fauna of bryozoans, echinoderms, cushion and branching sponges and seaweeds is often associated with this habitat. The sponge species include *Tethya aurantium, Scypha ciliata, Pachymatisma johnstonia, Dysidea fragilis, Cliona celata* and *Stelligera stuposa*. Free-roaming echinoderms include the common starfish *Asterias rubens*, the sunstar *Crossaster papposus* and the brittlestar *Ophiura albida*. Occasional growths of dead man’s fingers *Alcyonium digitatum* and clumps of the hydroid *Nemertesia antennina* are found attached to rocky outcrops and boulders, whilst the anemone *Urticina felina* may be seen in crevices in the rock or on gravely patches between boulders. Colonial ascidians such as *Clavelina lepadiformis* and didemnids may occasionally be present. A wide range of seaweeds may be present, including *Dictyota dichotoma, Plocamium cartilagineum, Dictyopteris membranacea, Cryptopleura ramosa* and *Heterosiphonia plumosa*.

Environmental preferences

Salinity	Fully marine
Wave exposure	Exposed to moderately exposed
Tidal streams	Moderately tide-swept
Substratum	Bedrock, boulders and cobbles in slightly silty conditions
Zone/depth	Lower infralittoral to lower circalittoral

Life history (biogenic habitat)
Musculus discors is a protandrous hermaphrodite: that is, individuals are male when small but then become female when larger and older. The females will lay a relatively small number of large eggs (300 µm by 220 µm) in 3-4 rows in mucus strings within a ‘nest’ made from byssus threads. Embryos of 400 µm in length are found within the mucus strings. Development is direct, there being no pelagic phase. The juveniles leave the egg string as free-living ‘crawl-aways’.

UK & Wales distribution
Although *Musculus discors*, as a species, is widely distributed around the UK, it has only been recorded as forming biogenic beds from a few isolated localities off the Welsh coast and off the south coast of Ireland. *Musculus discors* beds are currently recorded from NW Anglesey (Holyhead Bay), from Porth Colmon on the north coast of the Lleyn peninsula, and in Pembrokeshire at Abereiddy on the north coast and at the entrance to Milford Haven.

Statutory sites in Wales (where habitat is known to occur)
Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau Special Area of Conservation (SAC)
Sir Benfro Forol / Pembrokeshire Marine Special Area of Conservation (SAC)
Note that occurrence in a statutory site does not indicate that this habitat or species is protected through the site designation or its management.
Relevant UK/international legislation & other priority listings
Musculus discors beds are listed as one of the habitats and species ‘of principal importance for the purpose of conserving biodiversity’ in Wales, under Section 42 of the Natural Environment and Rural Communities (NERC) Act 2006.

Relevant biotopes

Biotope code	Title
CR.MCR.CMus.Mdis	*Musculus discors* beds on moderately exposed circalittoral rock

Main Threats

Commercial fishing: bottom fishing gear can result in significant physical damage to benthic habitats such as *Musculus discors* beds. Mobile fishing gear is known to operate in the vicinity of where *M. discors* beds have been recorded off the Welsh coast, and the extent of this practice may expand in the future.

Smothering: in addition to direct physical damage to beds from mobile fishing gear, re-suspension, subsequent settling of sediments and potential smothering are also of concern for this biogenic reef community.
Note that as these *M. discors* beds are found in distinct discrete locations, any damage to them may result in possible local extinction.

Gaps in knowledge
It is quite likely that there may be other, as yet undiscovered, *Musculus discors* beds present off the Welsh coast.

A2.2.5 *Modiolus modiolus* beds (OSPAR and BAP descriptions)

The BAP and OSPAR definitions for this priority habitat are equivalent.

OSPAR Description

EUNIS Code: A5.621, A5.622, A5.623 and A5.624

National Marine Habitat Classification for UK & Ireland code: SS.SBR.SMus.ModT, SS.SBR.SMus.ModMx, SS.SBR.SMus.ModHAs and SS.SBR.SMus.ModCvar

The horse mussel *Modiolus modiolus* forms dense beds, at depths up to 70m (but may extend onto the lower shore), mostly in fully saline conditions and often in tide-swept areas. Although *M. modiolus* is a widespread and common species, horse mussel beds (with typically 30% cover or more) are more limited in their distribution. *Modiolus* beds are found on a range of substrata, from cobbles through to muddy gravels and sands, where they tend to have a stabilising effect, due to the production of byssal threads. Communities associated with *Modiolus* beds are diverse, with a wide range of epibiota and infauna being recorded, including hydroids, red seaweeds, solitary ascidians and bivalves such as *Aequipecten opercularis* and *Chlamys varia*. As *M. modiolus* is an Arctic-Boreal species, its distribution ranges from the seas around Scandinavia (including Skagerrak & Kattegat) and Iceland south to the Bay of Biscay.

BAP description

Horse Mussel Beds

This habitat description has been adapted from the 1994 UK BAP Action Plan for *Modiolus modiolus* beds and would benefit from an update
Correspondence with existing habitats

OSPAR habitat: *Modiolus modiolus* reefs

Habitats Directive –Annex 1: Large shallow inlets and bays and Reefs

Description

The horse mussel *Modiolus modiolus* forms dense beds at depths of 5-70 m in fully saline, often moderately tide-swept areas off northern and western parts of the British Isles. Although it is a widespread and common species, true beds forming a distinctive biotope are much more limited and are not known south of the Humber and Severn estuaries. Beds are known from Shetland, Orkney, the Hebrides and other parts of western Scotland, the Ards Peninsula, Strangford Lough, off both ends of the Isle of Man, off north-west Anglesey and north of the Lleyn Peninsula. Dense beds of young *Modiolus modiolus* also occur in the Bristol Channel but often seem not to survive to adulthood. Off North Sea coasts occasional beds occur between Berwickshire and the Humber, and probably elsewhere.

M. modiolus can occur as relatively small, dense beds of epifaunal mussels carpeting steep rocky surfaces, as in some Scottish sealochs, but is more frequently recessed at least partly into mixed or muddy sediments in a variety of tidal regimes. In some sea lochs and open sea areas, extensive expanses of seabed are covered in scattered clumps of semi-recessed *M. modiolus* on muddy gravels. In a few places in the UK, beds are more or less continuous and may be raised up to several metres above the surrounding seabed by an accumulation of shell, faeces, pseudofaeces and sand. In some areas of very strong currents extensive areas of stony and gravelly sediment are bound together by more or less completely recessed *M. modiolus*, creating waves or mounds with steep faces up to one metre high and many metres long. These areas of semi-recessed and recessed beds may in some cases extend over hundreds of hectares, and in many cases may be considered as `biogenic reefs`, though they are all referred to here as beds. The JNCC Marine Nature Conservation Review (MNCR) has identified four major biotopes dominated by dense *M. modiolus*.

M. modiolus is a long-lived species and individuals within beds are frequently 25 years old or more. Juvenile *M. modiolus* are heavily preyed upon, especially by crabs and starfish, until they are about 3-6 years old, but predation is low thereafter. Recruitment is slow and may be very sporadic; there may be poor recruitment over a number of years in some populations.

There have been no studies of the recovery of damaged beds but full recovery after severe damage would undoubtedly take many years at best and may not occur at all. Some beds may be self maintaining relict features.

The byssus threads secreted by *M. modiolus* have an important stabilising effect on the seabed, binding together living *M. modiolus*, dead shell, and sediments. As *M. modiolus* is a filter feeder, the accumulation of faeces and pseudofaeces probably represents an important flux of organic material from the plankton to the benthos. This rich food source, together with the varied habitat, means that extremely rich associated faunas, sometimes with hundreds of species, may occur on dense beds.

The composition of the biotopes is variable, and is influenced by the depth, degree of water movement, substrate, and density of *M. modiolus*. Sponges, ascidians, soft corals, anemones, hydroids, bryozoans, tubeworms, brittlestars, urchins, starfish, barnacles, crabs, spider crabs and other decapods, whelks and other gastropods, scallops and fish all tend to be abundant as epifauna, while there may also be coralline algae and other red seaweeds in shallower areas. Infauna often includes the purple heart urchin *Spatangus purpureus* and numerous bivalves. The possible role of *M. modiolus* beds as nursery areas for other species has not been investigated.

Relevant biotope

EUNIS Code: A5.621, A5.622, A5.623 and A5.624

National Marine Habitat Classification for UK & Ireland code:

SS.SBR.SMus.ModT, *Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata

SS.SBR.SMus.ModMx, *Modiolus modiolus* beds on open coast circalittoral mixed sediment

SS.SBR.SMus.ModHAs *Modiolus modiolus* beds with fine hydroids and large solitary ascidians on very sheltered circalittoral mixed substrata and

SS.SBR.SMus.ModCvar *Modiolus modiolus* beds with fine hydroids and large solitary ascidians on very sheltered circalittoral mixed substrata

Current and potential threats

- *Fishing*: Particularly using trawls and dredges for scallops and queen scallops, is known to have caused widespread and long-lasting damage to beds in Strangford Lough and off the south-east of the Isle of Man. Effects include flattening clumps of *M. modiolus* causing fatalities, and loss of much of the associated epifauna, especially emergent types such as *Alcyonium digitatum*. Fishing impacts are likely to be occurring on *M. modiolus* beds elsewhere.
- *Physical impacts: Modiolus* beds are likely to be badly damaged by any other physical impacts, such as aggregate extraction, trenching and pipe/cable-laying, dumping of spoil/cuttings, or use of jack-up drilling rigs.
- *Contaminants : M. modiolus* is known to accumulate contaminants such as heavy metals in spoil disposal areas but the effects on condition, reproduction and mortality rates are unknown.
- *Commercial consumption: M. modiolus* has until now been taken for consumption only on a very small scale in a few localities.
- *Natural fluctuations*: In spawning, settlement and recruitment into adult sizes occur in some beds, with predation of young mussels probably being very influential. These must affect the population structure of *M. modiolus* beds over periods of a few years, but in the long term they seem to be stable features.

A2.2.6 *Ostrea edulis* beds (OSPAR definition)

EUNIS Code: A5.435

National Marine Habitat Classification for UK & Ireland code: SS.SMx.IMx.Ost

Beds of the oyster *Ostrea edulis* occurring at densities of 5 or more per m^2 on shallow mostly sheltered sediments (typically 0-10m depth, but occasionally down to 30m). There may be considerable quantities of dead oyster shell making up a substantial portion of the substratum. The clumps of dead shells and oysters can support large numbers of the ascidians *Ascidiella aspersa* and *Ascidiella scabra*. Several conspicuously large polychaetes, such as *Chaetopterus variopedatus* and terebellids, may be present as well as additional suspension-feeding polychaetes such as *Myxicola infundibulum*, *Sabella pavonina* and *Lanice conchilega*. A turf of seaweeds such as *Plocamium cartilagineum*, *Nitophyllum punctatum* and *Spyridia filamentosa* may also be present (Connor *et al*, 2004).

A2.2.7 Maerl beds (OSPAR and BAP descriptions)

BAP description

Maerl Beds

This habitat description has been adapted from the 1994 UK BAP Action Plan for Maerl and would benefit from an update http://www.ukbap.org.uk/UKPlans.aspx?ID=40.

Correspondence with existing habitats

OSPAR habitat: Maerl beds

Habitats Directive Annex 1: Large shallow inlets and bays & Sandbanks which are slightly covered by seawater all the time.

Description

Maerl is a collective term for several species of calcified red seaweed. It grows as unattached nodules on the seabed, and can form extensive beds in favourable conditions. Maerl is slow-growing, but over long periods its dead calcareous skeleton can accumulate into deep deposits (an important habitat in its own right), overlain by a thin layer of pink, living maerl.

Maerl beds typically develop where there is some tidal flow, such as in the narrows and rapids of sea lochs, or the straits and sounds between islands. Beds may also develop in more open areas where wave action is sufficient to remove fine sediments, but not strong enough to break the brittle maerl branches. Live maerl has been found at depths of 40m, but beds are typically much shallower, above 20 m and extending up to the low tide level.

Maerl beds are found off the southern and western coasts of the British Isles, north to Shetland, but are particularly well developed around the Scottish islands and in sea loch narrows, around Orkney, and in the south in the Fal Estuary. Maerl beds also occur in other western European waters, from the Mediterranean to Scandinavia.

The distributions of the three main maerl bed-forming species in the UK are not entirely clear because of problems with identification in the field. *Phymatolithon* *calcareum* occurs throughout British waters, while *Lithothamnion glaciale* is a northern species with its southern limits at Lundy in the Bristol Channel and in the North Sea, off Yorkshire. *Lithothamnion corallioides* has caused the most problems with identification, but appears to be a south-western species with Scottish records as yet unconfirmed. Currently, it is known to occur in less than 15 of the ten km squares for the UK as defined by JNCC.

Maerl beds are an important habitat for a wide variety of marine animals and plants which live amongst or are attached to its branches, or burrow in the coarse gravel of dead maerl beneath the top living layer. Maerl beds, because of the wide geographical range over which they occur, have a wide range of associated animals and plants, with species diversity tending to be greater in the south and west. Due to the fragility of maerl, the beds are easily damaged and have probably declined substantially in some areas.

Relevant biotope

Only one biotope is associated with this habitat which is; SS.SMp.Mrl Maerl beds

Current and potential threats

- *Commercial extraction* for use as a soil conditioner on acidic ground, as an animal food additive, for the filtration of acid drinking water and in pharmaceutical and cosmetic products.
- *Scallop dredging* has been identified as the biggest impact on maerl beds of both maerl, by breaking and burying the thin layer of living maerl, and the associated species. Other types of mobile fishing gear are also likely to damage the living layer of maerl on top of the bed.
- *Heavy anchors and mooring chains* could cause considerable damage to maerl beds.
- *Eutrophication,* which has causes smothering of the maerl by excess growth of other seaweeds and increased sedimentation.
- *Finfish farms* nutrient and chemical discharges that can effect the fauna associated with maerl beds may be affected.
- *Obstruction to water flow* building of barrages, causeways and bridges are potential blockages to water flow, particularly in sea lochs and between islands causing fine sediment particles to accumulate between the maerl fragments and smother the bed.

OSPAR definition

EUNIS Code: A5.51

National Marine Habitat Classification for UK & Ireland code : SS.SMp.Mrl

"Maerl" is a collective term for several species of calcified red seaweed (e.g. *Phymatolithon calcareum*, *Lithothamnion glaciale*, *Lithothamnion corallioides* and *Lithophyllum fasciculatum*) which live unattached on sediments. In favourable conditions, these species can form extensive beds, typically 30% cover or more, mostly in coarse clean sediments of gravels and clean sands or muddy mixed sediments, which occur either on the open coast or in tide-swept channels of marine inlets, where it grows as unattached nodules or ‘rhodoliths’. Maerl beds have been recorded from a variety of depths, ranging from the lower shore to 30m depth. As maerl requires light to photosynthesize, depth is determined by water turbidity. In fully marine conditions the dominant species is typically *P. calcareum*, whilst under variable salinity conditions such as sealochs, beds of *L. glaciale* may develop. Maerl beds have been recorded off the southern and western coasts of the British Isles, north to Shetland, in France and other western European waters.

A2.2.8 *Sabellaria alveolata* reefs (BAP)

BAP description

Sabellaria alveolata Reefs

This habitat description has been adapted from the 1994 UK BAP Action Plan for *Sabellaria alveolata* reefs and therefore would benefit from an update http://www.ukbap.org.uk/UKPlans.aspx?ID=32.

Correspondence with existing habitats

Habitats Directive –Annex 1: Reefs

Description

Sabellaria alveolata reefs are formed by the honeycomb worm *Sabellaria alveolata*, a polychaete which constructs tubes in tightly packed masses with a distinctive honeycomb-like appearance. These reefs can be up to 30 or even 50 cm thick and take the form of hummocks, sheets or more massive formations. Reefs are mainly found on the bottom third of the shore, but may reach mean high water of neap tides and extend into the shallow subtidal in places. They do not seem to penetrate far into low salinity areas. Reefs form on a variety of hard substrata, from pebbles to bedrock, in areas with a good supply of suspended sand grains from which the animals form their tubes, and include areas of sediment when an attachment has been established. The larvae are strongly stimulated to settle by the presence of existing colonies or their dead remains. *S. alveolata* has a very variable recruitment and the cover in any one area may vary greatly over a number of years, although in the long term reefs tend mainly to be found on the same shores.

In Britain, *S*. *alveolata* reefs are found only on shores with strong to moderate wave action in the south and west, between Lyme Bay on the south coast of England and the Scottish coast of the Solway Firth. The reefs have also been found on parts of the Northern Ireland coast. The British Isles represent the northern extremity of the range in the north-east Atlantic, which extends south to Morocco. The reefs also occur in the Mediterranean.

Individual worms have a lifespan of typically three to five years, and possibly up to nine years, but reefs themselves may last longer as a result of further settlement of worms onto existing colonies. Typically in the first two years or so, after a heavy intertidal settlement, there are few associated species. Over time, seaweeds including fucoids, *Palmaria palmata*, *Polysiphonia* spp, *Ceramium* spp, *Enteromorpha* spp and *Ulva lactuca*, and animals including barnacles, dogwhelks, winkles, mussels and other bivalves such as *Nucula nucleus*, *Sphenia binghami* and *Musculus discors*, colonise the reef. Small polychaetes such as *Fabricia stellaris, Golfingia* spp and syllidae predators may occur within the colonies. Blennies, small crabs (*Carcinus maenas*) and other crustacea (such as *Unicola crenatipalma*) can be found within crevices. Older reefs may increase the biodiversity and stability of what would otherwise be sand abraded rocks and boulders. Sheet-like reefs may restrict drainage of the shore, creating rockpools where there would otherwise be none. Less is known about subtidal communities.

In Britain, *S. alveolata* forms well developed reefs over much of its range. The most numerous and extensive areas occur on the Cumbrian coast, particularly between the Morecambe Bay and the Solway Estuary and at Dubmill Point. Reefs are also found in Cardigan Bay and in the Bristol Channel, including the coasts of south Wales, north Devon, Somerset and Avon. Very extensive subtidal reefs occur in the Severn Estuary, and subtidal populations have also been reported in the Walney Channel (Morecambe Bay) and from Glassdrumman, Northern Ireland.

There is evidence of a significant contraction in range on the south coast of England over a period of at least 20 years until 1984. Declines have also been reported in the western part of the north Cornish coast, the upper parts of the Bristol Channel and in North Wales and the Dee Estuary. Causes have not been postulated and it is difficult to assess the true significance of these changes given the natural variability of the species. For example, *S. alveolata* reefs have recently developed off Heysham (in Morecambe Bay), dominating two hectares of boulder scar from where it had been absent for 30 years

Relevant biotopes

LS.LBR.Sab Littoral *Sabellaria* honeycomb worm reefs

SS.SBR.PoR.SalvMx *Sabellaria alveolata* on variable salinity sublittoral mixed sediment

Current and potential threats

- *Cold winters / climate change Sabellaria alveolata* reefs are at the northern end of their range in Britain and are affected by extremely cold winters, after which they may die back for many years, particularly at higher shore levels.
- *Prolonged burial* will cause mortality. But can tolerate burial for a period of days or even weeks
- *Accumulations or losses of sand* as a result of shoreline development, which is the major cause of loss in parts of Europe. These developments may have positive or negative effects depending on the nature of the changes.
- *Trampling damage* by beach users and extraction of the worms for angling bait both occur, but on a limited and local scale.
- *Competition for space with common mussels Mytilus edulis* occurs, especially on boulder scars, but factors influencing this are unknown. Heavy settlement

of mussels on *S. alveolata* reefs has been suspected of causing short term destabilisation and loss of habitat.

