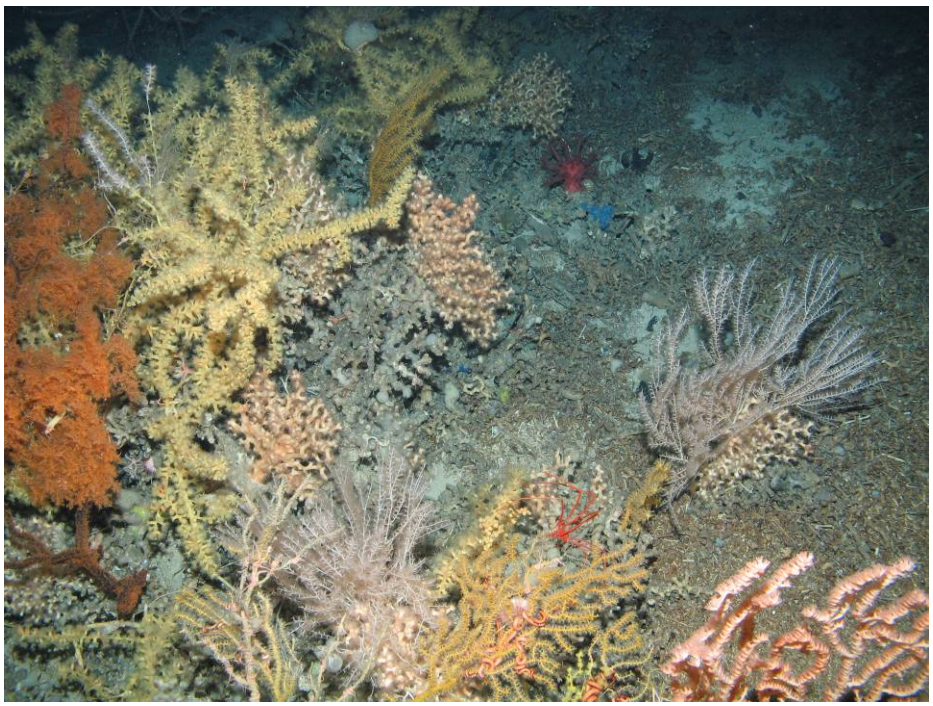
Offshore Special Area of Conservation: Anton Dohrn Seamount

SAC Selection Assessment Document



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Version 5.0 (31st October 2012)

[1] Gorgonians, *Lophelia pertusa,* antipatharians and soft corals at Anton Dohrn Seamount

Introduction

This document provides detailed information about the Anton Dohrn Seamount site and evaluates its interest features according to the Habitats Directive selection criteria and guiding principles.

The advice contained within this document is produced to fulfil requirements of JNCC under Part 2 of the Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended), relating to the conservation of natural habitat types and habitats of species through identification of Special Areas of Conservation (SACs) in UK offshore waters. Under these Regulations, JNCC has an obligation to provide certain advice to the Scottish Government to enable Ministers and Competent Authorities to fulfil their obligations under the Regulations.

This document includes information required under Regulation 7 of the Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended), to enable the Secretary of State to transmit to the European Commission the list of sites eligible for designation as Special Areas of Conservation (SACs). JNCC have been asked by the Scottish Government to provide this information.

Sites eligible for designation as offshore marine SACs are selected on the basis of the criteria set out in Annex III (Stage 1) to the Habitats Directive and relevant scientific information. Sites are considered only if they host a Habitats Directive Annex I habitat or Annex II species. Moreover, sites for Annex II species that are highly mobile must contain a clearly identifiable area that presents physical and biological factors essential to these species' life and reproduction in order to be eligible. Socio-economic factors are not taken into account in the identification of sites to be proposed to the European Commission.[2]

In addition to information on the Annex I habitats and/or Annex II species hosted within the site, this document contains i) a chart of the site, ii) its name, location and extent, and iii) the data resulting from application of the criteria specified in Annex III (Stage 1) to the Habitats Directive. This is in line with legal requirements outlined under Regulation 7. JNCC has adhered to the format established by the Commission for providing site information. This format is set out in the 'Natura 2000 Standard data form' (CEC, 2011) (prepared by the European Topic Centre for Biodiversity and Nature Conservation on behalf of the European Commission to collect standardised information on SACs throughout Europe).

[2] Following European Court of Justice 'First Corporate Shipping' judgement C-371/98 (7 November 2000)

Document Version Control

Version and issue date	Amendments made	Issued to and date
SACSAD Version 5.0 (31.10.12)	Updated to candidate SAC throughout. Centroid location amended.	Scottish Government
SACSAD Version 4.0 (31.08.12)	Updated following consultation and submission to MPA sub-group – Section 12, references and links.	Scottish Government
SAC SAD Version 3.0 (05.03.12)	Updated to possible SAC throughout.	Public consultation
SAC SAD Version 2.0 (12.12.11)	Updated to draft SAC throughout. Sub-group and Technical group comments incorporated, text and maps amended. Appendix added, references updated, sentence added to section 9.1	Scottish Government
SAC SAD Version 1.0 (08.09.11)	Comments incorporated and document sent to MPATG for approval	MPA Technical group and UKMBPSG
SAC SAD version 0.1 (10.06.11)	Proposed site boundary defined; SAC SAD drafted	MPA and Marine Advice teams

Further information

This document is available as a pdf file on JNCC's website for download if required (jncc.defra.gov.uk).

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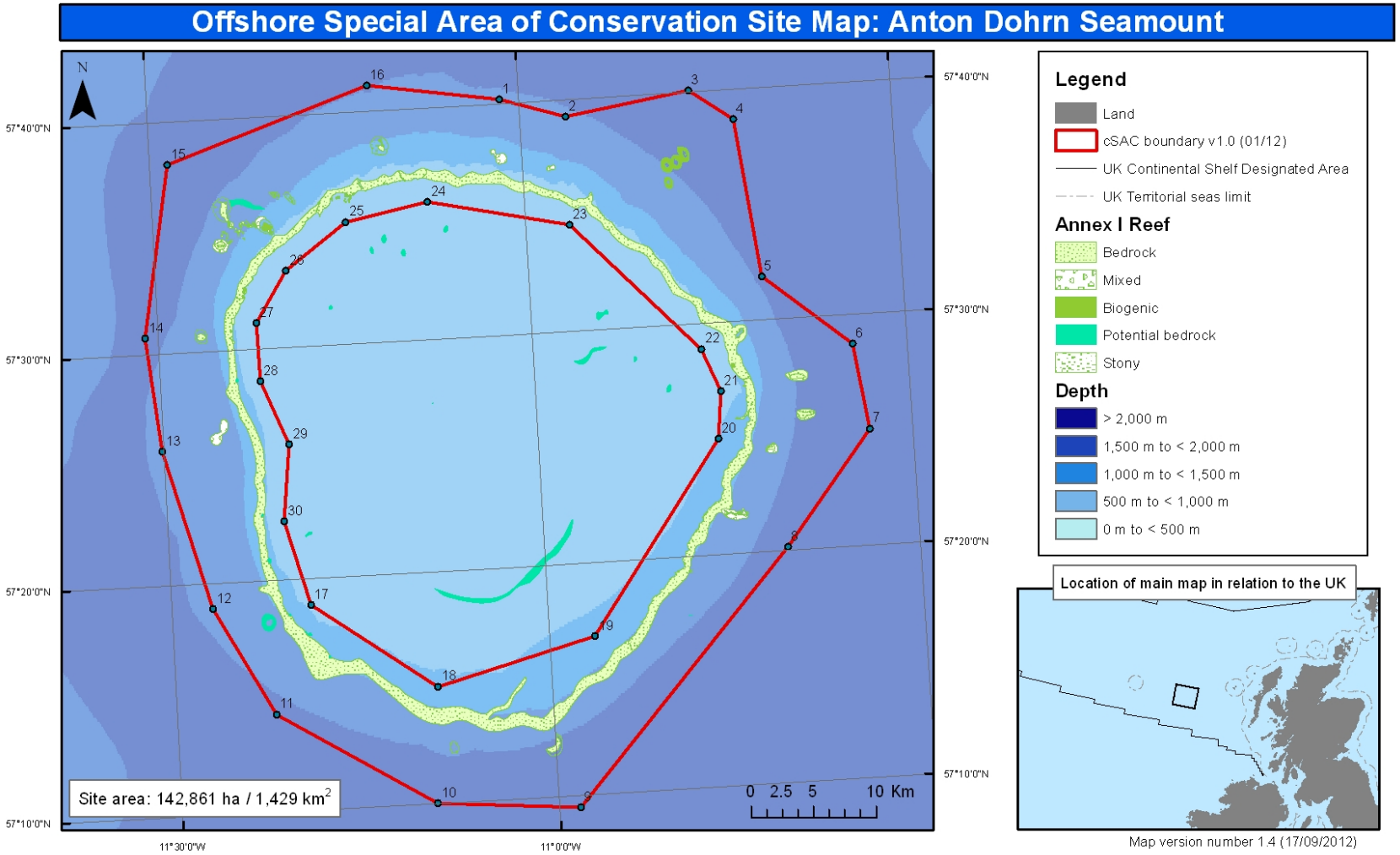
Site Name SAC: Selection Assessment Document

1. Site name Anton Dohrn Seamount	**2. Site centre location** 57º12'52″, -11º01'23″ (Datum: WGS 1984) Centroid restricted to within site boundary.
3. Site surface area 142,861 ha/1,429 km^2 (Datum: WGS 1984 UTM Zone 29 North, calculated in ArcGIS)	**4. Biogeographic region** Atlantic

5. Interest features under the EU Habitats Directive

1170 Reefs

6. Map of site



Map version number 1.4 (17/09/2012)

Boundary co-ordinates: *Outer boundary:*1) 57º40'11″, -11º-1'-34″, 2) 57º39'18″, -10º-56'-19″, 3) 57º40'6″, -10º-46'-19″, 4) 57º38'45″, -10º-42'-50″, 5) 57º31'52″, -10º-41'-21″, 6) 57º28'45″, -10º-34'-25″, 7) 57º25'2″, -10º-33'-28″, 8) 57º20'10″, -10º-40'-37″, 9) 57º9'29″, -10º-58'-20″, 10) 57º10'2″, -11º-9'-41″, 11) 57º14'15″, -11º-22'-7″, 12) 57º18'56″, -11º-26'-45″, 13) 57º25'49″, -11º-30'-10″, 14) 57º30'44″, -11º-31'-3″, 15) 57º38'10″, -11º-28'-34″, 16) 57º41'8″, -11º-12'-10″. *Inner boundary:*17) 57º18'52″, -11º-18'-56″, 18) 57º15'4″, -11º-9'-9″, 19) 57º16'51″, -10º-56'-24″, 20) 57º25'1″, -10º-45'-37″, 21) 57º27'3″, -10º-45'-12″, 22) 57º28'55″, -10º-46'-32″, 23) 57º34'37″, -10º-56'-30″, 24) 57º35'58″, -11º-7'-48″, 25) 57º35'18″, -11º-14'-29″, 26) 57º33'21″, -11º-19'-29″, 27) 57º31'9″, -11º-22'-7″, 28) 57º28'38″, -11º-22'-1″, 29) 57º25'51″, -11º-19'-59″, 30) 57º22'32″, -11º-20'-42″.

Site map projected in WGS 84 (Zone 28N). NOT TO BE USED FOR NAVIGATION. Seabed habitat data derived from BGS 1:250,000 seabed sediment maps . The exact limits of the UK Continental Shelf are set out in orders made under section 1(7) of the Continental Shelf Act 1964 (© Crown Copyright). World Vector Shoreline © US Defense Mapping Agency. Bathymetry © British Crown Copyright. All rights reserved. Permission Number Defra012012.001. This product has been derived in part from material obtained from the UK Hydrographic Office with the permission of the Controller of Her Majesty's Stationery Office and UK Hydrographic Office (www.ukho.gov.uk). Map copyright JNCC 2012. DB

7. Site summary

Anton Dohrn Seamount is located to the west of Scotland, about 200km from the Outer Hebrides in the central Rockall Trough. The seamount is a former volcano, roughly circular in shape. The top is fairly uniform in depth (at 1100m) and is interspersed with features extending to a maximum height of around 530m below sea level. The top is surrounded by steep (20 - 50^{o}) cliff slopes extending down towards a moat at ~2400m water depth. It is approximately 1800m high from the deepest point of the moat to the crest of the feature, and about 40km in diameter (Long *et al,* 2010). Geologically, the feature developed on highly stretched and thinned continental crust and is partially buried by Palaeocene and other younger Cenozoic sediments on the lower slopes. The majority of Anton Dohrn Seamount is composed of basaltic lavas which form outcrops at the seabed, on the crest and steep flanks of the seamount. One area of exposed basalt outcrop forms a central pinnacle that marks the shallowest point of the seamount at a depth of ~530m (Long *et al,* 2010, Howell *et al,* 2010). On the lower flanks, parasitic cones occur that were formed when volcanic material erupted from lateral fractures rather than the central vent (Long *et al,* 2010).

The site is proposed for its Annex I reef, consisting of bedrock, biogenic and stony reef. The upper regions of the seamount flanks are bedrock reef grading to stony reef on the lower flanks. These habitats support assemblages of holothurians (sea cucumbers), ophiuroids (brittlestars), caryophyllid cup corals and encrusting and lamellate sponges. At the base of the seamount flanks, bedrock and stony reef outcrop on ridges, extending radially from the centre of the seamount, and on parasitic cones. Both these features support dense aggregations of gorgonians (sea whips or sea fans) and other corals. JNCC have commissioned a contract to improve the definition of the OSPAR habitat 'coral gardens' (OSPAR, 2010) and apply the definition to infer the location of coral garden habitat in UK waters. The results support the presence of coral gardens on the parasitic cones and flanks of Anton Dohrn seamount within the cSAC boundary (Henry & Roberts, in prep). A rockfall-landslide reef feature is also apparent on the north-west seamount flank.

Biogenic reef, in the form of live cold-water coral reef (*Lophelia pertusa*), occurs on the top of small mounds which are located along the edge of the cliff. Sediment in-filled dead *L. pertusa* frameworks are situated on the radial ridges, parasitic cones and the rockfall-landslide feature. The dead coral frameworks also represent the Annex I reef sub-type, biogenic reef. These frameworks were probably produced during the growth stages of *L. pertusa* (Wilson, 1979) and support a rich assemblage of associated fauna. Corals associated with the live and dead *L. pertusa* biogenic reef include *Madrepora oculata*, antipatharians and gorgonians. Also found were a squat lobster (*Munida* sp.) and the pencil urchin, *Cidaris cidaris*.

Anton Dohrn is located within the Rockall Trough and Bank Regional Sea (JNCC, 2004; Defra, 2004). Within this Regional Sea three other areas are SACs with Annex I reef as a qualifying feature. These are noted below with their characteristic features.

SAC	Notable characteristics of Reef interest feature
Darwin Mounds cSAC/SCI	Cold water coral reefs composed principally of the scleractinian coral, *L. pertusa* growing on (hundreds of) cone-shaped sandy mounds at a depth of approximately 1000m. The site covers an area of around 100 km². There are two main 'dense' fields referred to as Darwin Mounds East and Darwin Mounds West. The corals provide a habitat for various species of larger invertebrates such as sponges and brisingiids. The mounds support significant populations of the xenophyophore, *Syringammina fragilissima*

North West Rockall Bank cSAC/SCI	Iceberg ploughmarks containing cobbles and boulders provide stony reef habitat. Associated biological communities include *Reteporella* sp.*, Caryophyllia* sp.*,* serpulid worms and a large variety of sponge species. Interspersed with the stony reef, biogenic reef occurs as *L. pertusa* reef. Associated species include erect sponges, *C. cidaris* and stands of *M. oculata*. Cobble rubble surrounds the living reefs in many places, and supports fauna such as the squat lobster, *Munida rugosa*, the holothurian, *Stichopus tremulus*, ophiuroids and encrusting yellow sponges.
East Rockall Bank cSAC	Bedrock, stony and cold water coral biogenic reef in the deep circalittoral to bathyal zone. Bedrock and stony reef supports assemblages of stylasterid lace corals and lobose sponges. Parasitic cones in the north of the site support sediment in-filled dead *L. pertusa* framework and live cold water coral reef, with antipatharians and gorgonians. Two canyon features cut into the flanks of the site and these are characterised by xenophyophores and decapod shrimps, with one canyon also supporting an abundance of caryophyllid corals and sea pens.

Three of the sites represent different types of Annex I reef; the Darwin Mounds supports biogenic reef, NW Rockall Bank supports both *L. pertusa* biogenic reef and stony reef, and Anton Dohrn represents a seamount with biogenic, bedrock and stony reef. East Rockall Bank also supports a mixture of bedrock, stony and biogenic reef. Biogenic reefs have not been widely observed in the UK deep-sea environment, although limited survey of these regions has been undertaken (Long *et al,* 2010). Recommendation of all these sites within the same Regional Sea is justified partly because of the differences between the reef types at each site (structure and associated communities) to ensure the variation of types is represented in the network of SACs, and partly to ensure sufficient proportion of the total UK resource of reef is included within the UK SAC network (JNCC, 2009). The UK location of reef, including *Lophelia* and deep circalittoral reef types, is concentrated in waters to the west and north of Scotland, hence the greater number of sites recommended for these reef types in Scottish waters compared to the rest of UK waters.

Within adjacent regional seas nine other areas have been proposed or are being considered for their Annex I reef. These are shown below with its characteristic features.

SAC	**Notable characteristics of the reef interest feature**
Sanday SAC (Scottish Continental Shelf Regional Sea)	Bedrock reef of low topographic complexity in intertidal and subtidal waters with moderate energy levels. The reefs are in full salinity waters, and are subject to strong coastal influence. Dense forests of kelp *Laminaria* spp (to 20m depth) provide a habitat for species-rich, red algal turf communities. Sponges (e.g.*Clathrina coriacea*) and ascidians (e.g. *Aplidium punctum*) occur on the vertical rock faces. The tide-swept north coast supports a rich fauna of dense bryozoan/hydroid turf and dense brittlestar and horse mussel (*Modiolus modiolus)* beds in mixed sediment below the kelp zone.
Papa Stour SAC (Scottish Continental Shelf Regional Sea)	Very exposed bedrock and stony reefs of high topographic complexity (intertidal, infralittoral and circalittoral) reaching depths of more than 30m. The reefs are in full salinity waters, and are subject to moderate coastal influence. Extensive kelp forests extend to depths of up to 28m. Circalittoral communities are dominated by the soft coral *Alcyonium digitatum*, the featherstar *Antedon bifida*, encrusting coralline algae and the serpulid worm *Pomatoceros,* with turfs of the jewel anemone *Corynactis viridis*, ascidians and bryozoans. Scour-tolerant organisms such as the hydroid *Abietinaria abietina* and the

	brittlestar *Ophiocomina nigra* are also present.
North Rona SAC (Scottish Continental Shelf Regional Sea)	Bedrock reef habitats of low and medium topographic complexity extending from the intertidal to the circalittoral. Support rich marine communities characteristic of very exposed, conditions (sponges, anemones, soft corals and ascidians). Kelp forests extend as deep as 35m. The reef is subject to full salinity and moderate coastal influences. The influence of the North Atlantic Drift is apparent in the presence of many southern species, but colder sub-arctic water accounts for the northern elements of the fauna and flora.
Sullom Voe SAC (Scottish Continental Shelf Regional Sea)	Bedrock, stony and biogenic reef (*Modiolus modiolus*) in intertidal to circalittoral waters. Present in full salinity waters, exposed to a strong coastal influence and low to high energy levels. Intertidal rocky reefs range from steep, moderately-exposed bedrock at the seaward limit of the site to gradually sloping, extremely-sheltered bedrock in the inner reaches of the voes. Sublittoral bedrock is dominated by forests of the kelp *Laminaria hyperborea*. Bedrock and boulders below the kelp forest are heavily grazed but coralline algae, the keel worm *Pomatoceros triqueter* and the soft coral *Alcyonium digitatum*, may be present. There is a well-established horse mussel, *Modiolus modiolus* reef throughout the channel.
St Kilda SAC (Scottish Continental Shelf Regional Sea)	Extremely wave-exposed bedrock reefs composed of hard, igneous rock, forming steep and vertical faces. These topographically complex reefs extend to depths of 50 m (encompassing the intertidal, infralittoral and circalittoral) and are subject to minimal coastal influence, full salinity waters and moderate to full energy levels. Dense kelp forests may occur as deep as 35 m due to water clarity. The reefs are dominated by diverse communities of anemones, sponges and soft corals, with different species of sponge, hydroid and bryozoan occurring in surge gullies and caves.
Stanton Banks cSAC/SCI (Scottish Continental Shelf Regional Sea)	Stanton Banks are a series of granite rises which outcrop from the seafloor south of the Outer Hebrides. Although rounded by glacial action, they remain deeply fissured and extremely rugged. The inter-connecting gullies are filled with rippled coarse shell sand. The tops of the banks are smooth and characteristically colonised by encrusting red algae and small encrusting sponges. On the slopes, where the rock is less smooth, crinoids (featherstars), dead man's fingers, *Alcyonium digitatum* and hydroid corals are abundant. At their edges, the banks are fringed with boulders and cobbles.
Solan Bank cSAC (Scottish Continental Shelf Regional Sea)	This site presents highly topographic bedrock and smooth, undulating bedrock reef outcrops and stony reef (comprising boulders and cobbles) in a range of depth zonations from the infralittoral to deep circalittoral and within a range of energy levels with a resulting broad range of ecological communities and faunal diversity. The reefs support encrusting bryozoans, encrusting coralline algae, caryophyllid cup corals and ophiuroids. Highly sediment-scoured bedrock is mainly colonised by the keel worm *Pomatoceros triqueter.* Less-scoured bedrock support a range of sponges, bryozoans and hydroids. In shallower areas with increased water movement there is an increasing abundance of the soft coral, *Alcyonium digitatum*, the cup coral, *Caryophyllia smithii* and the jewel anemone, *Corynactis viridis*, with red algae and kelp in the shallowest areas.
Wyville Thomson Ridge cSAC/SCI (in both Scottish	The Wyville Thomson Ridge is a rock ridge situated in the Atlantic Ocean at the northern end of the Rockall Trough. It is approximately 20km wide and 70km long and rises from over 1000m depth to less than 400m at the summit. The Ridge is composed of extensive areas

Continental Shelf Regional Sea and Faroe-Shetland Channel Regional Sea)	of stony reef interspersed with gravel areas and bedrock reef along the flanks. The rock and stony reef areas support diverse biological communities, representative of hard substratum in deep water, including a range of sponges; stylasterid, cup and soft corals; brachiopods; cyclostome bryozoans; dense beds of crinoids and ophiuroids; echinoids (sea urchins), holothurians and pycnogonids (sea spiders). Communities on the bedrock reef vary in species composition between the two sides of the ridge due to the influences of different water masses. This combination of water masses in one area is unique in UK waters.
Hatton Bank cSAC (Atlantic North West Approaches Regional Sea)	Hatton Bank is a large volcanic bank, situated in the Atlantic North-West Approaches, towards the western extent of the UK Continental Shelf. The vast size and topographic complexity of the Hatton Bank supports a wide diversity of biological communities, each associated with different geomorphological structures and substratum types. The bank supports extensive areas of bedrock reef (particularly on the ridges along the top of the bank) and stony reef. Also present are elaborate cold water coral reefs, frequently associated with topographically distinct features, including pinnacles and mounds tens of metres in height and hundreds of metres in width.