- *Variable recruitment : S. alveolata* is naturally subject to very variable recruitment, but the factors influencing this are not fully understood. Lack of larval supply and wave exposure is thought to be an important factor in the general absence of reefs on Anglesey and near to major peninsulas such as south-west Cornwall, Pembrokeshire and the Lleyn Peninsula.

A2.2.9 *Sabellaria spinulosa* reefs (OSPAR and BAP Descriptions)

BAP description

***Sabellaria spinulosa* Reefs**

This habitat description has been adapted from the 1994 UK BAP Action Plan for *Sabellaria spinulosa* reefs and therefore would benefit from an update http://www.ukbap.org.uk/UKPlans.aspx?ID=38.
Correspondence with existing habitats
OSPAR habitat: *Sabellaria spinulosa* reefs
Habitats Directive –Annex 1: Reefs

Description

Sabellaria spinulosa reefs comprise of dense subtidal aggregations of this small, tube-building polychaete worm. Sabellaria spinulosa can act to stabilise cobble, pebble and gravel habitats, providing a consolidated habitat for epibenthic species. They are solid (albeit fragile), massive structures at least several centimetres thick, raised above the surrounding seabed, and persisting for many years. As such, they provide a biogenic habitat that allows many other associated species to become established. The *S. spinulosa* reef habitats of greatest nature conservation significance are those which occur on predominantly sediment or mixed sediment areas. These enable a range of epibenthic species with their associated fauna and a specialised 'crevice` infauna, which would not otherwise be found in the area, to become established. Studies have compared an area of *S. spinulosa* with other macrofaunal communities in the Bristol Channel and found that the former had a higher faunal diversity (more than 88 species) and higher annual production (dominated by suspension-feeders) than other benthic communities in the area.

S. spinulosa requires only a few key environmental factors for survival in UK waters. Most important seems to be a good supply of sand grains for tube building, put into suspension by strong water movement (either tidal currents or wave action). S. spinulosa also appears to be very tolerant of polluted conditions. The worms need some form of hard substratum to which their tubes will initially be attached, whether bedrock, boulders, artificial substrata, pebbles or shell fragments. However, the presence of extensive reefs in predominantly sediment areas indicates that, once an initial concretion of tubes has formed, additional worms may settle onto the colony enabling it to grow to considerable size without the need for additional 'anchorage` points. Published work has noted that the planktonic larvae are strongly stimulated to settle onto living or old colonies of *S. spinulosa*, although they will eventually (after two or three months in the plankton) settle onto any suitable substratum in the absence of other individuals.

Given its few key requirements, and its tolerance of poor water quality, *S. spinulosa* is naturally common around the British Isles. It is found in the subtidal and lower intertidal/sublittoral fringe with a wide distribution throughout the north-east Atlantic, especially in areas of turbid seawater with a high sediment load. Recent research in the Wash using remote video, identified very extensive areas of reef rising up to 60 cm above the seabed and almost continuously covering a linear extent of 300 m. However, in most parts of its geographical range *S. spinulosa* does not form reefs, but is solitary or in small groups encrusting pebbles, shell, kelp holdfasts and bedrock. It is often cryptic and easily overlooked in these habitats. Where conditions are favourable, much more extensive thin crusts can be formed, sometimes covering extensive areas of seabed. However, these crusts may be only seasonal features, being broken up during winter storms and quickly reforming through new settlement the following spring. There are extensive examples of this form of colony on the west Wales coast, particularly off the Lleyn Peninsula and Sarnau candidate Special Area of Conservation (cSAC) and the Berwickshire and North Northumberland Coast cSAC. These crusts are not considered to constitute true *S. spinulosa* reef habitats because of their ephemeral nature, which does not provide a stable biogenic habitat enabling associated species to become established in areas where they are otherwise absent.

The closely related *Sabellaria alveolata* has been recorded as living for up to nine years. It is possible that *S. spinulosa* is similarly long-lived. The examination of reefs in the Bristol Channel revealed that they possessed only a small number of young, derived from sources outside of the study area. The adults in the colony were not gravid during the study and grew very little. The age of a colony may greatly exceed the age of the oldest individuals present, as empty concretions of *S. spinulosa* sand tubes are frequently found and must be able to persist for some time in the marine environment. However, there have been no studies of the longevity of individual worms, or the longevity and stability of colonies or reefs.

Consideration of the present and historical status of this habitat in the Wadden Sea area is useful because it has been much better studied than in the UK. Large subtidal *S. spinulosa* reefs in the German Wadden Sea, which provided an important habitat for a wide range of associated species, have been completely lost since the 1920s. *S. spinulosa* now appears in the Red List of Macrofaunal Benthic Invertebrates of the Wadden Sea.

Relevant biotopes
SS.SBR.PoR.SspiMx **-** *Sabellaria spinulosa* on stable circalittoral mixed sediment

Current and potential threats

Dredging for oysters and mussels, trawling for shrimp or fin fish, net fishing and potting can all cause physical damage to erect *S. spinulosa* reef communities. The impact of the mobile gear breaks the reefs down into small chunks which no longer provide a habitat for the rich infauna and epifauna associated with this biotope..

Aggregate dredging often takes place in areas of mixed sediment where *S. spinulosa* reefs may occur. The impacts of this activity on their long-term survival is unknown, but suspension of fine material during adjacent dredging activity is not considered likely to have detrimental effects on the habitat.

Pollution is listed as one of the major threats to *S. spinulosa* in the Wadden Sea. However, pollution was not identify as a significant problem (sludge dumping in Dublin Bay actually encouraged the establishment of *Sabellaria*) unless high sedimentation drastically changed the substratum. *S. spinulosa* reefs in the Wadden Sea, destroyed by fishing activities, have been replaced by beds of mussel *Mytilus edulis* and sand-dwelling amphipods *Bathyporeia* spp. This is partly attributed to an increase in coastal eutrophication, favouring *Mytilus*.

OSPAR definition

EUNIS Code: A4.22 and A5.611

National Marine Habitat Classification for UK & Ireland code: SS.SBR.PoR.SspiMx and CR.MCR.CSab

Two sub-types: *Sabellaria spinulosa* reefs on rock
Sabellaria spinulosa reefs on mixed (sediment) substrata

The tube-building polychaete *Sabellaria spinulosa* can form dense aggregations on mixed substrata and on rocky habitats. In mixed substrata habitats, comprised variously of sand, gravel, pebble and cobble, the *Sabellaria* covers 30% or more of the substrata and needs to be sufficiently thick and persistent to support an associated epibiota community which is distinct from surrounding habitats. On rocky habitats of bedrock, boulder and cobble, the *Sabellaria* covers 50% or more of the rock and may form a crust or be thicker in structure. In some areas, these two variations of reef type may grade into each other. *Sabellaria* reefs have been recorded in depths between 10-50m BCD or more. The reef infauna typically comprises polychaete species such as *Protodorvillea kefersteini*, *Scoloplos armiger*, *Harmothoe* spp., *Mediomastus fragilis*, *Lanice conchilega* and cirratulids together with the bivalves *Abra alba* and *Nucula* spp. and tube-building amphipods such as *Ampelisca* spp. Epifauna comprise calcareous tubeworms, pycnogonids, hermit crabs, amphipods, hydroids, bryozoans, sponges and ascidians. *S. spinulosa* reefs are often found in areas with quite high levels of natural sediment disturbance; in some areas of reef, individual clumps of *Sabellaria* may periodically break down and rebuild following storm events. *S. spinulosa* reefs have been recorded from all European coasts except the Baltic Sea, Skagerrak and Kattegat. Areas of dead *Sabellaria* reef indicate the site supported reef habitat in the past and should be reported as this habitat type.

A2.2.10 Serpulid reefs (BAP description)

Serpulid Reefs

This habitat description has been adapted from the 1994 UK BAP Action Plan for Serpulid reefs and therefore would benefit from an update http://www.ukbap.org.uk/UKPlans.aspx?ID=43.

Correspondence with existing habitats

Habitats Directive – Annex 1: Reefs & Large shallow inlets and bays

Description

Serpula vermicularis is a marine worm which makes a hard, calcareous tube 4-5 mm in diameter and up to 150 mm long. In most places the worms are solitary with the base of the tube attached to stones or shells, and the feeding end growing up into the water. The worms can also aggregate into clumps or 'reefs' up to 1 m across. The species has a worldwide distribution (except for polar seas) in sheltered sites, but the reef form has been reported from very few locations. In the UK, reefs have only been found in Loch Creran, and the Linne Mhuirich arm of Loch Sween, both sea lochs on the west mainland coast of Scotland. The reefs in Loch Sween are now reported to be dead. Small *Serpula vermicularis* reefs have also been found in two loughs on the west coast of Ireland, but the best developed reefs in the world are in Loch Creran.

The serpulid reefs in Loch Creran begin as single tubes on stones or shells on a sandy mud seabed. As more worms settle and grow on already established ones the reef grows upwards and outwards to form a rounded clump of white tubes, similar to a coral head. The worms extend their feeding fans, which are about 2 cm across and a range of colours from white through orange to bright red, from the ends of the tubes. The larger reefs, over 1 m in diameter, tend to collapse outwards from the centre but the collapsed sections continue growing. The reefs are best developed in a relatively narrow vertical zone in the loch, at a depth between 6-10 m.

The reefs are a haven for other marine wildlife on the muddy seabed where there is little other solid attachment, and become covered with orange sponges, colonial and solitary sea squirts, hydroids and seaweeds. Mobile animals live between the tubes in the centre of the reef; particularly common are brittlestars, terebellid worms, small spider crabs, squat lobsters, hermit crabs, starfish and a range of marine snails.

The reefs at Loch Creran, at least in the sublittoral fringe, have declined over the last 100 years (together with eelgrass *Zostera marina* beds), while those in Loch Sween apparently died between 1982 and the mid 1990s.

Relevant biotopes

SS.SBR.PoR.Ser *Serpula vermicularis* reefs on very sheltered circalittoral muddy sand

Current and potential threats

- Mobile fishing gear: serpulid reefs are fragile and vulnerable to mechanical disturbance, such as from mobile fishing gear, which would seriously damage the reefs.

- Anchors and mooring chains, movement of fish farm cages, creels can all cause mechanical damage.
- Blockages to water flow e.g. building of barrages, causeways and bridges. Serpulid worms rely on water movement to feed; in both Loch Creran and Loch Sween this is a relatively gentle flow. However, changes in the water flow may have adverse effects on the reefs and their associated fauna and flora.
- Smothering: serpulid tube apertures become blocked by sediments that settle out of the water column onto the seabed. Hence serpulids will be affected by any activities that result in the either heavy particle suspension or sedimentation.

- Pollution e.g. effluent discharge. There was a seaweed processing factory which discharged organic effluent straight into Loch Creran. It is thought that the effluent was responsible for the lack of serpulids in the area, as when the factory closed the serpulids began to colonise the area. The effluents from finfish farms might also be considered a potential threat although some of the best reefs in Loch Creran are adjacent to the moorings of a salmon farm. Finfish farms routinely use chemicals which are specifically toxic to fish lice and other crustaceans and molluscs. When such chemicals disperse in the marine environment, there is the possibility that the rich infauna of the reefs may be affected

A2.2.11 Seagrass beds (OSPAR and BAP descriptions)

BAP description

Seagrass Beds

This habitat description has been adapted from the 1994 UK BAP Action Plan for Seagrass beds reefs and therefore would benefit from an update http://www.ukbap.org.uk/UKPlans.aspx?ID=35. This habitat includes both intertidal and subtidal seagrass beds.

Correspondence with existing habitats

Intertidal seagrass beds:

OSPAR habitat : *Zostera* beds

Habitats Directive –Annex 1: Mudflats and sandflats covered by water at low tide

Subtidal seagrass beds:

Habitats Directive –Annex 1: Lagoons

Description

Seagrass beds develop in intertidal and shallow subtidal areas on sands and muds. They may be found in marine inlets and bays but also in other areas, such as lagoons and channels, which are sheltered from significant wave action.

Three species of *Zostera* occur in the UK, and all are considered to be scarce (present in 16-100 ten km squares). Dwarf eelgrass *Zostera noltii* is found highest on the shore, often adjacent to lower saltmarsh communities, narrow-leaved eelgrass *Zostera angustifolia* on the mid to lower shore and eelgrass *Zostera marina* predominantly in the sublittoral. The plants stabilise the substratum, are an important source of organic matter, and provide shelter and a surface for attachment by other species. Eelgrass is an important source of food for wildfowl, particularly brent goose and widgeon which feed on intertidal beds. Where this habitat is well developed the leaves of eelgrass plants may be colonised by diatoms and algae such as *Enteromorpha* spp, *Cladophora rectangularis, Rhodophysema georgii*, *Ceramium rubrum*, stalked jellyfish and anemones. The soft sediment infauna may include amphipods, polychaete worms, bivalves and echinoderms. The shelter provided by seagrass beds makes them important nursery areas for flatfish and, in some areas, for cephalopods. Adult fish frequently seen in *Zostera* beds include pollack, two-spotted goby and various wrasse. Two species of pipefish, *Entelurus aequoraeus* and *Syngnathus typhie* are almost totally restricted to seagrass beds while the red algae *Polysiphonia harveyi* which has only recently been recorded from the British Isles is often associated with eelgrass beds.

Five different community types have been identified for seagrass beds from the southern North Sea and the Channel and 16 microhabitats including the seagrass itself, sessile epifauna, infauna and free swimming animals not confined to a special part of the community. The diversity of species will depend on environmental factors such as salinity and tidal exposure and the density of microhabitats, but it is potentially highest in the perennial fully marine subtidal communities and may be lowest in intertidal, estuarine, annual beds.

The Cromarty Firth supports what is most probably the largest total area of dwarf eelgrass and narrow leaved eelgrass in Britain (approximately 1200 ha) while the Maplin Sands is estimated to be the largest surviving continuous population of dwarf eelgrass in Europe (covering around 325 ha). The Fleet has the most extensive population of all three *Zostera* species in Britain. Other important sites are the Exe Estuary, Maplin Sands, the Solents marshes and the Isles of Scilly, Morfa Nefyn, Milford Haven, the Moray Firth, Carlingford Lough, Dundrum Bay, Strangford Lough and Lough Foyle.

Relevant biotopes

Intertidal Seagrass beds

LS.LMp.LSgr Seagrass beds on littoral sediments

LS.LMp.LSgr.Znol *Zostera noltii* beds in littoral muddy sand

Subtidal Seagrass beds

SS.SMp.SSgr Sublittoral seagrass beds

SS.SMp.SSgr.Rup *Ruppia maritima* in reduced salinity infralittoral muddy sand

Current and potential threats

- *Disease*. A wasting disease was responsible for die-back of large areas of seagrass in the UK in the 1930s. The fungus and slime mould which colonised the weakened seagrass have recently reappeared in seagrass beds around the Isles of Scilly.
- *Natural cycles* . The extent of seagrass beds may change as a result of natural factors such as severe storms, exposure to air, and freshwater pulses. Grazing by wildfowl can have a dramatic seasonal effect with more than 60% reduction in leaf cover reported from some sites. Warm sea temperatures coupled with low level of sunlight may cause significant stress and die back of seagrass.
- *Physical disturbance*, for example by trampling, dredging, and use of mobile bottom fishing gear, land claim and adjacent coastal development through the

construction of sea defences and potential for changes in the hydrological regime.

- *Introduction of, and competition from*, alien species such as *Spartina anglica* and *Sargassum muticum*
- *Increased turbidity reducing photosynthesis*.
- *Nutrient enrichment* , at low levels, may increase production in *Zostera* while high nitrate concentrations have been implicated in the decline of mature *Z. marina* Phytoplankton blooms, resulting from nutrient enrichment, have been shown to reduce biomass and depth penetration of eelgrass. Eutrophication can also result in a shift to phytoplankton epiphyte or macroalgal dominance.
- *Marine pollution*. Eelgrass is known to accumulate Tributyl, tin and possibly other metals and organic pollutants. Several heavy metals and organic substances have been shown to reduce nitrogen fixation which may affect the viability of the plant, particularly in nutrient poor conditions. Accumulated pollutants may become concentrated through food chains.

OSPAR definition

EUNIS Code: A2.611, A5.533 and A5.545

National Marine Habitat Classification for UK & Ireland code: LS.LMP.LSgr and SS.SMP.SSgr

Two sub-types:

8.1 *Zostera marina* beds

8.2 *Zostera noltii* beds

i. Zostera marina

Zostera marina forms dense beds, with trailing leaves up to 1m long, in sheltered bays and lagoons from the lower shore to about 4m depth, typically on sand and sandy mud (occasionally with an admixture of gravel). Where their geographical range overlaps, such as the Solent in the UK, *Z. marina* passes upshore to *Z. noltii*.

ii. Zostera noltii

Z. noltii forms dense beds, with leaves up to 20cm long, typically in the intertidal region (although it can occur in the very shallow subtidal), on mud/sand mixtures of varying consistency.

To qualify as a *Zostera* 'bed', plant densities should provide at least 5% cover (although when *Zostera* densities are this low, expert judgement should be sought to define the bed). More typically, however, *Zostera* plant densities provide greater than 30% cover. Seagrass beds stabilise the substratum as well as providing a habitat for many other species. As well as an important source of organic matter, seagrass beds may also provide an important nursery habitat for juvenile fish (ICES, 2003).

A2.2.12 Coastal Saltmarsh (BAP description)

Coastal Saltmarsh
This habitat description has been adapted from the 1994 UK BAP Action Plan for Coastal saltmarsh beds and would benefit from an update.

Correspondence with existing habitats

Habitats Directive – Annex 1: Estuaries, Salicornia and other annuals colonising mud and sand, Spartina salt meadows and Meditterranean and thermo-Atlantic halophilous scrubs

Description

Coastal saltmarshes in the UK (also known as 'merse' in Scotland) comprise the upper, vegetated portions of intertidal mudflats, lying approximately between mean high water neap tides and mean high water spring tides. For the purposes of this action plan, however, the lower limit of saltmarsh is defined as the lower limit of pioneer saltmarsh vegetation (but excluding seagrass *Zostera* beds) and the upper limit as one metre above the level of highest astronomical tides to take in transitional zones.

Saltmarshes are usually restricted to comparatively sheltered locations in five main physiographic situations: in estuaries, in saline lagoons, behind barrier islands, at the heads of sea lochs, and on beach plains. The development of saltmarsh vegetation is dependent on the presence of intertidal mudflats.

Saltmarsh vegetation consists of a limited number of halophytic (salt tolerant) species adapted to regular immersion by the tides. A natural saltmarsh system shows a clear zonation according to the frequency of inundation. At the lowest level the pioneer glassworts *Salicornia* spp can withstand immersion by as many as 600 tides per year, while transitional species of the upper marsh can only withstand occasional inundation.

The communities of stabilised saltmarsh can be divided into species-poor low-mid marsh, and the more diverse communities of the mid-upper marsh. On traditionally grazed sites, saltmarsh vegetation is shorter and dominated by grasses. At the upper tidal limits, true saltmarsh communities are replaced by driftline, swamp or transitional communities which can only withstand occasional inundation. Saltmarsh communities are additionally affected by differences in climate, the particle size of the sediment and, within estuaries, by decreasing salinity in the upper reaches. Saltmarshes on fine sediments, which are predominant on the east coasts of Britain, tend to differ in species and community composition from those on the more sandy sediments typical of the west. The northern limits of some saltmarsh species also influence plant community variation between the north and south of Britain.