Note: cSAC = candidate SAC (site approved by Government)
SCI = Site of Community Importance adopted by the EC
See http://jncc.defra.gov.uk/page-4168 for flow diagram

As well as being in adjacent Regional Seas, all nine sites above support different sub-types of reef and have different characteristics, as well as contributing to the proportion of the UK reef resource included within the SAC network. Anton Dohrn reef is the only reef recommended as a SAC in UK waters occurring on a seamount, and spans a much deeper depth range at over 2000m to the base of the structure than other sites or possible sites. As such, many of the assemblages seen at this site have not been recorded previously in UK waters (Long *et al,* 2010).

8. Site boundary

The cSAC site boundary for Anton Dohrn Seamount has been defined using JNCC's marine SAC boundary definition guidelines (JNCC, 2012). The proposed boundary is a relatively simple polygon enclosing the minimum area necessary to ensure protection of the Annex I habitat.

The SAC boundary has been drawn in a ring shape that incorporates the Annex I habitats on the cliff edge, seamount flanks, radial ridges and parasitic cones. It excludes the central summit of the seamount, which comprises mostly sands and gravels, in order to reduce the area of 'non-interest-feature' included within the site boundary (JNCC, 2012). Features of the habitat map that have been defined as 'potential bedrock reef' are delineated from British Geological Survey seabed map data. These indicate where Annex I habitat may be present, but where the resolution is too coarse to accurately define these with any certainty, due to low sampling density. These features have therefore been excluded from the site boundary, except where they are located in close proximity to Annex I features associated with higher confidence levels.

As any bottom trawling that occurs in the area may pose a threat to the reef, the cSAC boundary includes a margin to allow for mobile gear on the seabed being at some distance from the location of a vessel at the sea surface (JNCC, 2012). The Annex I features at the foot of the seamount slope are situated at a maximum of 2000m water depth. Assuming a

ratio of 2:1 fishing warp length to depth on the continental shelf, the outer extent of the boundary is defined to include a margin of approximately 4000m from the reef feature. The Annex I features at the summit edge are located at approximately 1000m water depth. The inner extent of the boundary therefore includes a margin of approximately 2000m from the reef feature.

Vessel Monitoring System (VMS) data indicates that the seamount is fished regularly using bottom trawls (ICES, 2011a). Multibeam echosounder and seabed imagery data collected during the JNCC 2009 survey of Anton Dohrn Seamount (Stewart *et al,* 2009) was analysed during the International Council for the Exploration of the Sea (ICES) Working Group on Deep-water Ecology (WGDEC) meeting in May 2011, to define the presence of Vulnerable Marine Ecosystems. Subsequent ICES advice to the European Commission and to the North-East Atlantic Fisheries Commission (NEAFC), based on the work of this meeting, was that a fisheries closure on the flanks of the seamount should be implemented to protect *L. pertusa* biogenic reef and the OSPAR habitat, "coral gardens" on the flanks, parasitic cones and mound features of Anton Dohrn Seamount (ICES, 2011b). The proposed fisheries closure boundary traces the inner extent of the cSAC boundary, but has a narrower outer extent (Appendix I). This is due to the inclusion of a narrower fishing warp length to depth margin which extends from the base of the seamount slope at 1500m water depth. However, some Annex I features occur out to 2000m water depth, and the cSAC boundary is therefore wider to account for these features, following JNCC's marine SAC boundary definition guidelines (JNCC, 2012).

Note that the boundary is for the SAC. Any future management measures that may be required under the Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended) will be determined by Competent Authorities in consultation with JNCC, and may have different boundaries to the SAC site boundary.

9. Assessment of interest feature against selection criteria

9.1. Reefs – Annex III selection criteria (Stage 1A)

a) Representativity

Anton Dohrn Seamount is located in the Rockall Trough and Bank Regional Sea and represents hard bedrock reef of low topographic-complexity, stony reef, and biogenic *L. pertusa* reef in the deep circalittoral to bathyal zone. The site is located in full salinity waters, with minimal/no coastal influence and moderate energy levels.

Bedrock reef on parasitic cones and radial ridges supports relatively dense aggregations of gorgonians, antipatharians, *L. pertusa* and soft corals, representative of the deep water environment. No other recorded examples of this 'coral garden' habitat have been observed in the UK deep-sea (Long *et al,* 2010). Bedrock reef on the rockfall-landslide feature supports different assemblages, characterised by encrusting and massive lobose sponges, small colonies of *L. pertusa*, antipatharians and crinoids. This difference is likely to be a result of the depth and slope of the feature. Other regions of bedrock reef on the upper flanks support the holothurian, *Psolus sp.*, caryophyllid corals and lamellate sponges. Stony reef supports similar communities to neighbouring bedrock reef, with the two reef types being fairly well interdispersed on the flanks of the seamount. The species are representative of the depth of the site (Long *et al,* 2010). Biogenic reef is formed by live *L. pertusa* reef and sediment in-filled dead *L. pertusa* frameworks. Associated species include antipatharian, gorgonian, scleractinian and soft corals. These reefs are very different in

composition to anything else recorded from the UK deep-sea, and represent the deep (>1000m) location of the site (Long *et al, 2010)*.

Anton Dohrn Seamount is representative of a seamount reef habitat. Whilst recent studies suggest that seamounts are no more species-rich or diverse than other submarine topographic highs, and show similar species composition to nearby continental margin habitats (Howell *et al,* 2010), they do provide habitat heterogeneity. Anton Dohrn Seamount represents an excellent example of reef habitat, supporting a diverse range of associated species.

No severe damage from fishing activity is apparent from seabed imagery collected on Anton Dohrn Seamount, and the live biogenic reef was seen to be intact in most areas.

The grade for this site is therefore A: excellent representativity.

b) Area of habitat

The reef feature is approximately 12,845ha (128km^2) in area (flat mapped extent). This has been estimated from a review of multibeam data, sidescan sonar data and seabed imagery. The data was interpreted and the reef extent was mapped accordingly.

An estimate of the entire Annex I reef resource (bedrock, stony and biogenic reef) in UK waters is 7,180,000 hectares (JNCC P14a, 2008). This total extent figure gives the following thresholds for the grades of this criterion (CEC, 2011):

A – extents between 7,180,000 and 1,077,000 ha (15-100% of total resource)
B – extents between 1,077,000 and 143,600 ha (2-15% of total resource)
C – extents less than 143,600 ha (0-2% of total resource)

This site's feature therefore falls within the 0-2% bracket for Area of Habitat and is graded C.

c) Conservation of structure and functions

Degree of conservation of structure

Seamounts are commonly the focus of intensive commercial fisheries worldwide and trawling activity is particularly damaging to the slow-growing coral and sponge reef communities which occur on these structures (Schlacher *et al,* 2010), even with just a small number of tows (Clark and Tittensor, 2010). VMS data indicates that fishing occurs over the seamount, the majority of which is focused on the softer substrate on the summit. Fishing activity is also evident from video imagery collected on the JNCC survey, which revealed discarded fishing gear at two locations on the south eastern side of the seamount. In addition, faint lineations on the top of the seamount were detected from multibeam echosounder backscatter data collected on the same survey, which have been interpreted as trawl marks (Long *et al,* 2010). The majority of these were located at the cliff edge. Fish species of commercial interest were observed at various locations of the seamount (orange roughy and roundnose grenadier).

Commonly bottom trawling is focused on the summit of seamounts in order to land and stabilise trawl gear (Clark and Tittensor, 2010). Seabed imagery collected during the JNCC survey does not demonstrate any obvious signs of trawl damage to the Annex I reef features at Anton Dohrn Seamount. It is likely that the reef habitat has not been significantly damaged due to the location of the biogenic reef habitat on mounds on the cliff edge and parasitic cones at the base of the seamount flanks, which are out of the most-widely trawled regions.

Gill netting and long-lining both impact negatively on fragile coral reef. From the VMS data and from pictures of discarded gear (Appendix II, plate 4) it appears that they are conducted within the site but it is not possible to determine the level of effort.

The area is currently not exploited for oil and gas, so no pipelines or installations occur at the site.

Assuming no further damage has occurred to the features, the grading is II: structure well conserved.

Degree of conservation of functions

The prospects for the reefs to maintain their structure in the future, taking into account unfavourable influences and reasonable conservation effort, are good. A mechanism is available through the European Commission's Common Fisheries Policy regulations to modify fishing activity in the area if this is deemed to be necessary and ICES have advised the European Commission and NEAFC to close the flanks of Anton Dohrn Seamount to all fishing.

In addition, regulations are in place to manage oil and gas industry activity in and around SACs in the UK Continental Shelf Designated Area, and the laying of submarine cables and pipelines also requires regulatory consent. The site is distant from terrestrial sources of pollution.

The grading is II: good prospects.

Restoration possibilities

Restoration methods in the offshore area focus on the removal of impacts which should allow recovery where the habitat has not been removed. The majority of the Annex I reef at Anton Dohrn Seamount is bedrock and stony reef. Restoration of the biological communities of these reef sub-types would be possible if activities causing damage were removed and it is likely that a similar community to that present now would develop.

Individual *Lophelia pertusa* colonies can develop over tens of years (Bell and Smith, 1999; Roberts, 2002), however substantial biogenic reef structures have been found to be thousands of years old (Friewald *et al*, 2004) and are particularly sensitive to physical damage, especially if the hard substrata on which they grow are also removed or subject to sediment deposition (Shelton, 1980; Mortensen, 2001). Recent research suggests that stony (scleractinian) corals do not recover from trawling impact quickly, with one study showing no signs of recovery on trawled seamounts after 5 and 10 years (Williams *et al,* 2010). It is therefore likely that the *L. pertusa* biogenic reef at Anton Dohrn Seamount would also recover but at a much slower rate, if damaged.

The biogenic reef is considered the most sensitive biotope to trawling impact within this site. Due to the slow nature of its recovery, the grading is III: restoration difficult or impossible.

Overall grade

Due to the first sub-criterion of this criterion being graded II: structure well conserved and the second sub-criterion being graded II: good prospects, the overall grading is B: good conservation, regardless of the other sub-criteria.

d) Global assessment

The suggested grades for Stage 1A criteria a) - c) are A, C and B. Given these evaluations, and taking into account the rarity of this habitat in UK waters, the Global Assessment grade is B ('good conservation value').

Summary of scores for Stage 1a criteria

Habitat type	Representativity	Area of habitat	Structure and function	Global assessment
Anton Dohrn Seamount	A	C	B	B

9.2. Harbour porpoise (*Phocoena phocena)* - Annex III selection criteria (Stage 1B)

a) Size and density of the population of the species present on the site

Harbour porpoise (*Phocoena phocoena*) is found throughout the majority of UK continental shelf waters, with very few sightings off the continental shelf area (Reid *et al*., 2003; SCANS II, 2008). There are no records of the species within the cSAC boundaries of Anton Dohrn (Evans *et al*, 2003; Reid *et al,* 2003, CODA, 2009) and therefore the species is not considered a feature of the site. However, there have been some sightings to the east, outside of the site and as they are highly mobile, the assessment may change if new data become available.

9.3. Bottlenose dolphin (*Tursiops truncatus*) - Annex III selection criteria (Stage 1B)

a) Size and density of the population of the species present on the site

This species is found in many parts of UK waters, on the continental shelf and further offshore (Evans *et al,* 2003; Reid *et al,* 2003; SCANS II, 2008). There are no records of bottlenose dolphin occurrences within the cSAC (Reid *et al,* 2003; CODA, 2009) therefore the species is not considered a feature of the site. However, dolphin click trains (potentially bottlenose dolphins) have been recorded in the vicinity of the site (CODA, 2009). Consequently, this assessment may change if new data becomes available.

9.4. Grey seals (*Halichoerus grypus*) - Annex III selection criteria (Stage 1B)

a) Size and density of the population of the species present on the site

There are no records of grey seal occurrences within the cSAC boundary and therefore the species is not considered a feature of the site. This assessment may be revised at a later date depending on the outcome of data analyses to be commissioned by JNCC that will enable a more detailed assessment of the importance of areas for seals at sea.

9.5. Harbour (common) seals (*Phoca vitulina*) - Annex III selection criteria (Stage 1B)

a) Size and density of the population of the species present on the site

There are no records of harbour seal occurrences within the cSAC boundary and therefore the species is not considered a feature of the site. This assessment may be revised at a later date depending on the outcome of data analyses to be commissioned by JNCC that will enable a more detailed assessment of the importance of areas for seals at sea.

10. Sites to which this site is related

None

11. Supporting scientific documentation

Data to support this offshore SAC recommendation was collected in 2005 during the Department of Trade and Industry (DTI) (now DECC) Strategic Environmental Assessment (SEA7) survey of Rockall, Hatton and George Bligh Banks and Anton Dohrn Seamount (Narayanaswamy *et al,* 2006) and during a JNCC commissioned survey in 2009 aboard the *M/V Franklin* (Stewart *et al,* 2009).

The SEA7 survey was conducted on the *SV Kommander Jack* and collected full coverage multibeam echo-sounder and backscatter data over the seamount, as well as a corridor of deep-towed sidescan sonar (Jacobs*,* 2006). Seabed imagery was also collected using a drop camera system and a camera sledge system to collect both videos and stills. The JNCC survey undertook high-resolution multibeam echo-sounder and backscatter data collection over two areas on the north west and south east flanks of the seamount to refine the detail of data collected on the SEA7 survey. Due to the extensive depth of the site, no sidescan sonar was collected. Additional video and stills were collected at 27 stations using a drop frame camera system in order to groundtruth the acoustic data.

The multibeam echosounder bathymetric and backscatter data were used to understand the geomorphology of the seamount and create a broadscale habitat map. Seabed imagery data was analysed and classified into biotopes and these were overlain onto the broadscale habitat map to show the distribution of biotopes. The video and stills data was also used to establish areas of Annex I habitat which were mapped accordingly. Where groundtruth data was not available, extrapolation of acoustic data and analysis of slope was undertaken to map additional Annex I habitat and biotopes. Therefore, the ‘Map of Site’, in section 6 is a combination of observed and predicted reef extent relating to whether seabed imagery was used to determine the habitat (observed) or whether it has been based on the acoustic data and extrapolation from nearby polygons (predicted). In addition, these layers have been assigned a confidence score based on the underlying data. This confidence level was determined by whether high- or low- resolution MBES was available and whether this was used in combination with groundtruth data. 'Potential' reef is that habitat based purely on MBES mapped data, with no groundtruth data.

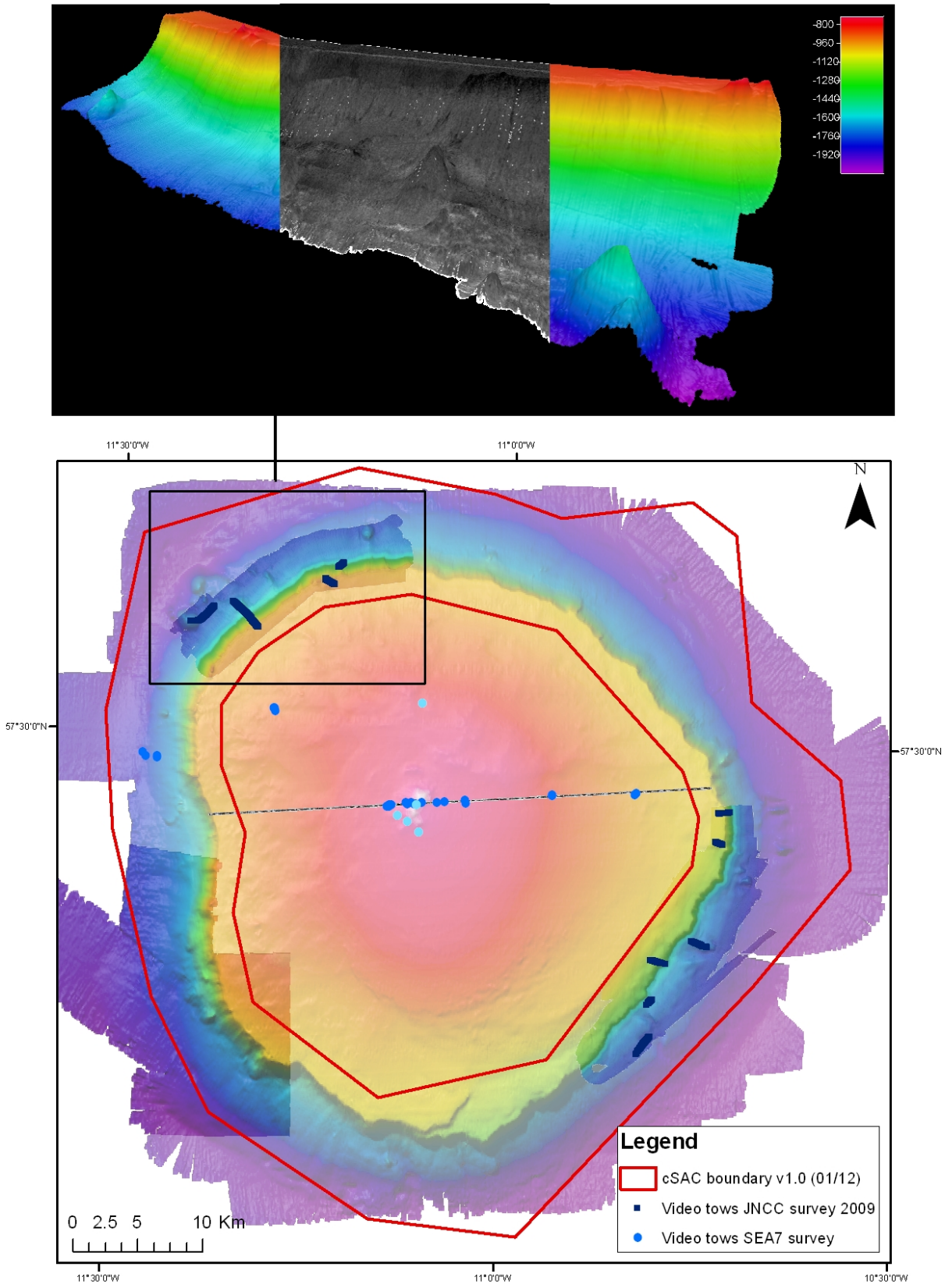


Figure 1. Survey data gathered at Anton Dohrn Seamount. Top image shows 3D multibeam bathymetry and backscatter across the NW region. Bottom image shows full coverage multibeam bathymetry data gathered during the SEA7 survey alongside a single corridor of sidescan sonar across the summit. Higher resolution multibeam bathymetry data was collected on the NW and SE areas during the 2009 JNCC commissioned survey.

12. Site overview and conservation interest

Anton Dohrn Seamount is a former volcano, active 70- 40 million years ago, located to the west of Scotland in the Rockall Trough (Long *et al,* 2010). The seamount comprises a relatively flat summit, surrounded by a steep cliff extending down to a moat at approximately 2400m depth. The central Rockall Trough lies on highly stretched and thinned continental crust and the bulk of Anton Dohrn probably comprises basaltic lavas (Jones *et al,* 1994). The lower slopes are partially covered by Palaeocene and younger Cenozoic sediments (Long *et al,* 2010). The site contains bedrock, stony and biogenic sub-types of Annex I reef which support a diverse range of associated species.

The shallowest point of the seamount lies at approximately 530m water depth towards the centre of the summit. Here, basaltic lava rock outcrops support a sparse epifauna of brachiopods and large barnacles (Narayanaswamy *et al,* 2006). Seabed imagery collected on the SEA7 survey revealed the area surrounding the summit to be composed mainly of sandy gravel and gravelly sand, supporting brachiopods, *C. cidaris* and *S. tremulus,* with assemblages of white encrusting sponges and serpulids on sandy gravel substrate towards the edge of the summit (Narayanaswamy *et al,* 2006).

At the summit edge, pebbles and cobbles are commonplace along with a number of small mound features which could be identified from multibeam bathymetry data collected on the JNCC 2009 survey (Stewart *et al,* 2009). Camera tows over two of these mound features revealed them to be composed of biogenic reef, supporting *L. pertusa*, antipatharian and gorgonian corals, anemones, echinoids, decapods and the fish species, Rattail (*Grenadier* sp.), North Atlantic codling *(Lepidion eques)* and false boarfish (*Neocytis helgi*) (Stewart *et al,* 2009). Between mounds, reef made up of dead *L. pertusa* framework and live *M. oculata* is present, with diverse associated fauna including coralliomorph anemones, *C. cidaris,* sponges and fish species.