Saltmarshes are an important resource for wading birds and wildfowl. They act as high tide refuges for birds feeding on adjacent mudflats, as breeding sites for waders, gulls and terns and as a source of food for passerine birds particularly in autumn and winter. In winter, grazed saltmarshes are used as feeding grounds by large flocks of wild ducks and geese. Areas with high structural and plant diversity, particularly where freshwater seepages provide a transition from fresh to brackish conditions, are particularly important for invertebrates. Saltmarshes also provide sheltered nursery sites for several species of fish.

Since medieval times, many saltmarshes have been reduced in extent by land claim. This practice continued until very recently; for instance, in the Wash 858 ha of saltmarsh were converted to agricultural use between 1970 and 1980. The land enclosed by sea walls was originally converted to grazing marsh with brackish ditches, but since the 1940s large areas of grazing marsh have been agriculturally improved to grow arable crops. As a consequence, many saltmarshes now adjoin arable land, and the upper and transitional zones of saltmarshes have become comparatively scarce in England. Sites still displaying a full range of zonation are particularly valuable for nature conservation. In Scotland and Wales, transitions (e.g. to freshwater, grassland and dune communities) are still comparatively common. In Northern Ireland most saltmarsh is composed of mid- and upper saltmarsh vegetation with transitions to freshwater or grassland.

The most recent saltmarsh surveys of the UK estimate the total extent of saltmarsh (including transitional communities) to be approximately 45,500 ha (England 32,500 ha, Scotland 6747 ha, Wales 6089 ha, and Northern Ireland 215 ha).This resource is concentrated in the major estuaries of low-lying land in eastern and north-west England and in Wales, with smaller areas in the estuaries of southern England, the firths of eastern and south-west Scotland and the sea loughs of Northern Ireland; north-west Scotland is characterised by a large number of very small saltmarsh sites at the heads of sea lochs, embayments and beaches. It is estimated that, at the mean high water line, 24% of the English coastline, 11% of the Welsh coastline and 3% of the Scottish coastline consists of saltmarsh vegetation.

Relevant biotope

LS.LMp.Sm Coastal saltmarsh

Current and potential threats

- *Land claim*. Large-scale saltmarsh land claim schemes for agriculture are now rare. Piecemeal smaller scale land claim for industry, port facilities, transport infrastructure and waste disposal is still comparatively common, and marina development on saltmarsh sites occurs occasionally.
- *Erosion and 'coastal squeeze'*. Erosion of the seaward edge of saltmarshes occurs widely in the high energy locations of the larger estuaries as a result of coastal processes. Many saltmarshes are being 'squeezed' between an eroding seaward edge and fixed flood defence walls. The erosional process is exacerbated in some locations by a reduced supply of sediment. 'Coastal squeeze' is most pronounced in south-east England. The best available information suggests that saltmarshes in the UK are being lost to erosion at a rate of 100 ha a year.
- *Sediment dynamics* Local sediment budgets may be affected by coast protection works, or by changes in estuary morphology caused by land claim, dredging of shipping channels and the impacts of flood defence works over the years.
- *Cord grass*. The small cordgrass, *Spartina maritima*, is the only species of cordgrass native to Great Britain. The smooth cordgrass, *S. alterniflora*, is a

naturalised alien that was introduced to the UK in the 1820s. This introduction led to its subsequent crossing with *S. maritima* resulting in both a sterile hybrid, Townsend's cordgrass *S. townsendii*, and a fertile hybrid, commoncordgrass *S. anglica*. The latter readily colonises mudflats and has spread around the coast.

- *Grazing*. Grazing has a marked effect on the structure and composition of saltmarsh vegetation by reducing the height of the vegetation and the diversity of plant and invertebrate species. Intensive grazing creates a sward attractive to wintering and passage wildfowl and waders, whilst less intense grazing produces a tussocky structure which favours breeding waders.
- *Other human influences*. Saltmarshes are affected by a range of other human influences including waste tipping, pollution, drowning by barrage construction, and military activity. Turf cutting, oil pollution, recreational pressure, agricultural improvement (re-seeding and draining) and eutrophication.

A2.2.13 Saline lagoons (BAP description)

Saline lagoons

This habitat description has been adapted from the 1994 UK BAP Action Plan for Coastal saltmarsh beds and would benefit from an update (http://www.ukbap.org.uk/UKPlans.aspx?ID=42).

Correspondence with existing habitats

Habitats Directive –Annex 1: Coastal Lagoons

Description

Lagoons in the UK are essentially bodies, natural or artificial, of salinewater partially separated from the adjacent sea. They retain a proportion of their seawater at low tide and may develop as brackish, full saline or hyper-saline water bodies.The largest lagoon in the UK is in excess of 800 ha (Loch of Stenness) although the rest are much smaller and some may be less than 1 ha. Lagoons can contain a variety of substrata, often soft sediments which in turn may support tasselweeds and stoneworts aswell as filamentous green and brown algae. In addition lagoons contain invertebrates rarely found elsewhere. They also provide important habitat for waterfowl, marshland birdsand seabirds. The flora and invertebrate fauna present can be divided into three main components: those that are essentially freshwater in origin, those that are marine/brackish species and those that are more specialist lagoonal species. The presence of certain indigenous and specialist plants and animals make this habitat important to the UK's overall biodiversity.

There are several different types of lagoons, ranging from those separated from the adjacent sea by a barrier of sand or shingle ('typical lagoons'), to those arising as ponded waters in depressions on soft sedimentary shores, to those separated by a rocky sill or artificial construction such as a sea wall. Sea water exchange in lagoons occurs through a natural or man-modified channel or by percolation through, or overtoppingof, the barrier. The salinity of the systems is determined by various levels of freshwater input from ground or surface waters. The degree of separation and the nature of the material separating the lagoon from the sea are the basis for distinguishing several different physiographic types of lagoon.

Relevant biotope

IR.LIR.Lag Submerged fucoids, green or red seaweeds (low salinity infralittoral rock)
SS.SSa.SSaLS Sublittoral sand in low or reduced salinity (lagoons)
SS.SMu.SMuLS Sublittoral mud in low or reduced salinity (lagoons)
SS.SMx.SMxLS Sublittoral mixed sediment in low or reduced salinity (lagoons)
SS.SMp.Ang Angiosperm communities in reduced salinity

Current and potential threats

- *Transient lagoons* Many lagoons, particularly in England and Wales, are naturally transient, salinity regimes change as succession leads to freshwater conditions and eventually to vegetation such as fen carr. Some formerly saline sites are now freshwater.
- *Infilling of lagoons*:The bar-built sedimentary barriers of 'typical' coastal lagoons tend to naturally move landwards with time. Lagoons behind them will eventually be in-filled as bar sediments approach the shore.
- *Pollution*, in particular nutrient enrichment leading to eutrophication, can have major detrimental effects. This may result from direct inputs to the lagoon or from water supply to the lagoon.
- *Artificial control of water* (sea and fresh) to lagoons can have profound influences on the habitat.

Many lagoons are often seen as candidates for infilling or land claim aspart of coastal development.

- *Coastal defence works* can prevent the movement of sediments along the shore and lead to a gradual loss of the natural coastal structures within which manycoastal lagoons are located.
- *Sea level rise*: The impact of coastal defences will be compounded by the effects of sea level rise.

A2.2.14 Deep-sea sponge aggregations (OSPAR definition)

EUNIS code: A6.62
National Marine Habitat Classification for UK & Ireland code: Not defined
Deep sea sponge aggregations are principally composed of sponges from two classes: Hexactinellida and Demospongia. They are known to occur between water depths of 250-1300m (Bett & Rice, 1992), where the water temperature ranges from 4-10°C and there is moderate current velocity (0.5 knots). Deep-sea sponge aggregations may be found on
soft substrata or hard substrata, such as boulders and cobbles which may lie on sediment. Iceberg plough-mark zones provide an ideal habitat for sponges because stable boulders and cobbles, exposed on the seabed, provide numerous attachment/settlement points (B. Bett, *pers comm.*). However, with 3.5kg of pure siliceous spicule material per m^2 reported from some sites (Gubbay, 2002), the occurrence of sponge fields can alter the characteristics of surrounding muddy sediments. Densities of occurrence are hard to quantify, but sponges in the class Hexactinellida have been reported at densities of 4-5 per m^2, whilst ‘massive’ growth forms of sponges from the class Demospongia have been reported at densities of 0.5-1 per m^2 (B. Bett, *pers comm.*). Deep-sea sponges have similar habitat preferences to cold-water corals, and hence are often found at the same location.

Research has shown that the dense mats of spicules present around sponge fields may inhibit colonisation by infaunal animals, resulting in a dominance of epifaunal elements (Gubbay, 2002). Sponge fields also support ophiuroids, which use the sponges as elevated perches.

A2.2.15 Carbonate mounds (OSPAR definition)

EUNIS code: A6.75
National Marine Habitat Classification for UK & Ireland code: Not defined
Carbonate mounds are distinct elevations of various shapes, which may be up to 350m high and 2km wide at their base (Weering *et al*, 2003). They occur offshore in water depths of 500-1100m with examples present in the Porcupine Seabight and Rockall Trough (Kenyon *et al,* 2003). Carbonate mounds may have a sediment veneer, typically composed of carbonate sands, muds and silts. The cold-water reef-building corals *Lophelia pertusa* and *Madrepora oculata*, as well as echiuran worms are characteristic fauna of carbonate mounds. Where cold-water corals (such as *Lophelia*) are present on the mound summit, coral debris may form a significant component of the overlying substratum.
There is currently speculation on the origin of carbonate mounds, with possible associations with fault-controlled methane seepage from deep hydrocarbon reservoirs, or gas-hydrate dissociation (Henriet *et al*, 1998) through to the debris from 'cold-water' coral colonies such as *Lophelia*.

A2.2.16 Carbonate reefs (NERC definition)

Carbonate reefs [Riffiau carbonad]
Habitat description
Carbonate reefs (correctly termed Methane Derived Authigenic Carbonate, or MDAC, reefs) have been created by the deposition of calcium carbonate, formed by the reaction of natural gas (methane) escaping from the seabed mixing with saltwater. The reefs are constantly developing with the continued release of natural gas from the seabed. Four such reefs have been found in shallow water (< 10 m) in the northern section of Cardigan Bay, within the Pen Llŷn a'r Sarnau SAC. Similar reefs of this type are generally found in a far greater depth of water (>500 m).
The main reef, Holden's Reef, lies 3 nm NW of Barmouth. It is named after Chris Holden who came across it in 2002 whilst exploring for potential archaeological sites. The reef is roughly circular, approximately 40 m in diameter and is surrounded by sand. A Phase 2 marine biological survey of the habitats and species present on the reef was undertaken in 2005. Lying between 6-9 m depth, it is the shallowest carbonate reef in the UK. Though silty, upward-facing surfaces have a variety of red foliose algae present amongst the lush bryozoan turf, including *Plocamium cartilagineum*, *Calliblepharis ciliata*, *Halurus flosculosus*, *Cryptopleura ramosa* and coralline crusts. The fauna is generally typified by the presence of silt-tolerant animals such as the encrusting sponges *Dysidea fragilis* and *Halichondria panicea*. In the summer months the seaweeds can become heavily encrusted with the bryozoan *Electra pilosa* and the ascidian *Molgula manhattensis* which can also form dense mats on the rock. Being surrounded by sand, the reef appears to act like an 'oasis' for fish, with wrasse, small gobies, bib, poor cod and pollack all present in large numbers.

The remaining three carbonate reefs (nick-named ‘Ugly’, ‘Big’ and ‘Small’) lie to the east and are lower-lying and less distinctive. The total area of carbonate reefs within the Pen Llŷn a’r Sarnau SAC is estimated to be 40,000 m^2. All of the reefs (referred to as the ‘Holden’s Reef complex’) qualify as “submarine structures made by leaking gases” under the EC Habitats Directive. These reefs offer a unique and diverse suite of habitats and assemblages of species within easy reach of diving scientists. Holden’s Reef forms part of the diving monitoring programme currently being undertaken by CCW for the Pen Llŷn a’r Sarnau SAC. The attributes being monitored are the extent of the reef, its rugosity and its fish population.

Environmental preferences

Salinity	Fully marine
Wave exposure	Exposed
Tidal streams	Moderately strong
Substratum	Carbonate bedrock similar in nature to hard (yet brittle) limestone.
Zone/depth	Upper circalittoral

UK & Wales distribution
The Holden’s Reef complex is the only known shallow water carbonate mound in Wales (and, to date, for the UK as a whole). It is situated in the northern sector of Cardigan Bay, 3 nm NW of Barmouth. Consequently, the habitat is restricted to an isolated location.

Statutory sites in Wales (where habitat is known to occur)
Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau Special Area of Conservation (SAC)
Note that occurrence in a statutory site does not indicate that this habitat or species is protected through the site designation or its management.

Relevant UK/international legislation & other priority listings
The four reefs constituting the Holden’s Reef complex have been identified as 'Submarine structures made by leaking gases' under the listing of SAC features.
The constituent parts of the Holden’s Reef complex are listed as one of the habitats and species ‘of principal importance for the purpose of conserving biodiversity’ in Wales, under Section 42 of the Natural Environment and Rural Communities (NERC) Act 2006.

Relevant biotopes
There are no biotopes which have been specifically drawn up for shallow water gas mounds. However, the following biotopes were recorded from the ‘Big’ and ‘Small’ reefs within the Holden’s Reef Complex in June 2005. They have also been recorded from the Holden’s Reef itself.

Biotope code	**Title**

IR.MIR.KR.XFoR	Dense foliose red seaweeds on moderately exposed, silted, stable infralittoral rock
CR.HCR.XFa.FluCoAs	*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock
CR.HCR.XFa.Mol	*Molgula manhattensis* with a hydroid and bryozoan turf on tide-swept moderately wave-exposed circalittoral rock

Main Threats
Destruction from benthic fishing gear: the location and composition of the carbonate reefs in Cardigan Bay make them both vulnerable and sensitive to damage arising from benthic fishing gear. Currently, there are no management measures in place to exclude or limit benthic fishing gear from the Holden's Reef Complex.
It is not known how long these structures have been there or how long they have taken to grow. If these structures were to be damaged by fishing gear, the time taken for them to recover (re-grow) is unknown.

Gaps in knowledge
It is thought these reefs are the only ones present in Welsh waters, but further searches may reveal more.
Further research into the ecology of these carbonate reefs is needed.

A2.2.17 Cold water coral reefs (OSPAR and BAP definitions)

BAP Description

Cold-water Coral Reefs
This habitat description has been adapted from the OSPAR habitat descriptions (2005) (www.ospar.org work areas/biological diversity and ecosystems. Definition available through the linked text ‘case reports)’ and information extracted from the *Lophelia pertusa* JAMP OSPAR assessment, 2008.

Correspondence with existing habitats

- 1994 UK BAP habitat : *Lophelia pertusa* Reefs http://www.ukbap.org.uk/UKPlans.aspx?ID=45).
- OSPAR habitat: *Lophelia pertusa* Reefs
- Habitats Directive-Annex 1:Reefs

Description
Lophelia pertusa, a cold water, reef-forming coral, has a wide geographic distribution ranging from 55°S to 70°N, where water temperatures typically remain between 4-8°C. These reefs are generally subject to moderate current velocities (0.5 knots). The majority of records occur in the north-east Atlantic. The extent of *L. pertusa* reefs vary and occur within a depth range of 200->2000 m. The species that associate with *L. pertusa* reefs change from one biogeographic province to another with an overall reduction in diversity from south to north coupled with a shift towards a more northern fauna (Hall-Spencer *et al.* 2002, 2007; Roberts *et al*. 2008).

The biological diversity of the reef community can be three times as high as the surrounding soft sediment (ICES, 2003), suggesting that these cold-water coral reefs may be biodiversity hotspots. Characteristic species include other hard corals, such as *Madrepora oculata* and *Solenosmilia variabilis*, the redfish *Sebastes viviparous* and the squat lobster *Munida sarsi*.

The reef-forming coral *Madrepora oculata* often occurs amongst *L. pertusa* reefs which trap sediment and create carbonate-rich deposits to form isolated habitats of high benthic biomass. The reefs commonly harbour abundant sessile suspension feeders and a multitude of grazing, scavenging and predatory invertebrates such as echiurans (e.g. *Bonellia* sp.), molluscs (e.g. *Acesta oxcavate*), crustaceans (*Pandalus* spp. *Munida* spp.*)* and echinoderms (e.g. *Cidaris* spp. *Gorgonocephalus* sp.) (Freiwald *et al*. 2004; Hovland, 2008; Roberts *et al*. 2006, 2008). *L. pertusa* reefs occur on hard substrata; this may be *Lophelia* rubble from an old colony or on glacial deposits. For this reason, *L. pertusa* reefs can be associated with iceberg plough-mark zones.

The conservation importance of *L. pertusa* reefs is increasingly recognised, not only because of their longevity and high biodiversity, but also due to potential benefits for commercial fisheries. Although functional relationships have not been demonstrated so far, the reefs are presumed to act as breeding grounds for commercial species such as redfish (*Sebastes* spp.), which hide amongst the complex 3-dimensional structure, and provide hunting territory for demersal predators such as monkfish, cod, ling, saithe and tusk (Husebo *et al*. 2002; Costello *et al*. 2005).

Lophelia pertusa larvae require hard substrata to settle and its reefs mainly occur at depths where temperature varies less than in surface waters, in areas with strong currents and sloping bathymetry which enhance the supply of organic material for reef growth (Frederiksen *et al*. 1992; Duineveld *et al*. 2004; Thiem *et al*. 2006). *Lophelia pertusa* requires temperatures between 4-13°C and salinities of around 35-38 psu, with oxygen concentrations >3 ml l^{-1} in waters saturated with aragonite (Freiwald *et al*. 2004; Taviani *et al*. 2005; Dodds et al. 2007; Davies *et al*. 2008).

Relevant biotopes
SS.SBR.Crl.Lop Coral reefs
SS.SBR.Crl.Lop *Lophelia* reefs

Current and potential threats
- *Fisheries:* Trawling
- *Offshore Industry:* Physical damage from construction and smothering resulting from the associated discharges of drilling mud and drill cuttings.
- *Eutrophication:* Resulting from discharges of land-based activities (Hall-Spencer, University of Plymouth, pers. comm. 2008)
- *Scientific sampling* Given the slow growth rate of the reefs, they may take centuries to recover from damage, if at all (Hall- Spencer, University of Plymouth, pers. comm. 2008).

OSPAR definition

EUNIS Code: A5.631 and A6.611

National Marine Habitat Classification for UK & Ireland code: SS.SBR.Crl.Lop

Lophelia pertusa, a cold water, reef-forming coral, has a wide geographic distribution ranging from 55°S to 70°N, where water temperatures typically remain between 4-8°C. These reefs are generally subject to moderate current velocities (0.5 knots). The majority of records occur in the north-east Atlantic. The extent of *L. pertusa* reefs vary, with examples off Norway several km long and more than 20m high. These reefs occur within a depth range of 200->2000m on the continental slope, and in shallower waters in Norwegian fjords and Swedish west coast. In Norwegian waters, *L. pertusa* reefs occur on the shelf and shelf break off the western and northern parts on local elevations of the sea floor and on the edges of escarpments. The biological diversity of the reef community can be three times as high as the surrounding soft sediment (ICES, 2003), suggesting that these cold-water coral reefs may be biodiversity hotspots. Characteristic species include other hard corals, such as *Madrepora oculata* and *Solenosmilia variabilis*, the redfish *Sebastes viviparous* and the squat lobster *Munida sarsi*. *L. pertusa* reefs occur on hard substrata; this may be *Lophelia* rubble from an old colony or on glacial deposits. For this reason, *L. pertusa* reefs can be associated with iceberg plough-mark zones. Areas of dead coral reef indicate the site supported coral reef habitat in the past and should be reported as this habitat type.