At the break of slope the substrate changes to boulder habitat, representing stony reef, and descending the flanks this becomes interspersed with outcrops of bedrock, representative of bedrock reef. Stills and videos from the JNCC 2009 survey (Stewart *et al,* 2010) reveal these areas support assemblages of the holothurian, *Psolus* sp*.,* ophiuriod species, encrusting sponges, caryophyllid corals and lamellate and lobose sponges, as well as small colonies of *L. pertusa,* antipatharian corals including *Leiopathes* sp. and *Stichopathes* sp., stylasterids, gorgonians, crinoids, sponges and the fish species, *Coryphaenoides rupestris* (roundnose grenadier) and *Hoplostethus atlanticus* (orange roughy). Towards the bottom of the flanks, stony reef predominates, supporting similar assemblages to the flanks, and this grades to finer gravels, sands and mud at the base of the flanks supporting a high density of xenophyophores. In addition at the base of the flanks, coralliomorphs, caryophyllids and decapod shrimps occur in shallower regions. In deeper regions species vary dependent on location around the seamount. Caryophyllid corals and sea pens (*Pennatula phosphorea)* occur on the north western side, and *Ophiomusium lymani,* stalked crinoids, holothurians and caryophyllid corals occur on the south eastern side where increased current flow supplies a food source for these deposit and suspension-feeders (Long *et al,* 2010).

In addition to bedrock outcrops on the flanks, ridges up to 100m in height extend radially from the centre of the seamount and are composed of bedrock and coarse substrate. At the base of the seamount flanks a number of conical features have formed, known as parasitic cones (Stewart *et al,* 2010). These features form when volcanic material erupts from lateral fractures rather than the central vent of the volcano (Long *et al,* 2010). The largest of these cones is ~400m high and ~1300m in diameter.

Both the radial ridges and parasitic cones are composed of bedrock and stony reef supporting dense aggregations of gorgonians and corals such as *L. pertusa* and bamboo

coral, as well as antipatharians, crinoids, sponges and the fish species, the rattails, *Coryphenoides gunteri* and *Coryphaenoides rupestris* (Roundnose grenadier), juvenile *Hoplostethus atlanticus* (orange roughy) and *Neocitis helgi* (false boarfish). Biogenic reef is present here, comprised of sediment in-filled dead *L. pertusa* frameworks. This framework is probably formed during the growth stages of *L. pertusa* coral. Wilson (1979) suggested *Lophelia* colonies grow laterally and are dependent on suitable hard substrates for attachment. As the colony grows, the living tissues withdraw from the lower parts of the colony and these are often attacked by boring sponges such as *Cliona* sp. As the lower structures weaken, they eventually collapse onto the surrounding sediments and those parts in contact with the sediment die-off, whilst the upper parts continue to grow and re-colonise the dead debris. Small portions of the colony may also break off through natural processes and can become cemented to the structure, providing substrate for lateral growth or for settlement of planulae for new colonies. Thickets form from the growth of satellite colonies around the original colony with dead debris providing a suitable structure for further growth of *Lophelia* colonies (Wilson, 1979). The dead *L. pertusa* frameworks at Anton Dohrn Seamount may therefore provide an important structure for further growth of live cold water coral and also provide habitat for a diverse range of associated fauna such as *M. oculata* corals, antipatharians, gorgonians, *Munida* sp. and *C. cidaris*.

Coral rubble, potentially formed from natural *L. pertusa* die-off and breakages, occurs in depressions in the radial ridges and along the sides of the parasitic cones. The local oceanography is perhaps an additional source of damage for the coral. Anton Dohrn seamount is located within the Rockall Trough where three active water masses combine to produce current velocities (0.3 – 1.0 m/s), strong enough to mobilise sediments in deep waters (>1000m) (Long *et al*, 2010). It has been observed that even slight turbulence, such as that caused by the advance of a submersible, can affect the collapse of a colony (Wilson, 1979). The rubble is dominated by encrusting sponges, glass sponges, the soft coral *Anthomastus* sp.*,* ophiuroids, brisingids asteroids and echinoids (Stewart *et al,* 2010).

On the north west flank of the seamount, an area of uneven topography was identified during the JNCC 2009 survey (Stewart *et al,* 2010), linked to a gully on the cliff wall. This has been interpreted as a submarine landslide or rockfall (Long *et al,* 2010), and represents bedrock reef with characteristic species including encrusting and lobose sponges, caryophyllid corals, small colonies of *L. pertusa*, antipatharians, gorgonians and crinoids, and biogenic reef formed from dead *L. pertusa* frameworks.

Eleven biotopes were identified at Anton Dohrn Seamount, and are shown in Table 1. Seven of these biotopes are previously undescribed, and new biotopes have therefore been proposed by Long *et al,* (2010) and have been submitted to JNCC for further investigation prior to updating the Marine Habitat Classification (Connor *et al*, 2004). Some of the proposed biotopes present correspond with the definition of Annex I reef.

Anton Dohrn Seamount is representative of a seamount reef habitat in deep (~530 - 2000m) waters. Recent research on seamounts has provided evidence that many seamount communities are vulnerable to fishing, and highly sensitive to bottom trawling disturbance, particularly coral communities (Clark and Tittensor, 2010; Williams *et al,* 2010). The importance of seamounts as a habitat is now widely recognised (Rogers, 1993, Clark, *et al.,* 2010, Clark *et al.* 2012). Seamounts are physically quite different to the surrounding flat abyssal plains (Hall-Spencer *et al*., 2007) and affect the physical structure of the water column surrounding them (Long *et al.* 2010) Seamounts have also been considered sites of high species abundance and biomass for suspension filter feeders such stony corals, gorgonian corals, black corals, sea anemones, sea pens, hydroids, sponges, sea squirts and crinoids (Rogers, 1994) particularly for filter feeders such as scleractinian corals (Rowden *et al*, 2010), and may be species rich due to the high variety of substrate types, topographical and environmental conditions which can produce a range of heterogenous meso- and micro-habitats (Rowden *et al,* 2010; O'Hara and Tittensor, 2010). While near-slope seamount

benthos has been found to be similar to that of neighbouring banks under the same environmental conditions (Howell *et al*., 2010), there are still highly diverse and have distinct fauna (notably Annex I reef) to that of the surrounding plains.

Anton Dohrn Seamount represents a variety of Annex I reef sub-types with a diverse range of associated species over a large depth range, some of which are very different in composition to anything else recorded from the UK deep-sea (Long *et al,* 2010).

Table 1. Summary of biotopes identified at Anton Dohrn Seamount from video and stills data analysis.

Biotope Name	Characterising species	Substrate	Supporting reference
Xenophyophores and ophiuroids on mixed substrate	Xenophyophores, ophiuroids and white encrusting sponges	Mixed	Newly proposed
Xenophyophores and sea pens on gravelly sand and mixed substrate	Xenophyophores, halcampids, anemones, cerianthids, ophiuroids and sea pens	Gravelly sand and mixed substrate	Newly proposed
Ophiomusium lymani and cerianthid anemones on mixed substrate	*Ophiomusium lymani*, white encrusting sponge and cerianthids.	Mixed	Newly proposed
Predominantly dead, low-lying coral framework	Dead *Lophelia pertusa*, halcampids, caryophyllids and ophiuroids and ascidians	Mixed *Annex I reef*	Howell *et al,* 2010
Colonies of *L. pertusa*, antipatharians and crinoids on bedrock and mixed substrate	Encrusting sponges, *L. pertusa*, antipatharians, crinoids and caryophyllids	Bedrock and mixed *Annex I reef*	Howell *et al,* 2010
Live biogenic coral reef	Dead and live *L. pertusa*, *M. oculata*, *C. cidaris*, anemones, *Munida* sp., Gorgonians and *Leiopathes* sp.	Bioherm *Annex I reef*	Howell *et al,* 2010
Gorgonian dominated 'coral garden'	Gorgonians, antipatharians, *L. pertusa* and soft corals	Mixed and bedrock *Annex I reef*	Newly proposed
L. pertusa, soft corals and sponges on mixed substrate	*L. pertusa*, lobose and glass sponges, soft corals and ophiuroids	Mixed *Annex I reef*	Newly proposed
Psolus, caryophyllids and lamellate sponges on mixed, boulder and bedrock substrate	*Psolus*, ophiuroids, encrusting sponges, caryophyllids and lamellate sponges.	Mixed cobbles and boulders and bedrock *Annex I reef*	Newly proposed
Serpulids, encrusting sponges and *Psolus* on mixed substrate	Serpulids, ophiuroids, encrusting sponges, *Psolus* and ascidians	Mixed	Newly proposed
Serpulids, encrusting sponges and *Cidaris* on mixed substrate	Serpulids, encrusting sponges and *C. cidaris*	Mixed	Howell *et al,* 2010

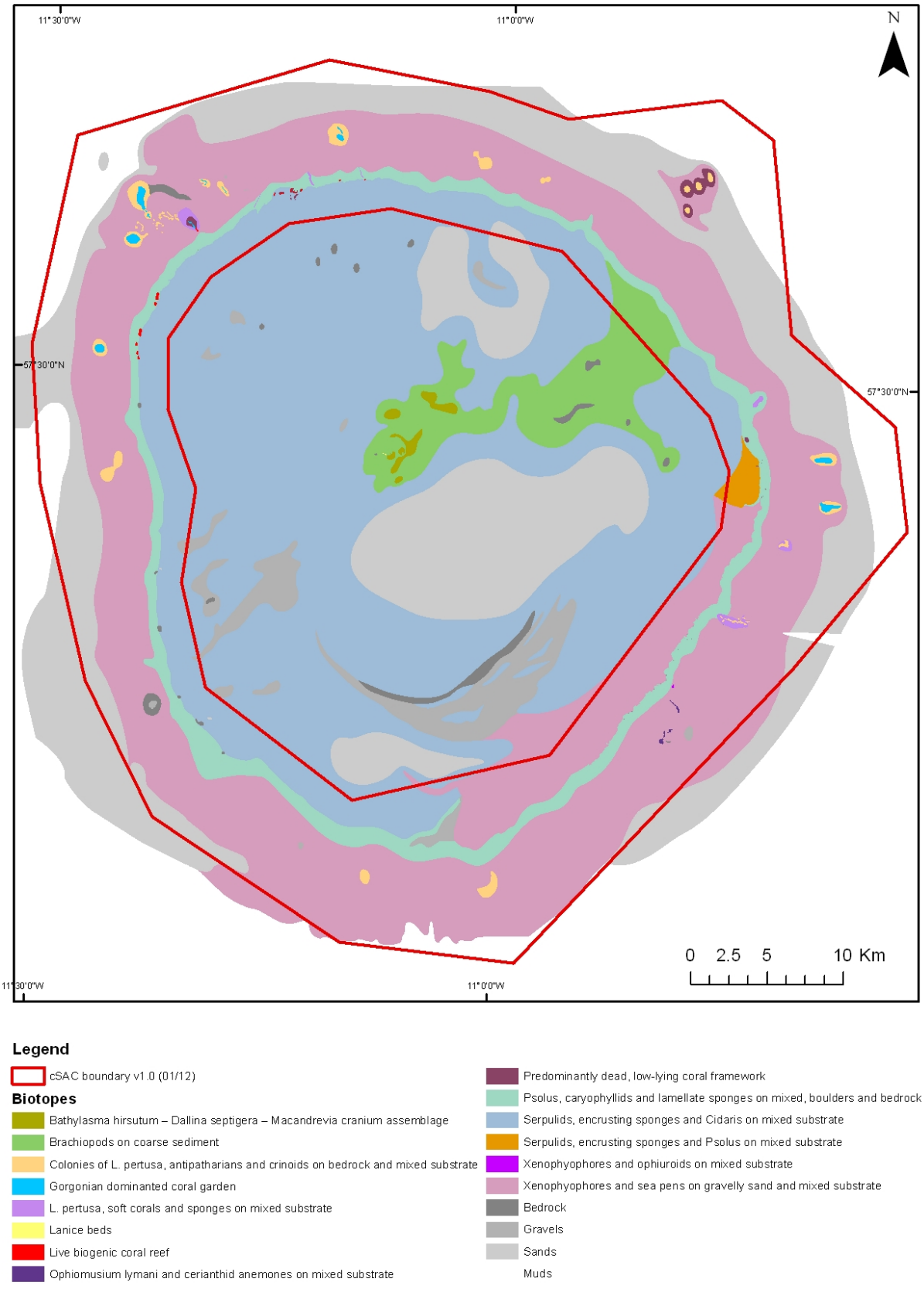


Figure 2. Biotope map illustrating the distribution of biotopes identified at Anton Dohrn, including seven newly-proposed biotopes. Map developed from imagery data from the JNCC 2009 and SEA 7 surveys and extrapolation of acoustic data (see Figure1)

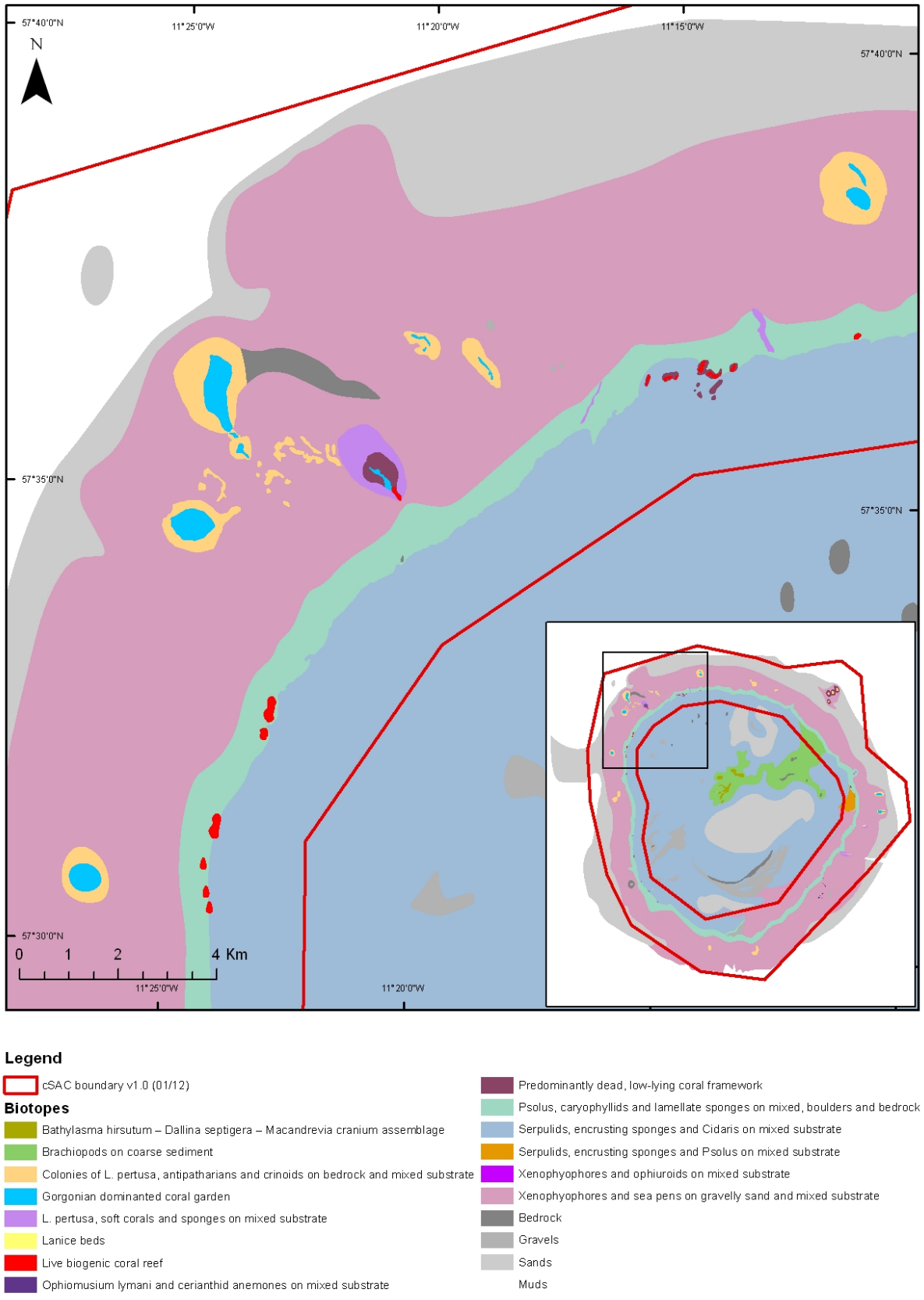


Figure 3. Close up section of biotope map illustrating the distribution of biotopes identified at Anton Dohrn, including seven newly-proposed biotopes

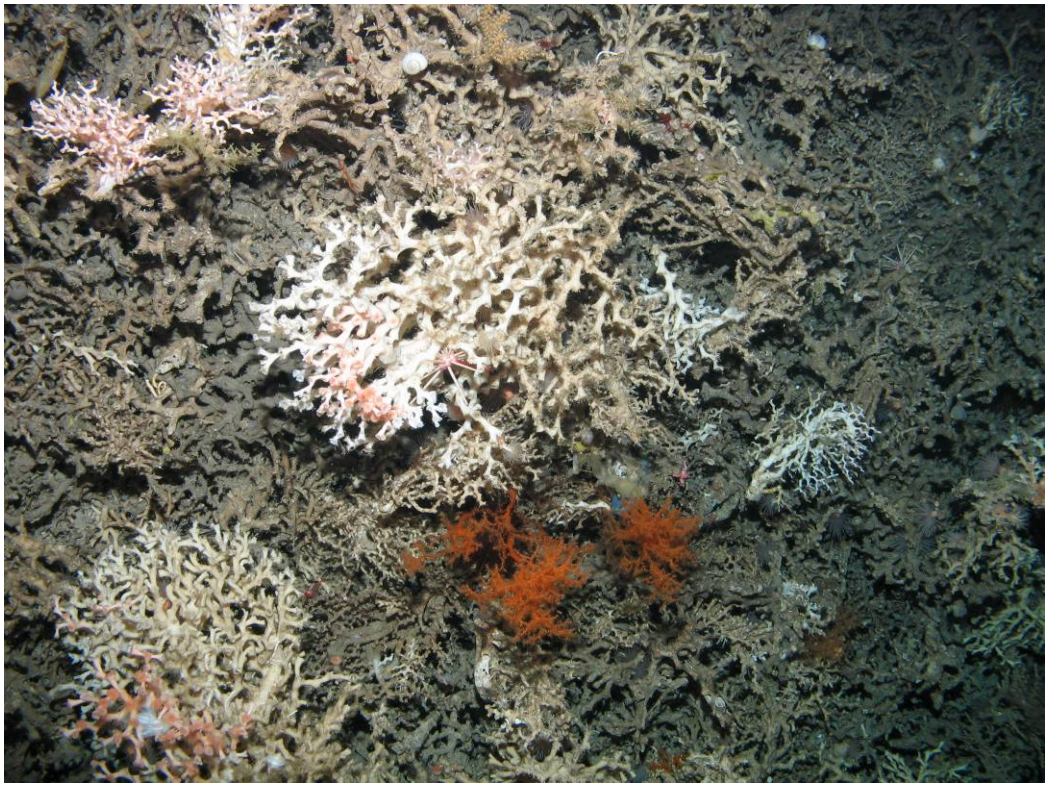


Plate 1. Dead sediment in-filled *L. pertusa* framework on a mound feature with live *L. pertusa* and *M. oculata* growing on the coral debris. Associated fauna includes *C. cidaris* and Actiniaria sp. (Station AD_DC_09, © JNCC).

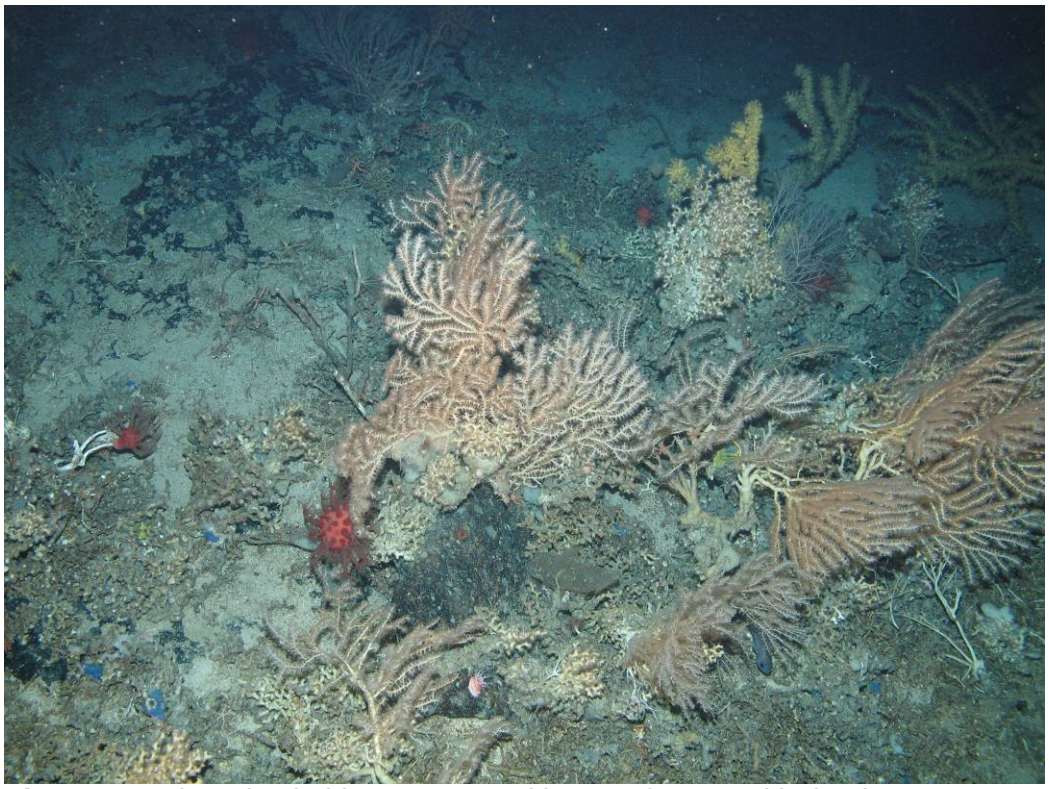


Plate 2. Coral garden habitat on a parasitic cone feature with dead *L. pertusa,* gorgonians, antipatharians and abundant associated fauna (station AD_DC_13, © JNCC).