A2.2.18 Coral gardens (OSPAR definition)

Habitat occurs within each of the following deep seabed EUNIS types:
A6.1 Deep-sea rock and artificial hard substrata
A6.2 Deep-sea mixed substrata
A6.3 Deep-sea sand
A6.4 Deep-sea muddy sand
A6.5 Deep-sea mud
A6.7 Raised features of the deep sea bed
A6.8. Deep sea trenches and canyons, channels, slope failures and slumps on the continental slope
A6.9 Vents, seeps, hypoxic and anoxic habitats of the deep sea

Where the coral garden communities found in the above EUNIS deep water habitats occur also in shallower water, such as in fjords or on the flanks of islands and seamounts (A6.7), they are also included in this definition

National Marine Habitat Classification for UK & Ireland code: Not defined

The main characteristic of a coral garden is a relatively dense aggregation of colonies or individuals of one or more coral species. Coral gardens can occur on a wide range of soft and hard seabed substrata. For example, soft-bottom coral gardens may be dominated by solitary scleractinians, sea pens or certain types of bamboo corals, whereas hard-bottom coral gardens are often found to be dominated by gorgonians, stylasterids, and/or black corals (ICES 2007).

The biological diversity of coral garden communities is typically high and often contains several species of coral belonging to different taxonomic groups, such as leather corals (Alcyonacea), gorgonians (Gorgonacea), sea pens (Pennatulacea), black corals (Antipatharia), hard corals (Scleractinia) and, in some places, stony hydroids (lace or hydrocorals: Stylasteridae). However, reef-forming hard corals (e.g. *Lophelia, Madrepora* and *Solenosmilia*), if present, occur only as small or scattered colonies and not as a dominating habitat component. The habitat can also include relatively large numbers of sponge species, although they are not a dominant component of the community. Other commonly associated fauna include basket stars (*Gorgonocephalus*), brittle stars, crinoids, molluscs, crustaceans and deep-water fish (Krieger and Wing 2002). Krieger and Wing (2002) conclude that the gorgonian coral *Primnoa* is both habitat and prey for fish and invertebrates and that its removal or damage may affect the populations of associated species.

Densities of coral species in the habitat vary depending on taxa and abiotic conditions, e.g. depth, current exposure, substrate). The few scientific investigations available indicate that smaller species (e.g. the gorgonians *Acanthogorgia* and *Primnoa*, and stylasterids) can occur in higher densities, e.g. 50 – 200 colonies per·100m^2, compared to larger species, such as *Paragorgia,* which may not reach densities of 1 or 2 per 100 m^2. Depending on biogeographic area and depth, coral gardens containing several coral species may in some places reach densities between 100 and 700 colonies per·100m^2. These densities merely indicate the biodiversity richness potential of coral gardens. In areas where the habitat has been disturbed, by for example, fishing activities, densities may be significantly reduced. Currently, it is not possible to determine threshold values for the presence of a coral garden as knowledge of the *in situ* growth forms and densities of coral gardens (or abundance of coral by-catch in fishing gear) is very limited, due to technical or operational restrictions. Visual survey techniques will hopefully add to our knowledge in the coming years.

Non-reef-forming cold-water corals occur in most regions of the North Atlantic, most commonly in water with temperatures between 3 and 8ºC (Madsen, 1944; Mortensen *et al*., 2006) in the north, but also in much warmer water in the south, e.g. around the Azores. Their bathymetric distribution varies between regions according to different hydrographic conditions, but also locally as an effect of topographic features and substrate composition. They can be found as shallow as 30 m depth (in Norwegian fjords) and down to several thousand meters on open ocean seamounts. The habitat is often subject to strong or moderate currents, which prevents silt deposition on the hard substrata that most coral species need for attachment. The hard substrata may be composed of bedrock or gravel/boulder, the latter often derived from glacial moraine deposition, whilst soft sandy/clayey sediments can also support cold-water corals (mostly seapens and some gorgonians within the Isididae).

Notes on practical identification and mapping of the habitat: Given the diversity of possible appearances of the habitat across the North East Atlantic, a more precise description of the habitat as it occurs in relation to different substrates, depths and regions will need to be developed. For individual locations, expert judgement is required to distinguish this habitat from surrounding habitats, including an assessment of the appropriate densities of octocoral species to constitute this habitat. As a first step to further clarification a site-by-site description of coral gardens is required that will lead to further refinement of this habitat definition and its inclusion in national and European habitat classifications. The habitat definition above does not encompass shelf and coastal water habitats with seapen and octocoral communities (for example *Alcyonium* spp. *Caryopyllia* spp.), including the OSPAR habitat 'seapens and burrowing megafauna' or deeper-water habitats where colonial scleractinian corals (*Lophelia pertusa* reefs) or sponges (Deep-sea sponge aggregations) dominate.

A2.2.19 Seamounts (OSPAR and BAP definition)

OSPAR definition

EUNIS Code: A6.72

National Marine Habitat Classification for UK & Ireland code: Not defined

Seamounts are defined as undersea mountains, with a crest that rises more than 1,000 metres above the surrounding sea floor (Menard, 1964 in Rogers, 1994). Seamounts can be a variety of shapes, but are generally conical with a circular, elliptical or more elongate base. Seamounts are volcanic in origin, and are often associated with seafloor 'hot-spots' (thinner areas of the earth's crust where magma can escape). Seamounts, often with a slope inclination of up to 60°, provide a striking contrast to the surrounding 'flat' abyssal plain. Their relief has profound effects on the surrounding oceanic circulation, with the formation of trapped waves, jets, eddies and closed circulations known as Taylor columns (Taylor, 1917 in Rogers, 1994). Seamounts occur frequently within the OSPAR Maritime Area. Analysis of narrow beam bathymetric data by the US Naval Oceanographic office from 1967-1989 identified more than 810 seamounts within the North Atlantic. The majority occur along the Mid-Atlantic ridge between Iceland and the Hayes fracture zone (Gubbay, 2002).

The enhanced currents that occur around seamounts provide ideal conditions for suspension feeders. Gorgonian, scleratinian and antipatharian corals may be particularly abundant, and other suspension feeders such as sponges, hydroids and ascidians are also present. Concentrations of commercially important fish species, such as orange roughy, aggregate around seamounts and live in close association with the benthic communities (Gubbay, 2002).

BAP Description

Seamounts are defined as undersea mountains, with a crest that rises more than 1,000 metres above the surrounding sea floor (Menard, 1964 in Rogers, 1994). Seamounts can be a variety of shapes, but are generally conical with a circular, elliptical or more elongate base. Seamounts are volcanic in origin, and are often associated with seafloor 'hot-spots' (thinner areas of the earth's crust where magma can escape). Seamounts, often with a slope inclination of up to 60°, provide a striking contrast to the surrounding 'flat' abyssal plain. Their relief has profound effects on the surrounding oceanic circulation, with the formation of trapped waves, jets, eddies and closed circulations known as Taylor columns (Taylor, 1917 in Rogers, 1994). Seamounts occur frequently within the OSPAR Maritime Area. Analysis of narrow beam bathymetric data by the US Naval Oceanographic office from 1967-1989 identified more than 810 seamounts within the North Atlantic. The majority occur along the Mid-Atlantic ridge between Iceland and the Hayes fracture zone (Gubbay, 2002). The enhanced currents that occur around seamounts provide ideal conditions for suspension feeders. Gorgonian, scleratinian and antipatharian corals may be particularly abundant, and other suspension feeders such as sponges, hydroids and ascidians are also present. Concentrations of commercially important fish species, such as orange roughy, aggregate around seamounts and live in close association with the benthic communities (Gubbay, 2002).

Seamounts are a distinct and different environment from much of the deep sea. They act as 'islands' for epibenthic and pelagic faunas, have a high rate of endemic species, are used as 'stepping stones' for the transoceanic dispersion of shell species and as reproduction/feeding grounds for migratory species (eg. Richer de Forges, 2000). Studies of the pelagic communities above seamounts reveal both qualitative and quantitative differences when compared to the surrounding water. The biomass of planktonic organisms over seamounts is often higher than surrounding areas, which, in turn, become an important component of the diet of fish and top predators such as sharks, rays, tuna and swordfish. The ecological importance of seamounts for top predators is emphasised by the fact that some far-ranging pelagic species concentrate their mating and spawning in such places. Two examples are the pelagic armorhead (*Pentaceros wheeleri*) and the scalloped hammerhead (*Sphyrna lewini*) (Boehlert & Sasaki, 1988).
Some seamounts are belied to act as a feeding ground, fish spawning or possibly nursery areas for many species since groups of small cetaceans such as bottlenose dolphin, common dolphin, spotted dolphin and pilot whales as well as captures of loggerhead turtles have been recorded in the area.
The benthic fauna are dominated by suspension feeders some of which are typically restricted to the seamount environment. They are characterised by high levels of endemism, which suggests limited reproductive dispersal. Sampling of the benthic seamount fauna in the SW Pacific, for example, suggests that some of these species are notably localised. Somewhere between 29-34% of the species collected during 23 cruises to the region are believed to be new to science and potentially endemic to these seamounts (Richer de Forges *et al.* 2000). Less is known about the level of endemism on seamounts in the North East Atlantic. The concentration of commercially valuable fish species around seamounts is well documented. Fishes such as the orange roughy and some deepwater oreos appear to be adapted to life in this environment, their substantial aggregations supported in the otherwise food-poor deep sea by the enhanced flow of prey organisms past the seamounts (Koslow & Gowlett-Holmes, 1998). Apart from these general characteristics of seamounts that make them ecological significant there are also unique situations which make some even more significant. They may have an important role as a 'stepping stone' for species colonising islands.

Marine Habitats Classification scheme v4.05 – not covered
EUNIS: A6.72, Seamounts, knolls and banks

A2.2.20 Fragile sponge and anthozoan communities on subtidal rocky habitats (BAP description)

These communities are found on bedrock which is locally sheltered but close to tide-swept or wave exposed areas. They are dominated by large, slow growing species such as branching sponges and sea fans. The branching sponges include species such as *Axinella dissimilis*, *Axinella damicornis*, *Axinella infundibuliformis*, *Homaxinella subdola* and to a lesser extent *Raspailia* and *Stelligera* species. Other sponge species which may be present include *Dysidea fragilis*, *Pachymatisma johnstonia*, *Esperiopsis fucorum*, *Hemimycale columella*, *Cliona celata*, *Stelligera rigida*, *Polymastia boletiformis*, *Polymastia mamillaris*, *Stelligera stuposa*, *Raspailia ramosa* and *Tethya aurantium*. A silty hydroid/bryozoan turf may develop in the understorey of this rich sponge assemblage, with species such as *Aglaophenia pluma*, *Cellaria sinuosa, Bugula flabellata*, *Bugula plumosa* and *Bugula turbinata*, and crisiids. Larger species of hydroids such as *Nemertesia antennina* and *Nemertesia ramosa* may be present prominent surfaces together with the bryozoans *Pentapora foliacea* and *Alcyonidium diaphanum*. Other fauna includes aggregations of the colonial ascidians *Clavelina*
lepadiformis and *Stolonica socialis*, together with the yellow cluster anemone *Parazoanthus*
axinellae.
In Wales, this community is primarily found where there is steeply sloping bedrock with local shelter.
Sites include north and west Anglesey, the Lleyn peninsula, and in Pembrokeshire from Strumble Head in the north to Stackpole in the south, excluding St Brides Bay. Elsewhere, this community is present around England's south-west peninsula from west Dorset to Lundy, and also off the southeast coast of Ireland.

Salinity Fully marine
Wave exposure Exposed to moderately exposed (though with local shelter)
Tidal streams Moderately strong (though with local shelter) to weak
Substratum Steeply sloping and inclined bedrock or large boulders
Zone/depth Upper circalittoral and lower circalittoral

CR.HCR.XFa.ByErSp.Eun *Eunicella verrucosa* and *Pentapora foliacea* on wave-exposed circalittoral rock
CR.HCR.XFa.ByErSp.DysAct Mixed turf of bryozoans and erect sponges with *Dysidea fragilis* and *Actinothoe sphyrodeta* on tide-swept wave exposed circalittoral rock
CR MCR.EcCR. Car Swi *Caryophyllia smithii* and *Swiftia pallida* on circalittoral rock
CR.MCR.EcCr.CarSwi.LgAs *Caryophyllia smithii*, *Swiftia pallida* and large solitary ascidians on exposed or moderately exposed circalittoral rock
CR.HCR.XFa.SwiLgAs Mixed turf of hydroids and large ascidians with *Swiftia pallida* and *Caryophyllia smithii* on weakly tide-swept circalittoral rock
CR.HCR.DpSp.PhaAxi *Phakellia ventilabrum* and Axinellid sponges on deep, wave-exposed circalittoral rock

A2.2.21 Intertidal boulder communities (BAP description)

Intertidal Underboulder Communities

Correspondence with existing habitat/s

- UK BAP broad habitat: Littoral rock
- May be component part of Annex 1 habitats
- LR.MLR.BF.Fser.Bo; IR.MIR.KR.Ldig.Bo at least – see note below

Description

This habitat is found from the mid-shore down to the extreme lower shore, and encompasses areas of boulders (greater than 256 mm diameter) that support a diverse underboulder community. The underboulder habitat, along with fissures, crevices and any interstitial spaces between adjacent boulders, form a series of microhabitats that add greatly to the biodiversity of a shore. The presence of boulders on a shore may also lead to local modification to wave exposure, current strength and levels of trapped organic matter in the area surrounding the boulders themselves. Altering the physical environment in this way results in an enhancement to the immediate biodiversity beyond the boulders themselves. This habitat can occur on a variety of substrata (including bedrock, mixed rock and sediment or mud), but there needs to be a sufficient gap on the underside of the boulder to support an under-boulder community. The richest underboulder communities are often found where there is running seawater (for instance, from pools or lagoons emptying after the tide has fallen). Boulders with a limited underboulder community are not included in this UK BAP habitat, as may occur for example where boulders are embedded in sediment, in low salinity conditions, and where boulders experience high levels of mobility and scour.

Underboulder habitat provides an environment of shade, moisture and shelter. The undersides of boulders can therefore sustain a diverse collection of animals needing these conditions to survive on an otherwise hostile shore. Underboulder communities are generally dominated by an encrusting fauna of sea mats (bryozoans), sponges (Porifera), sea squirts (ascidians), barnacles, coat-of-mail shells (chitons) and calcareous tube worms (polychaetes). Crustaceans such as the hairy porcelain crab *Porcellana platycheles*, the long-clawed porcelain crab *Pisidia longicornis,* other small crabs and squat lobsters shelter on the undersides of boulders together with scale worms and brittle stars. Herbivores include the top shells *Gibbula* spp*.* the winkle *Littorina littorea*, the cushion star *Asterina gibbosa* and the green sea urchin *Psammechinus miliaris*. Encrusting sponges can be predated upon by sea slugs such as the sea-lemon *Archidoris pseudoargus,* as are colonial seasquirts by the cowrie, *Trivia monacha.* Encrusting coralline algae are also found on the undersides of the boulders. The bulbous encrusting bryozoan *Turbicellepora magnicostata* is only recorded in the British Isles in the Isles of Scilly where it is largely restricted to underboulder habitat. Like other examples of hard substrata, the species composition of the upward face of boulders varies with a number of factors – geology, wave exposure, tidal strength and position on the shore *etc*.
Underboulder habitat plays an important role in the life cycle of marine animals, for example the undersurfaces are an important refuge for the eggs of fish, dog whelks and sea slugs. The sheltered gaps between and under the boulders provide security for mobile species such as larger crabs and fish, and also the juveniles of many more species.

Whilst boulders are widespread around the UK coast, only a component of these support a diverse underboulder community.

Summary of environmental preferences:

Salinity	Fully marine – variable salinity
Wave exposure	Exposed, moderately exposed and sheltered shores
Tidal streams	From moderate to strong
Substratum	Boulders overlying bedrock, mixed substrata and muddy sediment
Zone/depth	From the mid-eulittoral to the sublittoral fringe.

Illustrative biotopes

- LR.MLR.BF.Fser.Bo - *Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders
- IR.MIR.KR.Ldig.Bo - *Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders

Both these biotopes correlate directly with this habitat. However this underboulder habitat can also be associated with other biotopes which occur on boulders on the mid to lower shore.

Current and potential threats

The level of threat this habitat experiences is influenced by ease of access and proximity to dense populations. Consequently, in certain parts of the UK such as Scotland, it is not considered to be under threat.

- *Boulder turning for peelers*: This activity is undertaken as part of bait collection – the seeking of small, 'soft' crabs or 'peelers'. Where boulders are not replaced in their original position, the underboulder community is exposed to desiccation, predation and wave action, whilst the surface cover of seaweed becomes smothered by the displaced boulder.
- *Boulder turning for winkles*: This is where winkles are collected for human consumption, from around and underneath the boulders. Again, boulders may not be replaced in their original position.
- *Public shore visits:* One of the recreational activities to be had on a shore is to turn boulders to see what lives beneath. Chronically elevated levels of recreational disturbance is generally only associated with popular tourist destinations with easy shore access.
- *Water Quality:* De-oxygenation of underboulders and consequent death of underboulder fauna may be caused by anthropogenic organic input e.g. sewage and agricultural inputs, and also as a consequence of eutrophication. Note that de-oxygenation may also occur naturally from rotting seaweed drift.

A2.2.22 Littoral Chalk Communities

Intertidal Chalk

This habitat description has been adapted from the OSPAR habitat descriptions (2005) (www.ospar.org work areas/ biological diversity and ecosystems. Definition available through the linked text; 'case reports)'

Correspondence with existing habitats

- Part of 1994 UK BAP habitat Littoral and sublittoral chalk
- OSPAR Habitat: Littoral Chalk Communities
- Habitats Directive : Annex 1 Submerged or partially submerged caves & Reefs

Description

The erosion of chalk exposures on the coast has resulted in the formation of vertical cliffs and gently-sloping intertidal platforms with a range of micro-habitats of biological importance. Supralittoral and littoral fringe chalk cliffs and sea caves support various algal communities unique to this soft rock type. Orange, brownish or blackish gelatinous bands of algae, composed of an assemblage of Haptophyceae species such as *Apistonema* spp. *Pleurochrysis carterae* and the orange *Chrysotila lamellosa*, but other genera and species of Chrysophyceae, Haptophyceae and Prasinophyceae are likely to be present as well. The lower littoral fringe may be characterised by a dense mat of green algae *Enteromorpha* spp. and *Ulva lactuca*. Lower down the shore in the eulittoral the generally soft nature of the chalk results in the presence of a characteristic flora and fauna, notably 'rock-boring' invertebrates such as piddocks, overlain by mostly algal-dominated communities (fucoids and red algal turfs) (Gubbay, 2002). Such coastal exposures of chalk are rare in Europe, with those occurring on the southern and eastern coasts of England accounting for the greatest proportion (57%) (ICES, 2003).

A recent survey of chalk cliffs throughout England revealed that 56% of coastal chalk in Kent, and 33% in Sussex has been modified by coastal defence and other works. On the Isle of Thanet (Kent) this increases to 74%. There has been less alteration of chalk at lower shore levels except at some large port and harbour developments (e.g. Dover & Folkestone) (Doody *et al.* 1991; Fowler & Tittley, 1993). Elsewhere in England, coastal chalk remains in a largely natural state.

Relevant biotopes – marine habitat classification scheme v4.05

LR.HLR.FR.Osm *Osmundea pinnatifida* on moderately exposed mid eulittoral rock
LR.MLR.BF.Fser.Pid *Fucus serratus* and piddocks on lower eulittoral soft rock
LR.FLR.CvOv.ChrHap Chrysophyceae and Haptophyceae on vertical upper littoral fringe soft rock
IR.MIR.KR.Ldig.Pid *Laminaria digitata* and piddocks on sublittoral fringe soft rock
LR.FLR.Lic.Bli *Blidingia* spp. on vertical littoral fringe soft rock
LR.FLR.Lic.UloUro *Ulothrix flacca* and *Urospora* spp. on freshwater-influenced vertical littoral fringe soft rock

Current and potential threats

- *Coastal protection works*: Is the main threat to littoral chalk communities. Coast protection work has led to the loss of micro-habitats on the upper shore and the removal of splash-zone communities, including the unique algal communities (Anon, 2000; Fletcher, 1974; Fowler & Tittley, 1993; Wood & Wood, 1986)

- *Toxic contaminants*: The deterioration of waters quality by pollutants and nutrients has caused respectively the replacement of fucoid dominated biotopes by mussel-dominated biotopes, and the occurrence of nuisance *Enteromorpha* spp. blooms (Anon, 2000; Fletcher, 1974; Fowler & Tittley, 1993; Wood & Wood, 1986).
- *Physical loss*: The human disturbance especially be trampling, stone-turning, small-scale fishery and damage to rocks though removal of piddocks blooms (Anon, 2000; Fletcher, 1974; Fowler & Tittley, 1993; Wood & Wood, 1986)
- *Oil spills*: Chalk exposures are vulnerable to oil spills due to the proximity of major shipping lands e.g. Straits of Dover
- *Non-natives*:Native species such as *Sargassum muticum* and *Undaria pinnatifida* have been displaced by non natives along the English Channel have also been displaced, for example by. These threats are significant primarily mainly because of the relatively restricted distribution and small total area of this habitat type.

OSPAR Definition

EUNIS Code: Various including A1.126, A1.2143, A1.441, B3.114 and B3.115

National Marine Habitat Classification for UK & Ireland code: Littoral chalk biotopes (various including LR.HLR.FR.Osm, LR.MLR.BF.Fser.Pid, LR.FLR.CvOv.ChrHap, LR.FLR.Lic.Bli and LR.FLR.Lic.UloUro)

The erosion of chalk exposures on the coast has resulted in the formation of vertical cliffs and gently-sloping intertidal platforms with a range of micro-habitats of biological importance. Supralittoral and littoral fringe chalk cliffs and sea caves support various algal communities unique to this soft rock type. Orange, brownish or blackish gelatinous bands of algae, composed of an assemblage of Haptophyceae species such as *Apistonema* spp., *Pleurochrysis carterae* and the orange *Chrysotila lamellosa*, but other genera and species of Chrysophyceae, Haptophyceae and Prasinophyceae are likely to be present as well. The lower littoral fringe may be characterised by a dense mat of green algae *Enteromorpha* spp. and *Ulva lactuca*. Lower down the shore in the eulittoral the generally soft nature of the chalk results in the presence of a characteristic flora and fauna, notably 'rock-boring' invertebrates such as piddocks, overlain by mostly algal-dominated communities (fucoids and red algal turfs) (Gubbay, 2002). Such coastal exposures of chalk are rare in Europe, with those occurring on the southern and eastern coasts of England accounting for the greatest proportion (57%) (ICES, 2003). Elsewhere, this habitat occurs in France, Denmark and Germany.

A2.2.23 Sea pen and burrowing megafauna communities (OSPAR definition)

EUNIS Code: A5.361 and A5.362

National Marine Habitat Classification for UK & Ireland code: SS.SMu.CFiMu.SpnMeg and SS.SMu.CFiMu.MegMax

Plains of fine mud, at water depths ranging from 15-200m or more, which are heavily bioturbated by burrowing megafauna with burrows and mounds typically forming a prominent feature of the sediment surface. The habitat may include conspicuous populations of seapens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. The burrowing crustaceans present may include *Nephrops norvegicus*, *Calocaris macandreae* or *Callianassa subterranea*. In the deeper fiordic lochs which are protected by an entrance sill, the tall seapen *Funiculina quadrangularis* may also be present. The burrowing activity of megafauna creates a complex habitat, providing deep oxygen penetration. This habitat occurs extensively in sheltered basins of fjords, sea lochs, voes and in deeper offshore waters such as the North Sea and Irish Sea basins.

A2.2.24 Estuarine rocky habitats (BAP description)

Estuarine Rocky Habitats

Correspondence with existing habitats

- UK BAP broad habitat: Littoral rock
- May be a component part of Annex 1 habitats
- Numerous illustrative biotopes

Description

This habitat encompasses rocky habitats in estuaries, extending from supralittoral lichens down to the subtidal circalittoral. Estuarine rocky habitats incorporate substrata types such as bedrock and stable boulders. Generally rias, fjords and fjards are the most relevant types of inlet for rocky estuarine habitats.

Rocky habitat is a comparatively uncommon feature in estuaries in the UK. Although generally forming small areas in comparison with the extent of sediment substrates in estuaries, estuarine rocky habitats contribute much to the overall biodiversity within estuaries. Estuarine rocky habitats, along with a complex of other estuarine habitats, are part of the ‘connectivity’ of land, estuary and open sea. For example, the rich and sheltered waters of estuaries provide nursery grounds for fish, and estuarine rocky habitats are an important component of these nursery grounds.

Conditions in estuaries are distinctly different to those on the open coast, where rocky habitats are generally more abundant. Rocky habitats in estuaries are typically located in low wave energy environments with reduced salinity, and experience accelerated tidal streams with increased turbidity and siltation. The communities present on rocky habitats are adapted to these conditions and consequently their composition and character is different to that found on similar substrata on the open coast e.g. the cape form of the sugar kelp *Laminaria saccharina* and the tasselled morphology of sponges such as *Halichondria panicea*.

Depending on the extent and heterogeneity of the substrate, there can be a wide variety of community types associated with estuarine rocky habitats. The extent of rocky habitat in estuaries can range from a narrow strip restricted to the top of the shore to littoral reef structures extending to the subtidal, particularly in rias. Similarly, the topography of estuarine rocky shores varies from flat and gently sloping to rugged reefs and large boulders with many microhabitats.

In general terms, the supralittoral of rocky habitat supports yellow and grey lichens, with a band of the black lichen *Verrucaria maura* below. These bands may be unusually narrow in areas of low wave exposure. The remainder of the shore can be dominated by fucoids and kelp with an understorey of barnacles, algae, grazing molluscs and gammarids, and occasionally sponges and seasquirts. Where the topography is varied, there is added community interest - for example entangled turfs of the red algae *Gelidium pusillum* and *Catenella caespitosa* on shaded surfaces, dense covers of the seasquirt *Dendrodoa grossularia* on overhangs, variable salinity hydroids on shaded verticals, and green algae dominated rockpools in depressions.

The communities on subtidal estuarine rocky habitats are equally variable, and at the most diverse end of the scale, may support a rich and exceptionally abundant sessile epibiota of anemones (e.g. *Metridium senile* and *Diadumene sincta*), filter feeding sponges (e.g. *Halichondria panacea*, *Hymeniacidon perleve*, *Haliclona oculata*, *Raspalia* spp., *Suberties* spp. and *Stelligera* spp.), bryozoa (e,g, *Alcyonidium digitata*), hydroids (e.g. *Sertularella gaudichaudi*, *Bugula* spp. and *Tubularia* spp.) and seasquirts (e.g. *Ascidiella aspersa* and *Dendrodoa grossularia*).

Estuarine rocky habitats often display a transition of community types down the length of an estuary, reflecting the different environmental conditions i.e. those at the upper ends of estuaries being specific to ultra sheltered and low salinity to communities similar to open coast rock communities towards the mouth of estuaries.

This habitat excludes rocky habitats in areas of permanent full salinity. Some occurrences of estuarine rocky habitats may also fall within the BAP habitat of ‘Tideswept Channels’ and may contain examples of the BAP ‘Intertidal Underboulder Community’ habitat. The fucoid alga *Ascophyllum nodosum mackaii* and the native oyster *Ostrea edulis*, both UK BAP priority species, can be associated with estuarine rocky habitats.

Summary of environmental preferences:

Salinity	Variable - reduced
Wave exposure	Moderately exposed to ultra sheltered
Tidal streams	Weak - strong
Substratum	Bedrock, stable boulders
Zone/depth	Supralittoral to circalittoral

Most estuarine rocky habitats are found in the north and western UK; few examples are found on the predominantly soft shores of eastern England.

Illustrative biotopes

Some of the identified biotopes are associated with estuarine conditions only. However, not all biotopes identified are exclusive to an estuarine environment, and additional biotopes are included which may be found in estuarine conditions, but not exclusively.

- LR.LLR.FVS - Fucoids in variable salinity
- LR.LLR.FVS.PelVS - *Pelvetia canaliculata* on sheltered variable salinity littoral fringe rock
- LR.LLR.FVS.FspiVS - *Fucus spiralis* on sheltered variable salinity upper eulittoral rock
- LR.LLR.FVS.FvesVS - *Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata
- LR.LLR.FVS.AscVS - *Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock
- LR.LLR.FVS.Ascmac - *Ascophyllum nodosum* ecad *mackai* beds on extremely sheltered mid eulittoral mixed substrata
- LR.LLR.FVS.FserVS - *Fucus serratus* and large *Mytilus edulis* on variable salinity lower eulittoral rock
- LR.LLR.FVS.FCer - *Fucus ceranoides* on reduced salinity eulittoral rock
- IR.LIR.KVS.Cod - *Codium* spp. with red seaweeds and sparse *Laminaria saccharina* on shallow, heavily-silted, very sheltered infralittoral rock
- IR.LIR.KVS.LsacPsaVS - *Laminaria saccharina* and *Psammechinus miliaris* on variable salinity grazed infralittoral rock
- IR.LIR.KVS.LsacPhyVS - *Laminaria saccharina* with *Phyllophora* spp. and filamentous green seaweeds on variable or reduced salinity infralittoral rock

Further biotopes which are not exclusive to an estuarine environment:
LR.FLR.Eph.EntPor - *Porphyra purpurea* and *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock
LR.FLR.Eph.Ent - *Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock
LR.FLR.CvOv.SpR.Den - Sponges, shade-tolerant red seaweeds and *Dendrodoa grossularia* on wave-surged overhanging lower eulittoral bedrock and caves
LR.FLR.Rkp.G - Green seaweeds (*Enteromorpha* spp. and *Cladophora* spp.) in shallow upper shore rockpools
LR.FLR.Lic.Ver.Ver - *Verrucaria maura* on very exposed to very sheltered upper littoral fringe rock
LR.FLR.Lic.YG - Yellow and grey lichens on supralittoral rock

Current and potential threats

- *Commercial fisheries:* Communities in naturally sheltered conditions, such as those of estuarine rocky habitats, are not resilient to physical disturbance type impacts caused by mobile fishing gear.
- *Water Quality:* Estuaries are often major areas of urban and industrial development. As a result, estuaries and estuarine rocky habitats have experienced substantial losses through land claim, reduction in water quality (through industrial contaminants and also agricultural practices resulting in enhanced nutrient input and silt loading). Estuaries also receive disperse and point contaminant inputs from inland areas.
- *Dredging:* Estuaries form natural harbours and are used as safe havens for vessel traffic. With this use of estuaries is the associated need for navigational

channels and dredging, with both direct and indirect impacts on estuarine rocky habitats.

- *Coastal Protection:* Coastal defence is widespread in estuarine environments to protect private dwellings and also industrial infrastructure. This can have immediate direct impacts on estuarine rocky habitats or indirect impacts away from the point of coastal defence.
- *Climate Change:* In Wales, sea level rise and increased storminess are likely to exacerbate the existing infilling of south and west facing estuaries, where eroded sediment is deposited within the estuary, gradually covering rocky outcrops.
- Non-natives:

A2.2.25 Intertidal mudflats (OSPAR and BAP definitions)

BAP Description

Intertidal Mudflats
This habitat description has been adapted from the 1994 UK BAP Action Plan for Mudflats and would benefit from an update
http://www.ukbap.org.uk/UKPlans.aspx?ID=34.

Correspondence with existing habitats
OSPAR habitat : Intertidal mudflats
Habitats Directive –Annex 1 Large shallow inlet and bays

Description
Mudflats are sedimentary intertidal habitats created by deposition in low energy coastal environments, particularly estuaries and other sheltered areas. Their sediment consists mostly of silts and clays with a high organic content. Towards the mouths of estuaries where salinity and wave energy are higher the proportion of sand increases. Mudflats are intimately linked by physical processes to, and may be dependent on, other coastal habitats such as soft cliffs and saltmarshes. They commonly appear in the natural sequence of habitats between subtidal channels and vegetated saltmarshes. In large estuaries they may be several kilometres wide and commonly form the largest part of the intertidal area of estuaries. However, in many places they have been much reduced by land claim.

Mudflats, like other intertidal areas, dissipate wave energy, thus reducing the risk of eroding saltmarshes, damaging coastal defences and flooding low-lying land. The mud surface also plays an important role in nutrient chemistry. In areas receiving pollution, organic sediments sequester contaminants and may contain high concentrations of heavy metals.

Mudflats are characterised by high biological productivity and abundance of organisms, but low diversity with few rare species. The mudflat biota reflects the prevailing physical conditions. The JNCC Marine Nature Conservation Review (MNCR) biotope codes for mudflats are LMU.SMu (Sandy mud shores), LMU.Mu (Soft mud shores) and LMS.MS (Muddy sand shores). In areas of lowered salinity, the macroinvertebrate fauna is predominantly of the Petersen *Macoma* community,

characteristic species being: common cockle *Cerastoderma edule,* sand-hopper *Corophium volutator,* laver spire shell *Hydrobia ulvae*, ragworm *Hediste diversicolor* and, when salinity is low, large numbers of oligochaete annelids (principally *Tubificoides* spp). With a slight increase in the proportion of sand, the polychaetes catworm *Nephtys hombergi* and lugworm *Arenicola marina* occur. In slightly coarser areas, seagrass *(Zostera* spp) beds may develop. Where stones and shells provide an initial attachment for byssus threads, beds of the common mussel *Mytilus edulis* occur and accrete material through faecal deposition. Occasional stones or shells may also provide suitable attachment for stands of fucoid macroalgae such as *Fucus vesiculosus* or *F. spiralis*.
The surface of the sediment is often apparently devoid of vegetation, although mats of benthic microalgae (diatoms and euglenoids) are common. These produce mucilage (mucopolysaccharides) that binds the sediment. Under nutrient-rich conditions, there may be mats of the macroalgae *Enteromorpha* spp. or *Ulva* spp.

The total UK estuarine resource has been estimated as *c*588,000 ha of which 55% is intertidal area, mostly mud and sandflats with a lesser amount of saltmarsh. Intertidal flats cover about 270,000 ha. The UK has approximately 15% of the north-west European estuarine habitat.

Mudflats are highly productive areas which, together with other intertidal habitats, support large numbers of predatory birds and fish. They provide feeding and resting areas for internationally important populations of migrant and wintering waterfowl, and are also important nursery areas for flatfish. They are widespread in the UK with significant examples in the Wash, the Solway Firth, Mersey Estuary, Bridgwater Bay and Strangford Lough.

Illustrative biotopes
The 1994 UK BAP plan states the following biotopes are included in this habitat:
LMU.SMu (Sandy mud shores)
LMU.Mu (Soft mud shores) and
LMS.MS (Muddy sand shores).

However the Steering group associated with the marine UK BAP review have suggested that this habitat should focus on the following biotopes 2006 and any (important communities that these biotopes contain):

LS.LSa.MuSa : Polychaete / bivalve dominated muddy sand shores
LS.LMu : Littoral mud

The above grouping separates the habitat from shallow subtidal mud and coastal subtidal mud

Current and potential threats

- *Sea level rise*. Low water moves landward, but sea defences prevent a compensating landward migration of high water mark with the result that intertidal flats are squeezed out. Much of this loss is expected in southern and south-east England although research suggests that the major firths in Scotland will also be affected
- *Land claim*: Urban and transport infrastructure and for industry

- *Barrage schemes:* Water storage, amenity, tidal power and flood defence continue to pose a threat to the integrity and ecological value of mudflats in estuaries and enclosed bays.
- *Diffuse and point source discharges from agriculture, industry and urban areas*: Including polluted storm-water run-off, can create abiotic areas or produce algal mats which may affect invertebrate communities. They can also remove embedded fauna and destabilising sediments thus making them liable to erode.
- *Oil and gas extraction and related activities, and dredging for navigation*:Have an important effect on sediment biota and on sediment supply and transport
- Fishing and bait digging can have an adverse impact on community structure and substratum. For example, suction dredging for shellfish or juvenile flatfish bycatch from the shrimp fisheries may have a significant effect on important predator populations.
- *Human disturbance*: Affects bird populations` roosting and feeding areas.
- *Introduction of new or non-native species:* For example the spread of cord-grass *Spartina anglica* whichhas vegetated some upper-shore mudflat areas with important ecological consequences in some areas.
- *Estuarine dynamics* :Within estuaries, mudflats deposited in the past may erode due to changed estuarine dynamics and remobilised sediment may be redeposited elsewhere in the same littoral sediment cell.
- *Higher sea level and increased storm frequency:* Resulting from climate change, may further affect the sedimentation patterns of mudflats and estuaries.

OSPAR definition
EUNIS Code: A2.3
National Marine Habitat Classification for UK & Ireland code: LS.LMu
Two sub-types: 9.1 Marine intertidal mudflats
9.2 Estuarine intertidal mudflats
Intertidal mud typically forms extensive mudflats in calm coastal environments (particularly estuaries and other sheltered areas), although dry compacted mud can form steep and even vertical faces, particularly at the top of the shore adjacent to salt marshes. The upper limit of intertidal mudflats is often marked by saltmarsh, and the lower limit by Chart Datum. Sediments consist mainly of fine particles, mostly in the silt and clay fraction (particle size less than 0.063 mm in diameter), though sandy mud may contain up to 80% sand (mostly very fine and fine sand), often with a high organic content. Little oxygen penetrates these cohesive sediments, and an anoxic layer is often present within millimetres of the sediment surface. Intertidal mudflats support communities characterised by polychaetes, bivalves and oligochaetes. This priority habitat has been divided into two sub-types, based on the predominant salinity regime.