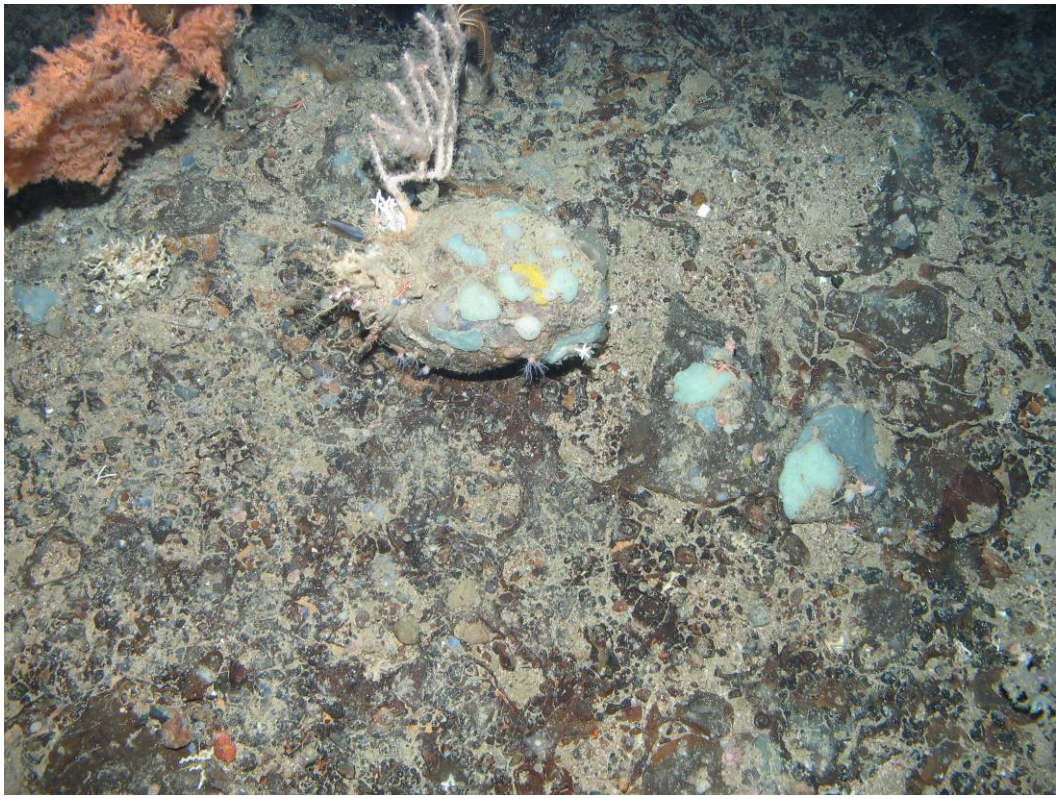


Plate 3. Bedrock outcrop on the flank in the south east of the seamount. Fauna include encrusting and massive globose sponges, antipatharia sp., *Psolus squamatus, Reteporella* sp. and a branching sponge species. (Station AD_DC_07, © JNCC).

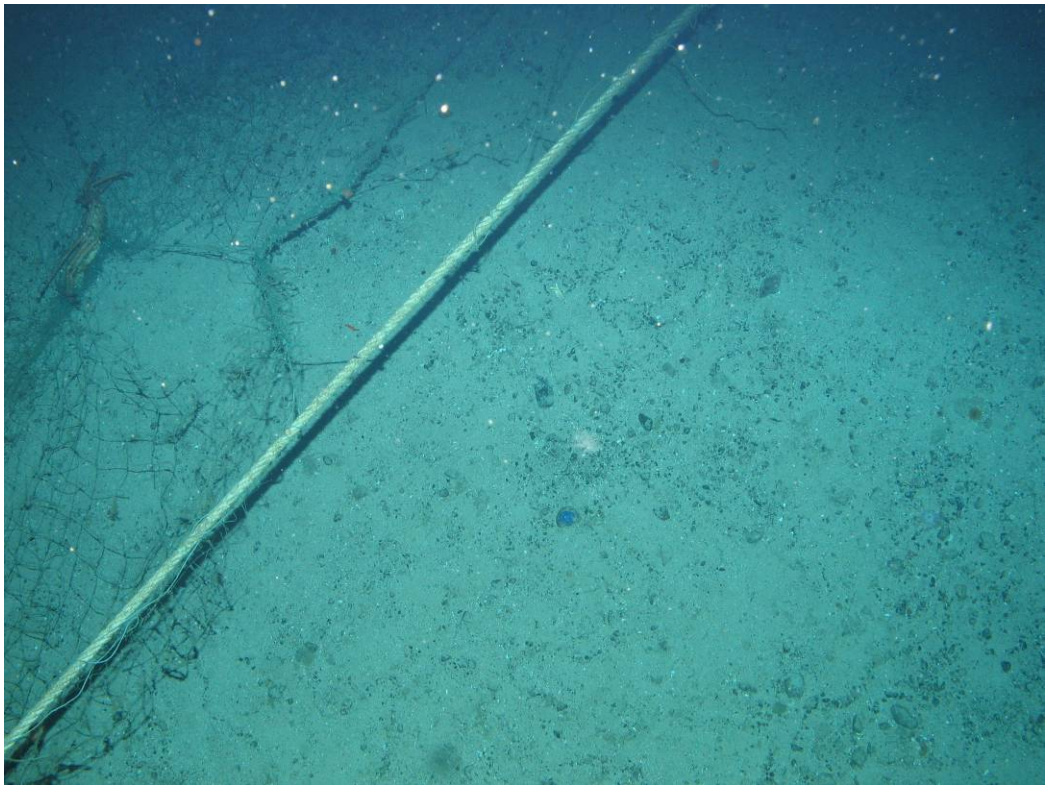


Plate 4. Discarded fishing gear (static net) on gravel substrate, found at the break in slope of the Anton Dohrn Seamount summit. (Station AD_DC_04, © JNCC).

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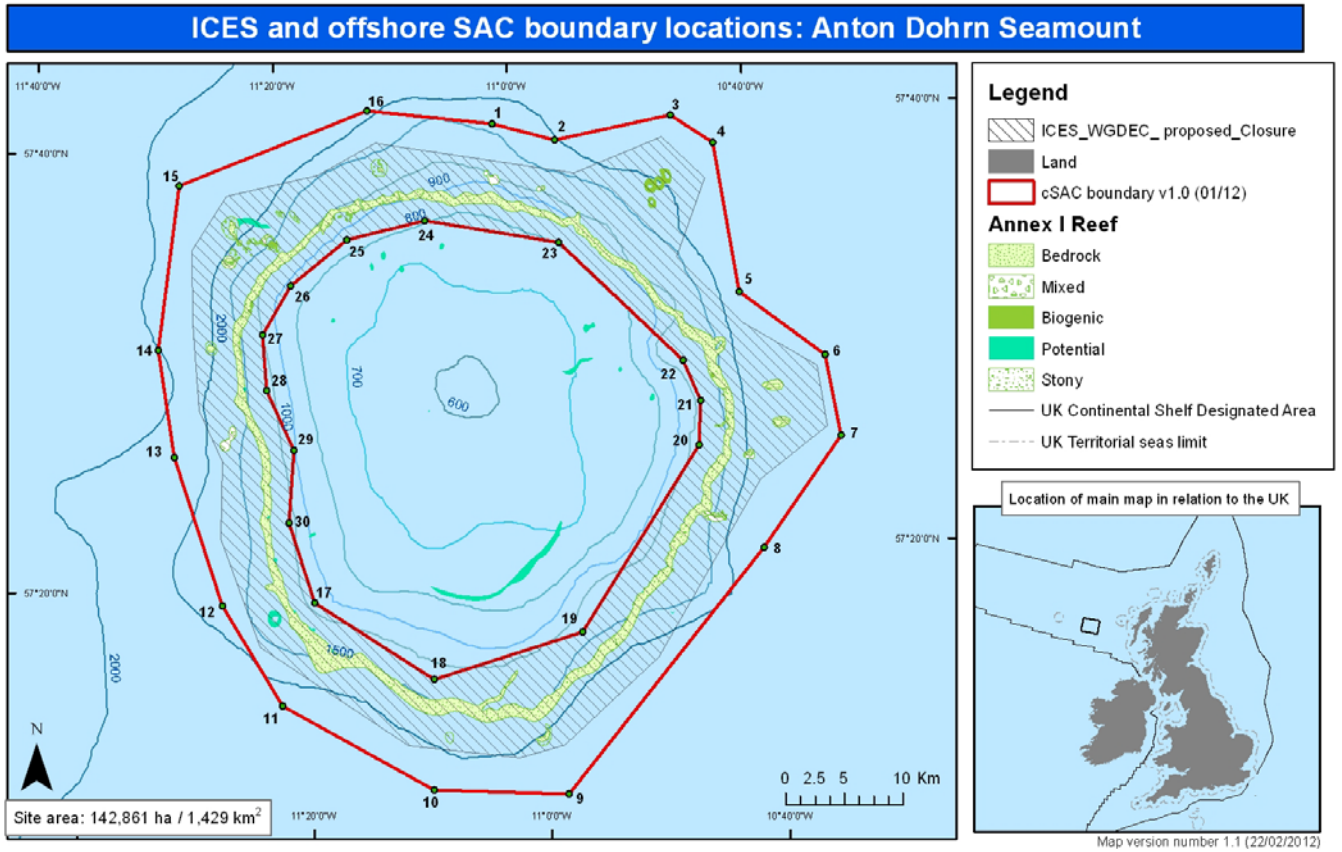
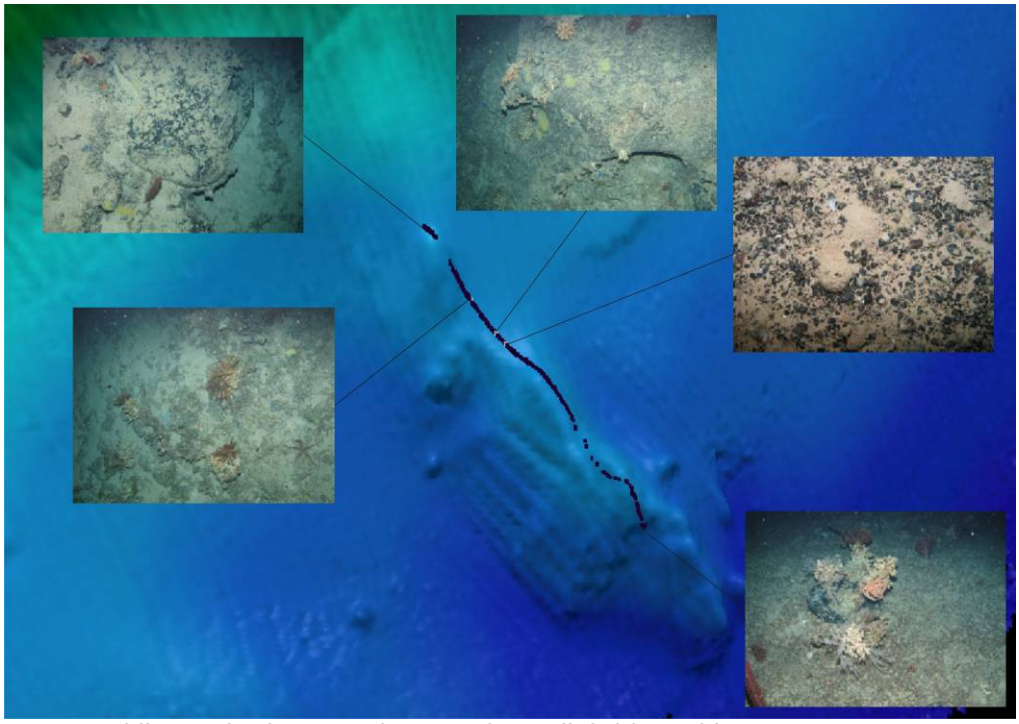
Appendix I