A2.2.26 Mud habitats in deep water (BAP description)

Mud Habitats in Deep Water
This habitat description has been adapted from the 1994 UK BAP Action Plan for Mud habitats in deep water and would benefit from an update http://www.ukbap.org.uk/UKPlans.aspx?ID=41. The Steering group associated with

the marine BAP review, agreed in 2007 that this habitat would benefit from being split into two subcategories i.e. coastal subtidal mud and shelf subtidal mud

Correspondence with existing habitats
OSPAR habitat : Sea-pen and burrowing megafauna communities
Habitats Directive –Annex 1 Large shallow inlets and bays

Description
Mud habitats in deep water (circalittoral muds) occur below 20-30 m in many areas of the UK's marine environment, including marine inlets such as sea lochs. The relatively stable conditions associated with deep mud habitats often lead to the establishment of communities of burrowing megafaunal species where bathyal species may occur with coastal species. The burrowing megafaunal species include burrowing crustaceans such as *Nephrops norvegicus* and *Callianassa subterranea*. The mud habitats in deep water can also support seapen populations and communities with *Amphiura* spp.

Burrows and mounds produced by megafauna are prominent features on the surface of plains of fine mud, amongst conspicuous populations of seapens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. These soft mud communities occur extensively throughout the more sheltered basins of sea lochs and voes. As these sites are typically sheltered from wave action, these communities may occur in quite shallow depths (15 m). These communities also occur in deep offshore waters of the North Sea, where densities of *N. norvegicus* can reach 68 per 100 m2, and in the Irish Sea. Other burrowing crustaceans include *Calocaris macandreae*, *C. subterranea* and *Goneplax rhomboides*. The echiuran *Maxmuelleria lankesteri* forms large mounds in some sea loch sites. Epibenthic scavengers include *Asterias rubens*, *Pagurus bernhardus* and *Liocarcinus depurator*. Brittlestars may be present and the infauna can contain populations of polychaetes and bivalves

Within deep fjordic sea lochs, 'forests' of the nationally scarce tall seapen *Funiculina quadrangularis* can occur, together with the other two species of seapens. However, as *F. quadrangularis* is considered to be a bathyal species which 'intrudes' into sea lochs and fjords, it may only be nationally scarce in inshore waters. The mud is also extensively burrowed by crustaceans, mainly *N. norvegicus,* and the goby *Lesueurigobius friesii* may be present in burrow entrances.

Areas of soft anoxic mud can have extensive bacterial mats of *Beggiatoa* spp. The anoxia may be the result of natural conditions of poor water exchange in some Scottish sea lochs or of nutrient enrichment under fish farm cages. The associated fauna is usually impoverished but scavenging species such as *Asterias rubens* and *Carcinus maenas* are typically present. In extreme conditions of anoxia, little survives except the *Beggiatoa*.

Offshore mud habitats can be characterised by the burrowing urchin *Brissopsis lyrifera* and the brittlestar *Amphiura chiajei* and in certain areas around the UK, such as the northern Irish Sea, this community may also include *N. norvegicus*.

In boreal and Arctic areas of water deeper than 100 m, the soft muds are dominated by a community of foraminiferans and hatchett shells *Thyasira* spp. with polychaete worms. There can be thousands of dead foraminiferan tests per square metre.

The most rare deep mud biotope is notable for the very high density of the rare sea squirt *Styela gelatinosa* and is known from only one site in the UK: Loch Goil, a Clyde sea loch. Within Loch Goil, the fine mud at 65 m has large numbers of solitary ascidicans, including *S. gelatinosa, Ascidia conchilega, Corella parallelogramma* and *Ascidiella* spp along with terebellid worms and the bivalve *Pseudamussium septemradiatum*. This biotope is considered to be an ice age relic.

Relevant biotopes
The biotopes associated with this habitat (agreed by the UK Marine BAP Review Steering Group (MPLUG, 2007) are:

SS.SMu.CSaMu Circalittoral sandy mud
SS.SMu.CFiMu Circalittoral fine mud
SS.SMu.OMu Offshore circalittoral mud

Particular attention focusses on the sub-biotopes that contain important biological communities e.g.
SS.SMu.CFiMu.SpnMeg Seapens, including *Funiculina quadrangularis*, and burrowing megafauna in undisturbed circalittoral fine mud
SS.SMu.CFiMu.SpnMeg Seapens and burrowing megafauna in circalittoral fine mud
SS.SMu.CFiMu.BlyrAchi *Brissopsis lyrifera* and *Amphiura chiajei* in circalittoral mud
SS.SMu.OMu.ForThy Foraminiferans and *Thyasira* sp. in deep circalittoral fine mud
SS.SMu.OMu.StyPse *Capitella capitata* and *Thyasira* spp. in organically-enriched offshore circalittoral mud and sandy mud

Current and potential threats

- *Demersal fishing*. principally for *Nephrops norvegicus*. *Nephrops* is one of most. The use of benthic trawls can result in the removal of non-target species and disturbance to the seabed. Potting for prawns and other crustacea selectively removes some of the burrowing megafauna from deep mud.
- *Marine fish farms*. may have direct effects on mud communities, including smothering and increasing the Biological Oxygen Demand of the mud. Additional effects may result from the discharges of chemicals, some of which are especially toxic to crustaceans.
- *Pollution*. Nutrient enrichment leading to eutrophication can have significant detrimental effects. This can lead to changes in the structure and composition of deep mud communities.
- *Development.* The construction of roads, bridges and barrages may affect the local hydrodynamic and sediment transport regimes of inshore enclosed areas and consequently affect the deep mud substratum.
- *Anchoring*. This can cause physical damage to static megafaunal species such as seapens and *S. gelatinosa*.
- *Offshore oil rigs and other oil installati*ons. These can cause a variety of disturbance effects such as smothering due to disposal of drill cuttings, localised disturbance of sediments due to anchors and rig feet implacement and trench digging for pipelines.

A2.2.27 Sheltered muddy gravels (BAP description)

Sheltered Muddy Gravels
This habitat description has been adapted from the 1994 UK BAP Action Plan for Sheltered Muddy Gravels and therefore would benefit from an update http://www.ukbap.org.uk/UKPlans.aspx?ID=36. The Steering group associated with the UK Marine BAP review, agreed in 2007 that this habitat would benefit from being split into two subcategories i.e*. Intertidal mixed sediments* and *Subtidal mixed sediments*

Correspondence with existing habitats
Intertidal mixed sediments
Habitats Directive –Annex 1: Mudflats and sandflats not covered by seawater at low tide, estuaries and large shallow inlets and bays.
Subtidal mixed sediments – Not covered

Description
Sheltered muddy gravel habitats occur principally in estuaries, rias and sea lochs, in areas protected from wave action and strong tidal streams. In fully marine conditions on the lower shore this habitat can be extremely species-rich because the complex nature of the substratum supports a high diversity of both infauna and epifauna. However, good quality examples of this habitat are very scarce. Polychaetes and bivalve molluscs are normally dominant and the most varied, but representatives of most marine phyla can be present. The fauna is often characterised by a large range in body size. As one moves into an estuary, with a consequent reduction in salinity, there is a marked reduction in species richness. Low salinity (mid to upper estuarine) muddy gravels have a lower, but distinctive, species diversity. This plan concentrates on the intertidal and shallow subtidal high salinity muddy gravel habitats.

The carpet shell mollusc *Venerupis senegalensis* is often, though not necessarily, present and can sometimes occur in large numbers. The blunt gaper *Mya truncata* is another characteristic species. There are considerable variations in the composition of these communities depending upon the sediment composition and salinity regime present. Members of the fully saline community can include the tube-dwelling polychaetes *Sabella pavonina, Myxicola infundibulum* and *Amphitrite edwardsi*, the sipunculan worm *Golfingia* sp, the anemones *Sagartia troglodytes* and *Cereus pedunculatus* and the holothurian *Labidoplax digitata*. Burrowing deposit-feeding polychaetes such as *Notomastus latericeus*, *Aphelochaeta marioni* and *Melinna palmata* may be abundant throughout the salinity range. The presence of coarse gravel and stones at the sediment surface often provides a substratum for the attachment of a variety of fauna and epiflora, for example fucoids, ephemeral green algae with associated littorinids and filamentous red algae.

Although the most diverse communities occur in fully saline conditions a number of different species can occur under reduced salinity (upper estuarine) conditions. Here, *Mya arenaria* may be present, with the polychaetes *Neanthes virens* and *Cirriformia tentaculata*, the cockle *Cerastoderma edule* and the native oyster *Ostrea edulis*. Oligochaetes and the rag worm *Hediste diversicolor* usually dominate the upper estuarine low salinity muddy gravels.

The prority habitat may be considered as an intertidal extension of a habitat more common in the sublittoral. The communities of interest to this plan are restricted to the intertidal and shallow sublittoral. Shallow subtidal muddy gravel (more than 3 m below Chart Datum) can contain communities of burrowing anemones such as *Mesacmaea mitchelli*, *Aureliania heterocera*, *Cereus pedunculatus* and *Cerianthus lloydii*. Deeper water muddy gravel associations are not considered here. However, there are similarities in the infaunal component of the offshore muddy-gravel (*Venerupis*) associations.

Relevant biotopes

Intertidal mixed sediment,
LS.LMx Littoral mixed sediment
LS.LMx.GvMu Hediste diversicolor dominated gravelly sandy mud shores
LS.LMx.Mx Species-rich mixed sediment shores
LS.LMx.Mx.CirCer Cirratulids and *Cerastoderma edule* in littoral mixed sediment

Subtidal mixed sediment,
SS.SMx.IMx Infralittoral mixed sediment
SS.SMx.IMx.CreAsAn *Crepidula fornicata* with ascidians and anemones on infralittoral coarse mixed sediment
SS.SMx.IMx.SpavSpAn *Sabella pavonina* with sponges and anemones on infralittoral mixed sediment
SS.SMx.IMx.VsenAsquAps *Venerupis senegalensis, Amphipholis squamata* and *Apseudes latreilli* in infralittoral mixed sediment

Analysis of the survey records held on the MNCR database suggests that fully saline sheltered muddy gravel communities are scarce in their British distribution. However, the biotope is found extensively in the Solent and Helford River. Other notable locations include the rias of south-west Britain, for example the Fal Estuary, Salcombe Harbour and Milford Haven. Other known sites include the Sound of Arisaig, Lough Foyle, the Dyfi Estuary and Llanbedrog on the Lleyn Peninsula.

Available descriptions of intertidal muddy gravel beds are often sparse on detail due to a lack of comprehensive data. They are not easy to survey and monitor, due to the large quantities of coarse material that would need to be laboriously sampled and sieved.

Historical data on the distribution of muddy gravel beds are also very limited, presumably for similar reasons to those given above. Information from surveys carried out in the early 1900s in certain inlets (particularly the Kingsbridge Estuary and Helford River) highlights the extremely diverse communities found in muddy gravel habitats at that time. A review of sediment shores in Great Britain in the late 1970s described a similar distribution of muddy gravel communities to that shown by more recent surveys.

Current and potential threats

- *Physical disturbance*: Coastal developments including the construction of marinas and slipways, sediment extraction, the widening and dredging of

channels and sea defences such as barrages. Such activity may alter tidal flow patterns, affecting the sedimentary conditions across the gravel beds.
- *Bait digging*: Threat is especially prevalent where king rag *Neanthes virens* is common.
- *Fisheries*: Intertidal mollusc beds, including *Venerupis senegalensis*, have been the subject of small fisheries in the past. The current fishery is small, but has the potential for resurgence, whereas *Mercenaria mercenaria* dredging in Southampton Water has severely disrupted this habitat.
- *Organic enrichment*, especially sewage pollution stress: Severe pollution can lead to anoxic conditions and a decrease in macrobenthic populations and species diversity.
- *Persistent bio-accumulating chemicals* (e.g. polychlorinated biphenyls and tri-butyl tin), waste discharges containing heavy metals and chemicals.
- *Introduction of non-native species*: *Crepidula fornicata* can dominate the fauna resulting in the smothering of the sediment surface leading to anoxia in the sediment. They are also considered a pest of oyster beds.

A2.2.28 Subtidal chalk (BAP description)

Subtidal chalk
This habitat description has been adapted from the 1994 UK BAP Action Plan for Littoral and Sublittoral chalk and the 2005 NI Action plan for Littoral and Sublittoral chalk and would benefit from expert input.

Correspondence with existing habitats
Part of 1994 BAP habitat: Littoral and sublittoral chalk
No OSPAR equivalent
Habitats Directive - Annex 1: Reefs

Description
A characteristic of chalk coasts, in contrast to many harder rocky coasts of western and northern Britain is the geomorphological structure in which, because of subaerial and marine erosion , a vertical cliff face abuts an extensive Foreshore (a wave eroded platform) often extending several hundreds of metres seawards. This is of significance in the formation of subtidal chalk sea caves and reefs habitats and the occurrence of the associated communities / biotopes (Tittley *et al*. 1998).

The most extensive areas of sublittoral chalk in Britain occur in Kent and Sussex. In south-east England shallow subtidal (up to 5 m) communities are limited or absent due to the unusual friable and easily eroded nature of chalk and the prevailing harsh environment, characterised by extreme water temperatures, high levels of turbidity, siltation and scouring (UK BAP). In these conditions it is difficult to undertake subtidal surveys and hence the extent of this habitat and its associated communities are not well documented (Tittley *et al*, 1998). However less robust species e.g. large seaweeds which are more prone to scouring are replaced by more opportunistic species. As a result the shallow subtidal is dominated by animals and communities that are low in species richness reflecting the hostile environment.

At Flamborough, the Isle of Wight and Studland, shallow subtidal (up to 5M) communities are more diverse and extend into deeper waters where harder rock occurs but there are less unique algal species present.

In Northern Ireland, Upper Cretaceous chalk deposits belong to the Ulster White Limestone Formation with exposures on the County Antrim coast. The Northern Ireland chalk forms extremely hard, low porosity deposits with subsequent erosion forming cobble and boulder spreads with subtidal reefs. Faults on the seabed offshore have also exposed Cretaceous deposits. (UK BAP) and off Rathlin there are spectacular, deep subtidal cliffs affected by strong tidal currents (NI BAP).

Little is known of the extent or nature of chalk in the sublittoral zone in the Republic of Ireland. Rathlin has extensive underwater exposures of chalk, and sublittoral caves are known to be present in chalk down to at least 75m depth. These caves support rich populations of rare species. During the Northern Ireland Sublittoral Survey (NISS) (Erwin *et al*. 1986) up to three species of rare sponge were found from chalk habitats, one of which was known from only one other locality, on the west coast of Sweden. It is reported that chalk and limestone have a far higher biodiversity than any other rock types in the sublittoral zone on the island (B. Picton, *pers. comm*.) (NI BAP).

Relevant biotopes
IR.MIR.KR.HiaSw *Hiatella arctica with seaweeds on vertical limestone / chalk.*
CR.MCR.SfR Soft rock communities

Current and potential threats

- *Coastal defence and other works*. This causes a heavier impact to littoral chalk communities however alteration of chalk have occurred at lower shore and subtidal levels (e.g. Thanet), an although large ports have been developed at Dover and Ramsgate with harbour developments at Margate, Folkestone, Newhaven and Brighton Marina.
- *Pollution and eutrophication*. The deterioration of water quality by pollutants and nutrients has caused respectively the replacement of fucoid dominated biotopes by mussel-dominated biotopes, and the occurrence of nuisance *Enteromorpha* spp blooms.
- *Small-scale fisheries andharvesting of piddocks*. Damage to subtidal reefs
- *Non-natives*. Native species along the English Channel have been displaced by the incursion of non-native species. For example, *Sargassum muticum, Polysiphonia harveyi* and *Undaria pinnatifida*.

A2.2.29 Subtidal mixed muddy sediments (NERC definition)

Sublittoral mixed muddy sediments [Gwaddodion lleidiog cymysg yn y gylchfa islanw]

Habitat description

These habitats incorporate a range of sediments which form a muddy matrix. They include heterogeneous muddy gravelly sands and also mosaics of cobbles and pebbles embedded in or lying on mixtures of sand, gravel and mud. These habitats (it would be inaccurate to refer to them in the singular) are often extremely species-rich because of the complex nature of the substratum which supports a high diversity of life both within and on the sediment surface. Polychaetes and bivalve molluscs are normally dominant and the most varied, but representatives of many other phyla can be present, including echinoderms, anemones, hydroids, crustacea and bryozoa.

The native oyster *Ostrea edulis*, fan mussel *Atrina fragilis* and timid burrowing anemone *Edwardsia timida* are all existing UK BAP species which are associated with sublittoral mixed muddy sediment habitats such as those described here. There are also a number of nationally rare and scarce species associated with these habitats including the mantis shrimp *Rissoides desmaresti* and the red alga *Anotrichium barbatum*.

Environmental preferences

Salinity	Fully marine
Wave exposure	Moderately exposed to very sheltered.
Tidal streams	Not known
Substratum	Muddy gravelly sands / mosaics of cobbles and pebbles embedded in or lying on sand, gravel or mud.
Zone/depth	Lower infralittoral to lower circalittoral

UK & Wales distribution

Current records indicate that this habitat is found in north west Wales (Anglesey coast, Menai Straits and the Lleyn peninsula), Cardigan Bay and within the Milford Haven waterway in Pembrokeshire.

Elsewhere in the UK it is present around much of the coast, but particularly where sheltered conditions prevail such as within sheltered bays or in deeper, offshore areas.

Statutory sites in Wales (where habitat is known or predicted to occur)

Y Fenai a Bae Conwy / Menai Strait and Conwy Bay Special Area of Conservation (SAC)

Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau Special Area of Conservation (SAC)

Bae Ceredigion / Cardigan Bay Special Area of Conservation (SAC)

Sir Benfro Forol / Pembrokeshire Marine Special Area of Conservation (SAC)

Bae Caerfyrddin ac Aberoedd / Carmarthen Bay & Estuaries European Marine Site (EMS)

Note that occurrence in a statutory site does not indicate that this habitat or species is protected through the site designation or its management.

Relevant UK/international legislation & other priority listings

Sublittoral mixed muddy sediments are listed as one of the habitats and species ‘of principal importance for the purpose of conserving biodiversity’ in Wales, under Section 42 of the Natural Environment and Rural Communities (NERC) Act 2006.

This habitat overlaps with the following SAC features: 'Large shallow inlets and bays', 'Estuaries' and possibly 'Sandbanks which are slightly covered by sea water all the time'. The exact nature of the overlap varies between and within each SAC.

Relevant biotopes

The following biotopes are likely to include sublittoral mixed muddy sediments:

Biotope code	Title
SS.SMx.IMx.VsenAsquAps	*Venerupis senegalensis*, *Amphipholis squamata* and *Apseudes latreilli* in infralittoral mixed sediment
SS.SMx.CMx.ClloMx	*Cerianthus lloydii* and other burrowing anemones in circalittoral muddy mixed sediment
SS.SMx.CMx.ClloMx.Nem	*Cerianthus lloydii* with *Nemertesia* spp. and other hydroids in circalittoral muddy mixed sediment
SS.SMx.CMx.MysThyMx	*Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment
SS.SMx.CMx.OphMx	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment
SS.SMx.OMx.PoVen	Polychaete-rich deep *Venus* community in offshore mixed sediments
SS.SMp.KSwSS.LsacR	*Laminaria saccharina* and red seaweeds on infralittoral sediments

Main Threats

Commercial fishing: this habitat is vulnerable to mobile fishing gear (e.g. trawling and dredging), where both the species and sediment structure are sensitive to physical disturbance. This habitat is generally found in relatively low wave energy environments, and it is unknown how long the sediment structure takes to recover from impacts arising from mobile fishing gear.

Anchoring: physical damage from anchors and mooring chains, particularly in harbours.

Coastal and harbour developments/maintenance: physical damage from dredges, trenching and cable/pipe-laying; increased turbidity; alteration of tidal flow patterns.

Waste dumping: smothering from dredge spoil.