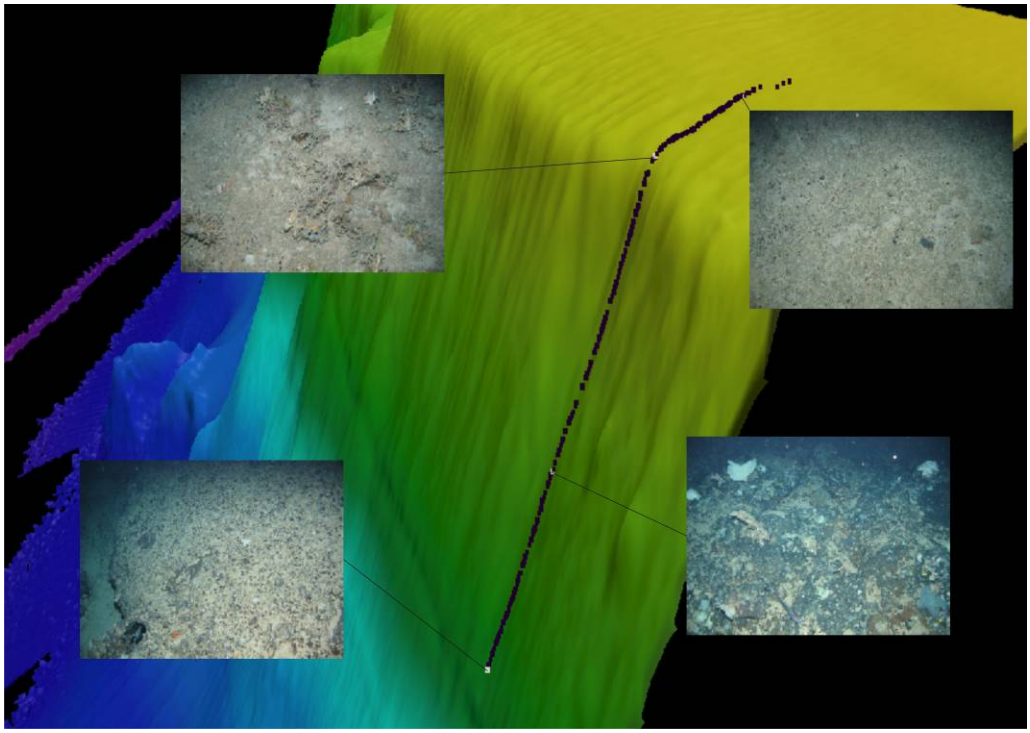
Boundary co-ordinates: *Outer boundary:*1) 57°40'11", -11°-1'-34", 2) 57°39'18", -10°-56'-19", 3) 57°40'6", -10°-46'-19", 4) 57°38'45", -10°-42'-50", 5) 57°31'52", -10°-41'-21", 6) 57°28'45", -10°-34'-25", 7) 57°25'2", -10°-33'-28", 8) 57°20'10", -10°-40'-37", 9) 57°9'29", -10°-58'-20", 10) 57°10'2", -11°-9'-41", 11) 57°14'15", -11°-22'-7", 12) 57°18'56", -11°-26'-45", 13) 57°25'49", -11°-30'-10", 14) 57°30'44", -11°-31'-3", 15) 57°38'10", -11°-28'-34", 16) 57°41'8", -11°-12'-10". *Inner boundary:*17) 57°18'52", -11°-18'-56", 18) 57°15'4", -11°-9'-9", 19) 57°16'51", -10°-56'-24", 20) 57°25'1", -10°-45'-37", 21) 57°27'3", -10°-45'-12", 22) 57°28'55", -10°-46'-32", 23) 57°34'37", -10°-56'-30", 24) 57°35'58", -11°-7'-48", 25) 57°35'18", -11°-14'-29", 26) 57°33'21", -11°-19'-29", 27) 57°31'9", -11°-22'-7", 28) 57°28'38", -11°-22'-1", 29) 57°25'51", -11°-19'-59", 30) 57°22'32", -11°-20'-42".

The Proposed ICES Working Group on Deep-sea Ecology (WGDEC) Anton Dohrn restricted area overlain with the offshore cSAC boundary.

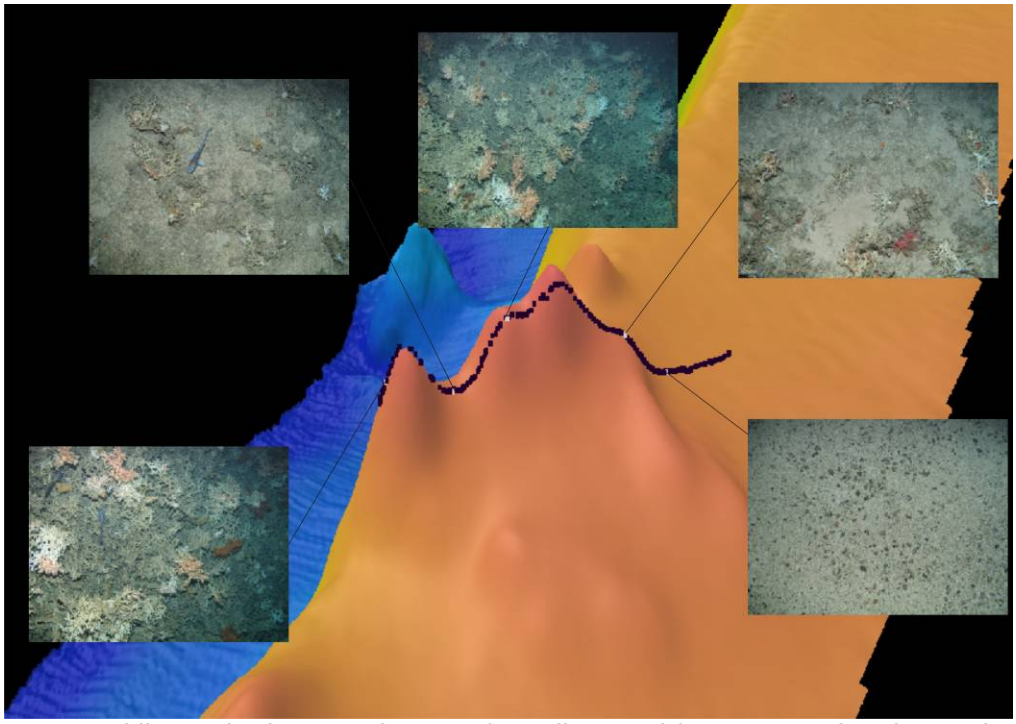
Appendix II



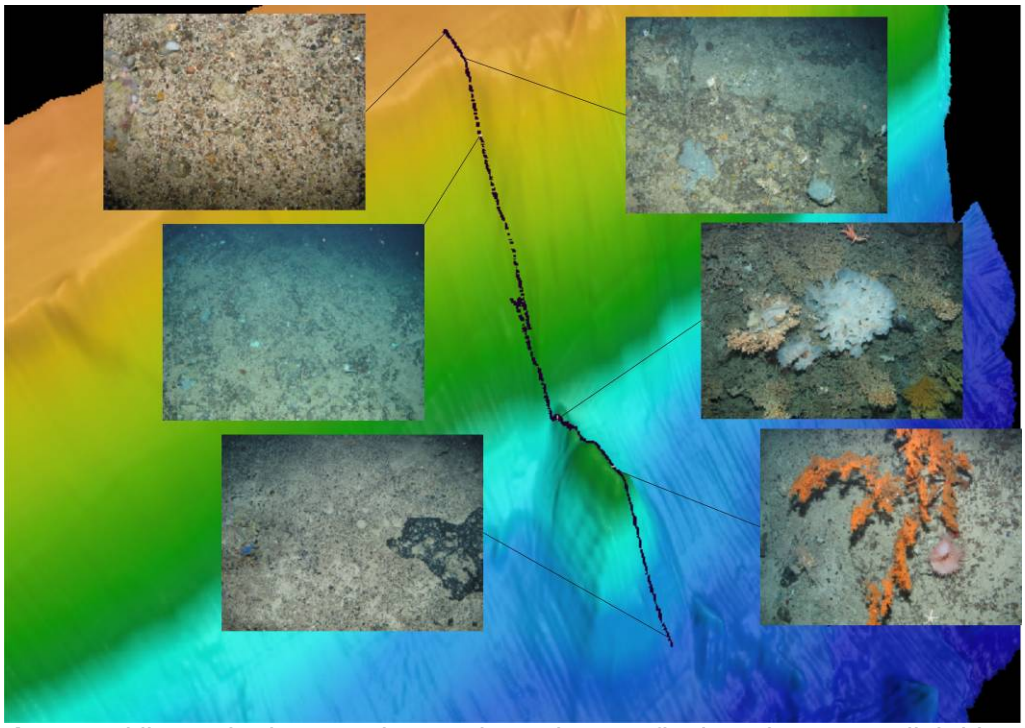
a. 3D multibeam bathymetry image of a radial ridge with camera tow AD_DC_02 draped. Selected images illustrate exposed bedrock outcrops with clumps of dead and live *L. pertusa*, encrusting sponges, sea pens, caryophyllid corals and crinoids.



b. 3D multibeam bathymetry image of the break of slope with the camera tow AD_DC_08 draped. Selected images illustrate mixed substrate habitat at the top of the slope with cobbles, pebbles and coral debris. Further down the slope, habitat changes to bedrock outcrops with encrusting sponges, lamellate sponges, the corkscrew antipatharian, *Stichopathes* sp., *P. squamatus* and *C. cidaris.*



c. 3D multibeam bathymetry image of small mound features on the slope edge with the camera tow AD_DC_09 draped. Selected images illustrate biogenic reef on the tops of the mounds with dead *L. pertusa* frameworks, as well as live *L. pertusa,* antipathrians, gorgonians, anemones and echinoids with reef rubble in between mounds.



d. 3D multibeam bathymetry image down the NW flank and onto a radial ridge feature with the camera tow AD_DC_12 draped. Selected images illustrate mixed cobble and pebble substrate at the top of the flank, moving into boulder and bedrock habitat on the flank with lamellate and lobose sponges. The radial reef is dominated by *L. pertusa* and bamboo corals, brisingids, crinoids, asteroids and gorgonians.