It is unknown how much damage has been caused to this habitat to date, but it is likely that the quality of the habitat has deteriorated. As the major factor that caused this decline (i.e. impacts from mobile fishing gear) still exists, the threat of further decline exists.

Gaps in knowledge
More research is required to identify the full distribution of this habitat.
Also, further work is required on the impacts of, and recovery from, benthic fishing gear.

A2.2.30 Subtidal sands and gravels (BAP description)

Subtidal Sands and Gravels

This habitat description has been adapted from the 1994 UK BAP Action Plan for Sublittoral sands and gravels.

Subtidal sands and gravel sediments are the most common habitats found below the level of the lowest low tide around the coast of the United Kingdom. The sands and gravels found to the west of the UK (English Channel and Irish Sea) are largely shell derived, whereas those from the North Sea are largely formed from rock material.

The Steering Group associated with the Marine UK BAP Review, agreed in 2007 that this habitat would benefit from being split into six subcategories (but would require expert input to define each of the subcategories) i.e.:
Estuarine subtidal course sediment
Shallow coarse sediment
Coastal course sediment
Shelf/ offshore coarse sediment
Estuarine subtidal sand
Shallow subtidal sand
Coastal subtidal sand
Shelf subtidal sand

For the purposes of this habitat action plan, inshore is defined as extending to six nautical miles, and offshore as six nautical miles to the limit of UK waters. This plan encompasses both the inshore and offshore environments.

Correspondence with existing habitats
Habitats Directive – Annex 1 :Sandbanks that are slightly covered by seawater all the time & Estuaries

Description
Sublittoral sand and gravel habitats occur in a wide variety of environments, from sheltered (sea lochs, enclosed bays and estuaries) to highly exposed conditions (open coast). The particle structure of these habitats ranges from mainly sand,

through various combinations of sand and gravel, to mainly gravel. While very large areas of seabed are covered by sand and gravel in various mixes, much of this area is covered by only very thin deposits over bedrock, glacial drift or mud. The strength of tidal currents and exposure to wave action are important determinants of the topography and stability of sand and gravel habitats.

The diversity of flora and fauna living within the biotopes varies according to the level of environmental stress to which they are exposed. Sand and gravel habitats that are exposed to variable salinity in the mid- and upper regions of estuaries, and those exposed to strong tidal currents or wave action, have low diversity and are inhabited by robust, errant fauna specific to the habitat such as small polychaetes, small or rapidly burrowing bivalves and amphipods. The epifauna in these habitats tends to be dominated by mobile predatory species. Upper estuarine mobile sands, subject to very low fluctuating salinity, are species poor. This habitat is characterised by mysids (*Neomysis integer*) and amphipods (*Gammarus* spp).

Coarse sand sediment can occur in sand-wave formations in shallow water, wave exposed and tide-swept coasts. The infauna in this type of habitat is highly impoverished and is typified by small opportunistic capitellid and spionid polychaetes and isopods (*Pontocrates arenarius, Haustorius arenarius* and *Eurydice pulchra*) that are adapted to living in a highly perturbed environment. The epifauna is characterised by mobile predators such as crabs (*Carcinus maenas* and *Liocarcinus* spp), hermit crabs (*Pagurus bernhardus*), whelks (*Buccinum undatum*), and occasionally sand eels (*Ammodytes* spp). Similar habitats also occur in estuaries where the marine fauna is replaced with a sparse low salinity tolerant fauna (Forth and Humber Estuaries, Solway Firth).
Well sorted medium and fine sands on exposed coasts subjected to frequent wave action and variable tidal currents are typified by errant polychaetes such as *Nephtys cirrosa* and isopods such as *Bathyporeia* spp (common in full salinity areas of many estuaries). A low salinity variant of this habitat occurs in the Humber and Severn Estuaries.

Loose, coarse sand habitats fully exposed to wave action and swept by strong tidal streams are comparative with the 'Shallow *Venus* Community', the 'Boreal Off-shore Sand Association' and the '*Goniadella-Spisula* Association' defined in past studies. This habitat is dominated by small or highly mobile polychaetes, thick shelled and rapidly burrowing bivalves (*Spisula elliptica* and *S. subtruncata*) and mobile amphipods that are adapted to periodic disturbance. It is a common habitat with examples found from Shetland to the Scilly Isles.

A close variant of this community occurs in fine compacted sands with moderate exposure and weak tidal currents. This habitat is characterised by the thin-shelled bivalve *Fabulina fabula*, and is found in the Irish Sea, north-east coast of England and in numerous Scottish sea lochs.

Sand mixed with cobbles and pebbles that is exposed to strong tidal streams and sand scour is characterised by conspicuous hydroids (*Sertularia cupressina* and *Hydrallmania falcata*) and bryozoans (*Flustra foliacea* and *Alcyonidium diaphanum*). These fauna increase the structural complexity of this habitat and may provide an important microhabitat for smaller fauna such as amphipods and shrimps. Examples of the habitat are to be found in Shapinsay Sound, Cromarty Firth, Lowestoft, Thames, Thanet, Menai Strait, Lough Foyle and in numerous Scottish sea lochs.

In contrast, those biotopes found in full salinity in sheltered or deeper waters that are less perturbed by natural disturbance are among the most diverse marine habitats with a wide range of anemones, polychaetes, bivalves, amphipods and both mobile and sessile epifauna. Clean stone gravel habitats are characterised by the sea anemones *Halcampa chrysanthellum* and *Edwardsia timida*, associated with hydroid/bryozoan turfs and red seaweeds. This habitat type has limited recorded distribution: Loch Creran, Loch Eynort (Skye), Church Bay (Rathlin Island) and Strangford Narrows.

Shallow areas with coarse sand swept by tidal currents but sheltered from wave exposure may develop dense beds of the polychaete *Lanice conchilega.* Dense beds of polychaete tubes reduce near-bed currents and significantly increase sediment stability. Examples are to be found in Outer Hebrides lagoons, Skye and sea lochs.

Circalittoral gravels, sands and shell gravel are split into three different biotopes and have communities of high diversity. These habitats are dominated by thick-shelled bivalve and echinoderms species, (e.g. *Pecten maximus, Circomphalus casina, Ensis arcuatus* and *Clausinella fasciata*), sessile sea cucumbers (*Neopentadactyla mixta*), and sea urchins (*Psammechinus miliaris* and *Spatangus purpureus*). These biotopes have been described by previous workers as the 'Boreal Off-Shore Gravel Association' and the 'Deep Venus Community' and can be found in Shetland, the western coasts, Irish Sea and English Channel.

Many of the inshore habitats are important nursery grounds for juvenile commercial species such as flatfishes and bass. Offshore, sand and gravel habitats support internationally important fish and shellfish fisheries while SE have recently carried out a comprehensive survey of benthic communities in the Greater Minch. Broad scale habitat mapping has also been carried out on behalf of the nature conservation agencies to support their work on marine SACs and by other organisations responsible for carrying out environmental assessments, for example for dredging and cable laying

Illustrative biotopes

SS.SCS.SCSVS Sublittoral coarse sediment in variable salinity (estuaries)
SS.SCS.ICS Infralittoral coarse sediment
SS.SCS.CCS Circalittoral coarse sediment
SS.SCS.OCS Offshore circalittoral coarse sediment
SS.SSa.SSaVS Sublittoral sand in variable salinity (estuaries)
SS.SSa.IFiSa Infralittoral fine sand
SS.SSa.IMuSa Infralittoral muddy sand
SS.SSa.CFiSa Circalittoral fine sand
SS.SSa.CMuSa Circalittoral muddy sand
SS.SSa.OSa Offshore circalittoral sand

Please note that only the highest biotope level has been recorded in this section, all of the above contain subbiotopes and some of these biotopes contain important biological communities as described in the main body of the habitat description.

Current and potential threats

- *Pollutants in riverine discharge*
- *Trawling and aggregate dredging activities*. Most flatfish fisheries are found in areas of sandy seabed and are subjected to intensive perturbation by bottom fishing gears. Gravel substrata are also disturbed by scallop dredging. Large bodied, slow growing fauna such as bivalves are sensitive to fishing as are biogenic reefs
- *Aggregate extraction in licensed areas*
- *Other physical disturbances* include land claim, construction of marinas and slip ways, the widening and dredging of channels, pipe and cable laying and the construction of sea defences. These activities can alter tidal flow regimes and wave exposure, or result in deposition of sediments that influence the structure of sedimentary habitats.
- *Organic pollution from sewage* discharge and aquaculture activities leading to anoxic conditions and a decrease in benthic diversity (e.g. polychlorinated biphenyls and tri-butyl tin), heavy metals and other chemicals. These pollutants have led to decreases in the populations of common whelks in the North Sea and cause DNA breakdown in some marine organisms.
- *Oil exploration*, leakages and shipping accidents lead to localised pollution of sediment organisms.

A2.2.31 Peat and clay exposures(BAP description)

Peat and Clay Exposures with Piddocks

Correspondence with existing habitats

- UK BAP broad habitat: Littoral sediment, Sublittoral sediment
- May be component part of Annex 1 habitats
- LR.HLR.FR.RPid and LR.MLR.MusF.MytPid; CR.MCR.SfR.Pid; CR.MCR.SfR (possibly)

Description

This habitat includes littoral and sublittoral examples of peat and clay exposures, both of which are soft enough to allow them to be bored by a variety of piddocks, particularly *Pholas dactylus*, *Barnea candida* and *Barnea parva*. Peat and clay exposures with either existing or historical evidence of piddock activity are unusual communities of limited extent, adding to the biodiversity interest where they occur. These unique and fragile habitats are irreplaceable, arising from former lake bed sediments and ancient forested peatland (or ‘submerged forests’). Depending on erosion at the site, both clay and peat can occur together or independently of each other.

Where peat is present on the shore or in shallow waters, the surface may be characterised by algal mats consisting of the red seaweed *Ceramium* spp. and the green seaweeds *Ulva lactuca* and *Ulva intestinalis.* However, sand scour can limit the cover provided by these seaweeds. The crabs *Carcinus maenas* and *Cancer pagurus* often occur in crevices in the peat, with hydroids in any small pools. On clay, seaweed cover is generally sparse with species such as *Mastocarpus stellatus* and *Ceramium spp.* attached to loose-lying pebbles or shells. On the surface of the clay, there may be small clumps of the mussel *Mytilus edulis*, together with barnacles and the winkle *Littorina littorea*. The polychaete worms *Polydora* spp. and *Hediste diversicolor* can sometimes be present within the clay. When the piddocks have died, their holes provide a micro-habitat for species such as small crabs and anemones such as *Cereus pedunculatus* and *Aulactinia verrucosa*.

It is known that peat and clay beds exist sublittorally, but the extent and maximum depth of this habitat is not known. There is little information on the communities associated with subtidal examples of peat and clay exposures, but the flora and fauna is likely to be different to those found associated with intertidal examples. It is possible that subtidal exposures of this BAP habitat support communities, which may or may not include piddocks. Surveys of a subtidal peat and clay exposure in the Menai Strait recorded the piddock *Zirfaea crispata*, a sparse cover of hydroids, e.g. *Sertularia cupressina, Hydrallmania falcata, Tubularia indivisa* and *Nemertesia antennina* and crabs - *Cancer pagurus*, *Necora puber* and *Carcinus meanas.*

Depending on its location, this habitat can experience periodic inundation and emergence from sediments. This habitat encompasses examples of peat and clay exposures with either existing or historical piddock activity (i.e. dead shells in piddock holes). This BAP habitat also encompasses occurrences of peat and clay exposures with no evidence of either past or present piddock activity, but which have the potential for this community to develop on the basis of environmental conditions and presence of similar beds locally. This BAP habitat does not include examples of harder sedimentary rock (e.g. limestone) with the piddock *Hiatella arctica*. It also does not include piddocks in sandstone, chalk and soft mudstone.

Summary of environmental preferences:

Salinity	Fully marine - variable
Wave exposure	Exposed to extremely sheltered
Tidal streams	Moderate to strong
Substratum	Exposures occur within a variety of shore types.
Zone/depth	Littoral to circalittoral

This habitat is distributed along the north and south coasts of Wales, and the south and east coasts of England. Clay exposures with piddocks are also found in Cumbria. Little is known about UK distribution of subtidal peat and clay exposures, but they are likely to occur in the vicinity of intertidal occurrences.

Illustrative biotopes

- LR.HLR.FR.RPid - *Ceramium* sp. and piddocks on eulittoral fossilised peat
- LR.MLR.MusF.MytPid - *Mytilus edulis* and piddocks on eulittoral firm clay
- CR.MCR.SfR – Soft rock communities
- CR.MCR.SfR.Pid - Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay

Both the above biotopes correlate with this BAP habitat. There are currently no biotopes that describe subtidal peat exposures.

Current and potential threats

- *Coastal development:* physical damage arising from development of infrastructure, trenching and cable/pipe-laying.
- *Coastal protection:* Coastal defence works can affect peat and clay habitats, both directly and indirectly, through habitat loss and also alteration of sediment regimes.
- *Dredging activity:* Maintenance and capital dredging operations may result in direct habitat removal or indirectly through changes in sediment and hydrological regimes.
- *Mussel fisheries:* Both peat and clay habitats are vulnerable to physical disturbance and smothering arising from dredge, mussel lay and mussel collection operations associated with commercial mussel fisheries.
- *Non-natives:* There is no evidence to suggest that native piddocks have been displaced in the UK, but in Belgium and The Netherlands, the non-native American piddock *Petricola pholadiformis*, has almost completely displaced the native piddock, *Barnea candida*. *Petricola pholadiformis* has been recorded in low abundances in exposures of this habitat in the UK.
- *Bait collection:* In some areas piddocks are harvested as fishing bait, which results in physical damage to the habitat.
- *Climate change:* Both clay and peat habitats are sensitive to increases in wave exposure, which can increase the rate of erosion. Elevated wave exposure may result from changes to tidal heights and increased storm events which may be linked to the effects of climate change.

A2.2.32 Tide swept communities (BAP description)

Tide-swept Channels

This habitat description has been adapted from the 1994 UK BAP Action Plan for *Sabellaria spinulosa* reefs and therefore would benefit from an update. In addition the Steering group associated with the marine BAP review, agreed in 2007 that this' habitat would benefit from being expanded and will be eventually renamed 'Tide-swept communities. The resulting habitat will encompass broader and deeper channels with strong currents rather than a much more restricted definition of very shallow channels with very rapid water movement. It is likely that, sometime in the future, CCW will take the lead on drafting the habitat definition.

Correspondence with existing habitats
Habitats Directive – Annex 1: Reefs and large shallow inlets and bays

Description
In this habitat action plan, the term 'tidal rapids' is used to cover a broad range of high energy environments including deep tidal streams and tide-swept habitats. The JNCC`s Marine Nature Conservation Review (MNCR) defined rapids as 'strong tidal streams resulting from a constriction in the coastline at the entrance to, or within the length of, an enclosed body of water such as a sea loch. Depth is usually shallower than five metres.' In deeper situations, defined in this plan as being more than five

metres, tidal streams may generate favourable conditions for diverse marine habitats (eg the entrances to fjordic sea lochs, between islands, or between islands and the mainland, particularly where tidal flow is funnelled by the shape of the coastline). Wherever they occur, strong tidal streams result in characteristic marine communities rich in diversity, nourished by a constantly renewed food source brought in on each tide.

The marine life associated with these habitats is abundant in animals fixed on or in the seabed, and typically include soft corals, hydroids (sea firs), bryozoans (sea mats), large sponges, anemones, mussels and brittlestars in dense beds. In shallow water, bedrock and boulders often support kelp and sea oak plants, which grow very long in the tidal currents, and have a variety of animals growing on them. Other smaller red and brown seaweeds grow on cobbles and pebbles, many of these being characteristic of tide-swept situations. Both the Menai Strait in North Wales and the Scilly Isles provide good examples of tide-swept communities considered to be of national importance. Also, the Dorn in Strangford Lough MNR is remarkable for its diversity of flora and fauna and for displaying a marked emergence phenomenon. Coarse gravel is a more difficult habitat for animals to colonise, as it is constantly moving, yet even here there are typical animals, such as sea cucumbers, worms and burrowing anemones. Maerl beds are also closely identified with the conditions found in tidal narrows and rapids in the south-west (the Fal estuary) and the north of the British Isles (Orkney).

In deeper water, such as between islands, strong tidal streams may be felt down to 30 m. For example, between the Pembrokeshire islands strong tidal currents in the centre of Ramsey Sound provide conditions for a distinctive community, unrecorded elsewhere in south-west Britain.

An important range of tidal rapid habitats are found in Scottish and Irish fjordic and fjardic sea lochs. Fjordic sea lochs occur in the more mountainous areas of the Scottish west coast and islands and were formed by the scouring action of glaciers and ice sheets. The result was an over-deepened basin (with some examples recording a charted depth of 200 m) or a series of basins connected to each other and the open sea by narrow and shallow 'sills' at depths of less than 30 m, with many less than 20 m. It is this high energy sill habitat, over which the tide flows, that produces the diverse communities that inhabit this environment. A considerable volume of water may move over the sill during the tidal cycle, with a tidal range in some Scottish sea lochs of up to 5 m on spring tides, generating a tidal flows of up to 10 knots. For example, Strangford Lough in Northern Ireland also has a long rapids system with very strong tidal streams up to 8 knots.

The variability of sea lochs in size, shape, number of basins and length and depth of sills, produces a wide range of marine communities. The seabed may be of bedrock and boulders, or a range of mixed material down to coarse shell gravel. The species composition of tidal rapids in some sea lochs may also be influenced by marked variations in salinity.

Fjardic sea lochs are much shallower often with a maze of islands and shallow basins connected by rapids, which are usually less than five metres deep and often intertidal. Fjardic sea lochs are found mainly in the Western Isles.

The morphology of fjords and fjards is therefore very different to lowland marine inlets and the estuaries of the south and east of the British Isles. However, in south-west England, eustatic change has created rias by drowning coastal river valleys such as the Dart, Tamar and Fal. At the narrow entrances of these rias, strong tidal currents have generated diverse habitats of biological significance.

Illustrative biotopes - marine habitat classification scheme v4.05
LR.HLR.FT Fucoids in tide-swept conditions
LR.HLR.FT.FserTX *Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata
IR.MIR.KR.LhypT *Laminaria hyperborea* on tide-swept, infralittoral rock
IR.MIR.KR.LhypTX *Laminaria hyperborea* on tide-swept, infralittoral mixed substrata.
IR.MIR.KT Kelp and seaweed communities in tide-swept sheltered conditions
CR.HCR.FaT Very tide-swept faunal communities
CR.MCR.CFaVS Circalittoral faunal communities in variable salinity
SS.SMp.KSwSS.LsacR.CbPb Red seaweeds and kelps on tide-swept mobile infralittoral cobbles and pebbles

Please note the above biotopes may or mat not be present in the newly defined and expanded habitat 'Tide-swept communities'.

Current and potential threats

- *Obstruction to the water flow* e.g. ferries running the entrance to sea lochs, bridges, causeways i.e. the causeway joining Vatersay with Barra (Churchill Barriers, Orkney
- *Tidal power generation* (in conjunction with bridge construction) change the ecology of the lochs considerably through restriction of seawater influence and consequent changes in salinity. The effects on the connecting rapids can also be expected to be drastic.
- *Fishing* - rapids often have dense beds of animals, for example mussels, which may become attractive for exploitation in the future. Rapids can be a sanctuary for crustaceans because strong tidal currents make creeling difficult.
- *Water pollution*. Although the currents in rapids may quickly disperse one-off sources of pollution, chronic continuing pollution could affect sensitive marine life.

Appendix C. Data Contacts

Organisation	Data required	Data offered?	Data received?
Adur District Council	*Edwardsia ivelli*	No data	NA
AFBI	All species and biotopes	Yes	Yes
AFBI	Passed us on to Matt Service	NA	NA
Artoo Marine Consultants	Saline lagoons	Yes	Yes
Botanical Society of the British Isles	*Spartina anglica* distribution	Yes	Yes
Botanical Society of the British Isles	*Spartina anglica* distribution, tetrad shapefile	Yes	No
BPS	Seaweed data	Yes	Yes
Bristol Record Centre	Seaweed data bpc	Yes	Yes
Bristol Record Centre	*Tenellia* and *Spartina* records	Yes	Yes
British Phycological Society	Seaweed data	yes - atlas and herbarium data - also poss seaweed survey data	NA
Cefas	Benthic invertebrate data	Yes	Yes
Cefas	Cefas data	Yes seahorse data being sent	Yes
Cefas	Cefas data	Passed us to relevant Cefas team	NA
Cefas	Species distribution	Yes	Yes
Chichester Harbour Conservancy	*Heleobia stagnorum* distribution	Referred to M.Willing	NA
CMACS	Isle of Man intertidal reports	Yes	Yes
Conchological Society	*Heleobia stagnorum* distribution	Yes	Yes, and compiling physical data also for other species

Organisation	**Data required**	**Data offered?**	**Data received?**
Conchological Society	Mollusc data	Yes	Yes
Cornwall Wildlife Trust	*Amphianthus dorhnii* distribution records	Yes	yes
Countryside Council for Wales	Expert for map checking	NA	NA
Countryside Council for Wales	Saltmarsh distribution in Wales	Yes	Yes
Devon Sea Fisheries Committee	*Crepidula fornicata* distribution records	Yes	Yes
DOENI	Species and biotope data	Yes	Yes
Dorset Wildlife Trust	Species and biotope mapping	Biotope data not available	No
DWT	Species and biotope mapping	Yes	Biotope not available
EMU	1A layers	Yes	Yes
Environment Agency	*Eriocheir sinensis* data	Yes licensing issues	Yes
Environment Agency	Species and biotope data	Yes	Yes
Environment Agency	Species and biotope data	Yes	Yes
Environment Agency	Species and biotope data	NA	NA
Environment Agency	Species and biotope data	Yes already sorted but not sent by central requests	Yes
Environment Agency	Species and biotope data	NA	NA
ERCCIS	Maerl & stallked jellyfish distribution in cornwal	Yes	Yes
Geodata	Offshore data ALSF/REA etc	Yes	Yes
Hampshire Wildlife Trust	*G.insensibilis*. All species & habitats. Hotspots	*G.insensibilis* so far	*G.insensibilis* so far
Individual	Fal & Helford records	Yes	Yes

Organisation	**Data required**	**Data offered?**	**Data received?**
Individual	Cornwall records, *Victorella pavida* data	Yes	Yes
Individual	Expert for map checking	NA	NA
Individual	Expert for map checking	NA	NA
Individual	Expert for Scotland for map checking	NA	NA
Individual	*Leptopsammia* & *Amphianthus* records	Yes	Yes
Individual	Welsh non native records	Yes	Yes
Isle of Man government	Species records in the Isle of Man	Yes	Yes
Isles of Scilly Wildlife Trust	Maerl records for Cornwall	Suggested good contacts	NA
Natural England	*Alkmaria* records	Yes paper	Yes
JNCC	JNCC data holdings	Yes	Yes
Kent & Essex Sea Fisheries Committee	*Ensis americanus* distribution records	Yes	Yes
Kent Wildlife Trust	Species and biotope data	Yes	Yes
Lancing parish council	*Edwardsia ivelli*	No data	NA
Lancing parish council	*Edwardsia ivelli*	Passed on to ranger	NA
Marine Biological Association	Deep sea data	Yes	Yes
Marine Biological Association	Marclim data	Yes	Yes
Marine Biological Association	Non native species records	Yes	Yes
Marine Biological Association	Non-native species record check	Yes papers and non published records	Yes
Marine Fish Information Services	*Hippocampus* species, *Gobius cobitis* records	Yes	Yes

Organisation	**Data required**	**Data offered?**	**Data received?**
Marine Scotland	*Pachycerianthus multiplicatus* and *Funiculina* data	Yes	Yes
Marine Scotland	Species and biotope data	Passed on to other staff	NA
MarLIN	MarLIN records	Yes	Yes
Marine Biological Association	Species and biotope data	Yes	Yes
Merman / BODC	CSEMP data	Yes	Yes
Merseyside Biobank	*Spartina anglica* records	Yes	Yes
Natural England	Passed us on to Willie McKnight	NA	NA
Natural England	Saline lagoons and saline lagoon species	Yes	Yes
Natural England	Species and biotope data	No response	No
Natural England	Species and biotope data	Data received 07/10/2009	Yes
Natural England	Species and biotope data	No response	No
Natural England	Species and biotope data	Yes	Yes
Natural England	Species and biotope data	Yes	Yes
Natural England	Species and biotope data	Some	Yes
Natural England	Species and biotope data	Yes	Yes
Natural England	Species and biotope data	No response	NA
Natural England	Species and biotope data	Yes	Yes
Natural England contractor	*Crassostrea gigas* in Kent area	yes	Yes
Natural History Museum	*Eriocheir sinensis* distribution	Yes	Yes
Natural History Museum	Expert for map checking	NA	NA
NMGW	*Arctica islandica* and *Thyasira gouldii*	Yes	Yes

Organisation	Data required	Data offered?	Data received?
North East Sea Fisheries Committee	*Palinurus* distribution records	Yes	Yes
Northern Ireland Environment Agency	Species and biotope data	Yes	Yes
Plymouth Marine Lab	Scillies All-Taxa Biodiversity Index	Yes	Yes
Queens University, Belfast	Non native seaweeds	Yes database	Data not available
Ranger	*Edwardsia ivelli*	Yes	Yes
Research thesis	*Crassostrea.gigas* in Devon	Yes	Partial data received
Research thesis	*Crassostrea.gigas* in Strangford Lough	Yes	No
Salacia Marine	*Palinurus elephas* distribution	Suggested good contacts	NA
Scottish Association for Marine Science	*Caprella mutica* distribution records	Yes	Yes
Scottish Association for Marine Science	Species and biotope data	Yes	No
Scottish Association for Marine Science	Species and biotope data	Yes	No
Scottish Environmental Protection Agency	Species and biotope data		
Scottish Environmental Protection Agency	Species and biotope data	Yes	Yes, but fishfarm
Scottish Environmental Protection Agency	Species and biotope data		Don’t know
Scottish Environmental Protection Agency	Species and biotope data	Yes	Partial
Scottish Natural Heritage	Expert for map checking	NA	NA

Organisation	Data required	Data offered?	Data received?
Scottish Natural Heritage	Saline lagoons, *Spartina* and saltmarsh	Yes	Yes
Scottish Natural Heritage	Species and biotope data	Yes	No
Scottish Natural Heritage	Species and biotope data	Yes	Yes
Seafish	*Crassostrea*	Yes	Report contained no new data
Seahorse Trust	UK seahorse records	Yes but not at full resolution	Only partial data supplied
Seasearch	Expert for map checking	NA	NA
Seasearch	*Leptopsammia* & *Amphianthus* records	Yes	Yes
Seasearch	Seasearch records and expert for map checking	Yes	Yes
Shellfish Association GB	UK shellfish distribution records	Report sent	Yes
Southern Sea Fisheries Committee	*Palinurus elephas* distribution	No relevant data	NA
student	*Caprella mutica* distribution records	Yes	Yes
Suffolk Biological Records Centre	Suffolk records of *Spartina anglica*	Yes	Yes
Sussex Wildlife Trust	*Spartina mutica* distribution in Sussex	Yes	Yes
Tullie House Museum and Art Gallery	*Eriocheir sinensis* in Duddon Estuary	Yes	No
Ulster Museum	*P.multiplicatus* in N.I.	confirmation of absence in N.I.	Yes
University of Bangor	English Channel dredge results	Yes	Yes

Organisation	Data required	Data offered?	Data received?
University of Bangor	Expert for map checking	NA	NA
University of Bangor	Expert for map checking	NA	NA
University of Bangor	*Modiolus* and North Wales data	Yes	Yes
University of Bournemouth	IOW records	Yes	Yes
University of Brighton	Saline lagoon species	Yes	Yes
University of Bristol (retired)	Expert for map checking	NA	NA
University of Plymouth	Maerl data	Yes	Yes
University of Portsmouth	Seaweed expert non natives for map checking	NA	NA
University of Ulster	*Tenellia* record	Yes	Yes
University of Bristol	*Arrhis phyllonyx* data	No data	NA
West Sussex county council	Saline lagoon species	No data	NA

Appendix D. Habitat Definition Issues

Habitat	BAP Definition	OSPAR Definition	Issues
Blue mussel beds	"This habitat includes intertidal and subtidal beds of the blue mussel Mytilus edulis on a variety of sediment types and in a range of conditions from open coasts to estuaries, marine inlets and deeper offshore habitats. The habitat only covers 'natural' beds on a variety of sediment types, and excludes artificially created mussel beds, and mussel beds which occur on rock and boulders." In addition this analyses excluded mussel crumble	N/A	There were difficulties differentiating between commercial beds and natural beds occurring in areas of commercial extraction. An additional layer of known Several Orders was produced to highlight commercial areas and beds removed where differentiation was possible. In addition it has been shown that there is considerable that hybridization between *M. edulis* and *M. galloprovincialis* is substantial in South western UK and Ireland and has been occurring over considerable evolutionary time. The concept of blue mussels as a species group rather than a species is not reflected in the current definition.

Habitat	BAP Definition	OSPAR Definition	Issues
Intertidal *Mytilus edulis* beds on mixed and sandy sediments	N/A	"National Marine Habitat Classification for UK & Ireland code: LS.LMX.LMus.Myt.Mx and LS.LMX.LMus.Myt.Sa Sediment shores characterised by beds of the mussel *Mytilus edulis* occur principally on mid and lower shore mixed substrata (mainly cobbles and pebbles on muddy sediments) but also on sands and muds."	In addition to the 'blue mussel bed definition' issues (see 2.2.2) the OSPAR definition is slightly contradictory in that it encompasses only the sand and mixed sediment biotope codes but mentions muds in the description.
Ostrea edulis beds	N/A	"Beds of the oyster *Ostrea edulis* occurring at densities of 5 or more per m^2 on shallow mostly sheltered sediments (typically 0-10m depth, but occasionally down to 30m). There may be considerable quantities of dead oyster shell making up a substantial portion of the substratum."	There is some contradiction in the OSPAR definition which has a defined quantitative limit 5 or more oysters per square metre and the JNCC definition of the SS.SMx.IMx.Ost habitat which does not. Based on quantitative survey data (Donnan, 2007) the abundance of the Loch Ryan beds (and all other beds known in Scotland) would disqualify them from the OSPAR definition, whereas they are likely to be (and have previously) been identified as SS.SMx.IMx.Ost in a non-quantitative survey and would therefore qualify as an Ostrea edulis bed.

Habitat	BAP Definition	OSPAR Definition	Issues
Seagrass beds	Seagrass beds develop in intertidal and shallow subtidal areas on sands and muds. They may be found in marine inlets and bays but also in other areas, such as lagoons and channels, which are sheltered from significant wave action."	"*Zostera* beds"	The BAP description includes *Ruppia maritima* (beaked tasselweed) in the biotope list but not in the description and the description includes Zostera angustifolia which is no longer recognised as a valid species.
Deep sea sponge-aggregation s	"Deep sea sponge aggregations are principally composed of sponges from two classes: Hexactinellida and Demospongia. They are known to occur between water depths of 250-1300m (Bett & Rice, 1992), where the water temperature ranges from 4-10°C and there is moderate current velocity (0.5 knots). Deep-sea sponge aggregations may be found on soft substrata or hard substrata, such as boulders and cobbles which may lie on sediment."	N/A	It is difficult from the description of a sponge aggregation to define the criteria for an aggregation. Mapping would be easier with more information of when a group of sponges counts as an aggregation and when it does not. This habitat is difficult to map with any certainty without further refinement of the guidance.

Habitat	BAP Definition	OSPAR Definition	Issues
Coral gardens	N/A	"The main characteristic of a coral garden is a relatively dense aggregation of colonies or individuals of one or more coral species. Coral gardens can occur on a wide range of soft and hard seabed substrata. For example, soft-bottom coral gardens may be dominated by solitary scleractinians, sea pens or certain types of bamboo corals, whereas hard-bottom coral gardens are often found to be dominated by gorgonians, stylasterids, and/or black corals."	The description for this habitat is quite vague and contains no biotope codes making it very difficult to distinguish a 'coral garden' habitat from the limited (often only presence/absence) species information available. For this analysis occurrences of gorgonian and antipatharian corals have been noted and recorded which may or may not indicate the presence of a coral garden. A map has also been defined by depth which indicates the potential area that coral gardens may occur as they may be found on many deep sea substrates. This habitat is impossible to map with any certainty without considerable refinement of the guidance.

Habitat	BAP Definition	OSPAR Definition	Issues
Intertidal underboulder communities	"This habitat is found from the mid-shore down to the extreme lower shore, and encompasses areas of boulders (greater than 256mm diameter) that support a diverse underboulder community. The underboulder habitat, along with fissures, crevices and any interstitial spaces between adjacent boulders, form a series of microhabitats that add greatly to the biodiversity of a shore."	N/A	This habitat is quite difficult to map as it may occur on a number of unspecified intertidal biotopes and is therefore reliant on this feature being noted in descriptions (where descriptions are available). Additional data developed by CCW has been included but it is likely that data for the rest of the UK is missing. The identification and clarification of further biotopes that this habitat may occur in and if required suffixing occurrences with the Bo code would assist future mapping greatly.
Littoral chalk communities	"The erosion of chalk exposures on the coast has resulted in the formation of vertical cliffs and gently-sloping intertidal platforms with a range of micro-habitats of biological importance. Supralittoral and littoral fringe chalk cliffs and sea caves support various algal communities unique to this soft rock type."	"The erosion of chalk exposures on the coast has resulted in the formation of vertical cliffs and gently-sloping intertidal platforms with a range of micro-habitats of biological importance. Supralittoral and littoral fringe chalk cliffs and sea caves support various algal communities unique to this soft rock type"	Although the definition suggests that the biotopes found on chalk are unique several of the existing biotopes defining littoral chalk communities do not differentiate between chalk and similar soft rock substrata such as soft limestone. This means littoral chalk communities cannot be extracted without reference geological data. IR.MIR.KR.Ldig.Pid in the BAP is a sublittoral biotope rather than an intertidal biotope.

Habitat	BAP Definition	OSPAR Definition	Issues
Intertidal mudflats	“Mudflats are sedimentary intertidal habitats created by deposition in low energy coastal environments, particularly estuaries and other sheltered areas. Their sediment consists mostly of silts and clays with a high organic content. Towards the mouths of estuaries where salinity and wave energy are higher the proportion of sand increases.”	“Intertidal mud typically forms extensive mudflats in calm coastal environments (particularly estuaries and other sheltered areas), although dry compacted mud can form steep and even vertical faces, particularly at the top of the shore adjacent to salt marshes. The upper limit of intertidal mudflats is often marked by saltmarsh, and the lower limit by Chart Datum. Sediments consist mainly of fine particles, mostly in the silt and clay fraction (particle size less than 0.063 mm in diameter), though sandy mud may contain up to 80% sand (mostly very fine and fine sand), often with a high organic content.”	The OSPAR description is broader than the habitats defined by the EUNIS codes as it does not include muddy sand communities.

Habitat	BAP Definition	OSPAR Definition	Issues
Tide swept communities	"In this habitat action plan, the term 'tidal rapids' is used to cover a broad range of high energy environments including deep tidal streams and tide-swept habitats. The JNCC`s Marine Nature Conservation Review (MNCR) defined rapids as 'strong tidal streams resulting from a constriction in the coastline at the entrance to, or within the length of, an enclosed body of water such as a sea loch. Depth is usually shallower than five metres.' In deeper situations, defined in this plan as being more than five metres, tidal streams may generate favourable conditions for diverse marine habitats (eg the entrances to fjordic sea lochs, between islands, or between islands and the mainland, particularly where tidal flow is funnelled by the shape of the coastline). Wherever they occur, strong tidal streams result in characteristic marine communities rich in	N/A	Tide swept communities are found outside tidal channels, a broader habitat than the definition has been mapped, although it is currently unclear if additional biotopes should be included in this broader definition. MarLIN developed parameters for tidal exposure required to provide suitable conditions for this community in order to enable a predicted area of habitat to be mapped.

Appendix E. Restriction of Use Document

MB0102 Task Reference	Derived Data Layer Title	Specific layers included in derived data layer	Restriction & Access	Copyright/Reference/ Acknowlegement	Comment	DAC
2C	Habitats Data Layers	Littoral Chalk Communities BGS, Sheltered Muddy Gravels BGS, Subtidal Chalk BGS, Subtidal Mixed Muddy Sediments BGS, Subtidal Sands and Gravels BGS, & Mud Habitats in Deep Water BGS.	Yes. BGS Licence required for use of identifed data layers	Derived from data provided by the British Geological Survey © NERC	Sheltered muddy gravels also uses wave exposure layer and maximum tidal bed shear stress layers from 2E	BGS
		Subtidal_chalk_modelled_poly_BGS and Littoral_chalk_communities_modelled_BGS	Yes. BGS Licence required for use	Derived from data provided by the British Geological Survey © NERC	Used BGS Solid Geology Layer	BGS
		All predicted Tideswept channels layers	Freely Available via MEDIN Data Archive Centre	Crown Copyright – Defra – MB0102	Uses ABPmer Maximum Tidal Bed Shear Stress and Maximum Current Magnitude layers from 2E	BODC
		Coral garden, Mud in deep water, and deep sea sponge distribution layers	Yes. SeaZone Licence required for use	See * below	Derived from the SeaZone 300m Bathymetry layer and inherit copyright restrictions applying to this layer.	DASSH
		Blue Mussel Beds, Carbonate Mounds, Carbonate Reefs, Coastal Saltmarsh, Cold water coral reef,Coral garden potential, Deep sea sponge aggregation potential, Estuarine rocky habitats, File shell beds, Fragile sponge anthozoan, Intertidal boulder communities, Intertidal mudflats, Intertidal mytilus edulis beds, Maerl beds, Modiolus modiolus beds, Musculus discors ,Ostrea edulis, Peat clay exposures, Sabellaria	Freely Available via MEDIN Data Archive Centre with the exception of Native	Crown Copyright – Defra – MB0102	All layers supplied for the specific uses outlined. They may not be disaggregated or used for any other purpose other than those specified in the license	DASSH

	alveolata reefs, Sabellaria spinulosa, Saline lagoons, Sea pens and burrowing megafauna, Seagrass beds, Seamounts, Serpulid reefs	**<u>oyster (Ostrea edulis); Carbonate Mounds; Cold-water coral reefs where Public version must be gridded (10 km square grid resolution)</u>.**	**document without the prior consent of the original data provider. Where agreed all data will be made available via MESH. Native Oyster; Carbonate Mounds and Cold-Water coral reefs data can only be provided in a 10km grid resolution and any data provision will need to be agreed prior to release.**

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